The Museum Handbook
Part I: Museum Collections

National Park Service
Museum Management Program
Washington, DC

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National Park Service *Museum Handbook*, Part I, Museum Collections

The National Park Service (NPS) Museum Management Program (MMP) develops policies and procedures for the preservation and protection of NPS museum collections managed in over 385 parks and centers throughout the US. The policies and procedures contained in this *Handbook* provide guidance for the management of NPS archeology, art, ethnography, history, biology, geology, and paleontology, and archival and manuscript collections.

The NPS *Museum Handbook,* Part I, Museum Collections was developed from earlier NPS museum publications, including the NPS *Field Manual for Museums* (1941), NPS *Museum Handbook*, Part I, Museum Collections (1967), and the *Manual for Museums* (1976). The *Handbook* was reissued in full in 1990. Updates and new additions are issued intermittently.

Museum Handbook,* Part I, *Museum Collections

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> Former *Appendix G, Protection of NPS Museum Collections*. (1996) – Danny McDaniel; John Hunter; Tony Knapp. (Contents to be incorporated into revised Chapter 14: Museum Security.)

Appendices

Appendix A, Mandates and Standards for NPS Museum Collections. (2000) – Steve Floray, based on the 1990 edition by Tony Knapp.

Appendix B, Accreditation. (2006) – Ann Hitchcock.

Appendix C, Professional Organizations and Societies. (2000) – Steve Floray, based on the 1990 edition by Tony Knapp.

Appendix D, Code of Ethics. (2006) – Ann Hitchcock.

Appendix E, Scope of Collections. (2003) – Steve Floray based on the 1990 and 1990 editions.

Appendix F, NPS Museum Collections Management Checklists. (1999) – Jessica S. Johnson, with additions by Steve Floray (2005).

Appendix G, Museum Firearms, Small Arms Ammunition, Munitions, and Artillery. (2022) — Joan Bacharach and Dara Shore.

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The appendix updates guidance, including for safe management of small arms ammunition, in the NPS Safety Alert: Discarded Military Munitions and Unexploded Ordnance (Feb 10, 2022).

(See Ch 14: Museum Security for former App G: Protection of National Park Service Museum Collections.)

Appendix H, Curatorial Health and Safety. (2000). Jessie Johnson, based on the 1990 edition by Tony Knapp, Bill Meuse, and Bart Roberts.

Appendix I, Curatorial Care of Archeological Objects. (2001) – Cynthia Murdock, Program Assistant, Museum Management Program, and Jessica S. Johnson, based on the 1999 edition by Brigid Sullivan, Regional Conservator, Midwest Region.

Appendix J, Curatorial Care of Paper Objects. (2003) – Sara J. Wolf.

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Appendix K, Curatorial Care of Textile Objects. (2002) – Sara J. Wolf.

Appendix L, Curatorial Care of Easel Paintings. (2000) – Jessica S. Johnson and Karen Bennett, Intern, MMP, based on the 1990 edition by Tom Carter.

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Appendix M, Management of Cellulose Nitrate and Cellulose Ester Film. (1999) – Diane Vogt O'Connor, Senior Archivist, MMP.

Appendix N, Curatorial Care of Wooden Objects. (2002) – Cynthia Murdock, based on the 1990 edition by Al Levitan, Furniture Conservator, Division of Conservation, HFC.

Appendix O, Curatorial Care of Metal Objects. (2002) – Martin Burke.

Appendix P, Curatorial Care of Ceramic, Glass, and Stone Objects. (2000) – Jessica S. Johnson, based on the 1990 edition by Shelley Sturman, Objects Conservator, and Judy Ozone, Objects Conservator, National Gallery of Art.

Appendix Q, Curatorial Care of Natural History Collections. (1999) – Catherine Hawks, Private Conservator.

Appendix R, Curatorial Care of Photographic Objects. (1996) – Debbie Hess Norris, Assistant Professor of Photographic Conservation, University of Delaware, and President of the American Institute for Conservation of Historic and Artistic Works.

Appendix S, Curatorial Care of Objects Made from Leather and Skin Products. (1996) – Toby Raphael, Conservator, Department of Conservation, HFC.

Appendix T, Curatorial Care of Biological Collections.(2005) - Stephen L. Williams, Assistant Professor of Museum Studies, Baylor University and Collections Manager, Strecker Museum Complex (adapted from Mr. Williams' Ph.D. dissertation); Catherine Hawks.

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INTRODUCTION

The *Museum Handbook* covers a broad range of topics to guide National Park Service staff in managing museum and archival collections:

- Part I covers planning, preservation, and protection for the disciplines and materials represented in NPS collections, including professional ethics, specialized storage, environment standards, conservation treatments, and emergency preparedness.

- Part II outlines procedures for museum record keeping, including accessioning, cataloging, loans, deaccessioning, photography, and reporting annual collection management data.

- Part III provides guidance on access and use for interpretation, education, exhibition, and research. It covers legal issues, publications, two and three-dimensional reproductions, using museum objects in exhibits and furnished historic structures, and providing access for research.

NPS staff responsible for collections should make informed choices based on their own skills and experience, standards and procedures outlined in the *Museum Handbook*, advice provided by specialists, and additional information provided in the references found in the *Museum Handbook*. Staff should, as needed, seek advice or technical information from regional and support offices, the Harpers Ferry Center, and the Park Museum Management Program, National Center for Cultural Resources.

By following the practices represented in this guidance, trained staff can ensure that the National Park Service collections will be, as mandated by the 1916 NPS Organic Act, preserved and maintained for the use and enjoyment of the present and future generations.

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Chapter 1: National Park Service Museums and Collections

CHAPTER 1: NATIONAL PARK SERVICE MUSEUMS AND COLLECTIONS

A. Overview

1. *What information will I find in this chapter?*

This chapter will introduce you to the National Park Service (NPS) museum program. It includes information on:

- The purpose of NPS museums
- The history of NPS museums
- The kinds of NPS museum collections
- Introduction to NPS museum collections management
- Organizational structure for the servicewide museum program
- Planning for park museum collections
- Ethics, standards, and professional organizations

2. *Where can I find additional information on these topics?*

Consult the references in sections G and H for a listing of associations, Web sites, books, and journals with useful information.

B. Purpose of National Park Service Museums

1. *What is a museum?*

In 1895, George Browne Goode, Director of the Smithsonian Institution's United States National Museum, defined a museum as "…an institution for the preservation of those objects which best illustrate the phenomena of nature and the works of Man, and the utilization of these for the increase in knowledge of the people," (Goode, 1895). The United States Congress, in the Museum and Library Services Act (Title II of P.L. 94–462), defined a museum as "…a public or private nonprofit agency or institution organized on a permanent basis for essentially educational or aesthetic purposes, that utilizes a professional staff, owns or utilizes tangible objects, cares for the tangible objects, and exhibits the tangible objects to the public on a regular basis." Both definitions have important qualifiers that distinguish museums from exhibit galleries, curio collections, and other types of property that an institution may manage. Professional museum associations offer additional variations on these basic definitions.

2. *What is a museum object?*

A museum object is a material thing possessing functional, aesthetic, cultural, symbolic, and/or scientific value, usually movable by nature or design. Museum objects include prehistoric and historic objects, artifacts, works of art, archival material, and natural history specimens that are part of a museum collection. (Large or immovable properties, such as monumental statuary, trains, nautical vessels, cairns, and rock paintings, are defined as structures or features of sites.) (See NPS *Cultural Resource Management Guideline*, Appendix A, Glossary.)

3. *What do museums do?*

Museums collect, preserve, study and interpret, and provide appropriate public access to natural and cultural materials that have been assembled according to a plan.

The collection must have a written scope statement (see *Museum Handbook,* Part I, Chapter 2, Scope of Collections). The items in the collection, whether cultural or natural, and their associated documentation are valuable for the information that they convey about people, processes, events, and interrelationships within cultural and natural systems. Placing objects within a broader context, through research, analysis and documentary records, provides the greatest public enjoyment and benefit.

4. *What do I need to know about a museum's primary responsibilities?*

With few exceptions, after their founding, museums continue to collect within their stated scope. All activities in the museum revolve around the collection. **Collecting, and documenting the resulting collection, is the first responsibility.**

Because the collection is a non-renewable resource, the museum must ensure its preservation. Museum objects and specimens lose their value if they, or their associated data, are damaged or lost. **Preserving the collection is the second responsibility.**

In order to ensure public benefit from the collections, the museum must provide for access, use, and interpretation, including research and exhibit. Research, by the museum staff and others, is the foundation for public exhibit and museum education programs. Research and the resulting interpretation to the public, either through exhibits or public programs, demonstrate the collection's value to the public. **Providing for collection access, use, and interpretation is the third responsibility.**

Museum Handbook, Part I, provides information on collecting, preservation, and protection. *Museum Handbook*, Part II, has procedures for documenting collections. *Museum Handbook*, Part III, addresses collections access and use.

5. *What is museum management?*

Museum management consists of the policy, procedures, processes, and activities that are essential to fulfilling functions that are specific to museums, such as acquiring, documenting, and preserving collections in appropriate facilities and providing for access to and use of the collections for such purposes as research, exhibition and education. The production of exhibits, the presentation of interpretive and education programs, and the publication of catalogs, books, and Web sites featuring museum collections and themes are part of museum management. The administrative functions relating to funding, human resources, maintenance, and property management are also part of museum management and require certain knowledge and skills specific to the museum environment.

6. *What is museum*

Museum collections management is one aspect of museum management. It *collections management?*

is a process, not a product. It is a systematic approach to the proper preservation and the wise use of museum objects. It includes any activity associated with the acquisition, accountability, documentation, conservation, protection, disposition, and use of museum objects. It involves assessing and planning for the short-term and long-term needs of a collection as well as carrying out the day-to-day activities of caring for objects on exhibit and in storage. The goal of collections management is to make museum collections available to the user for exhibit and study while preserving them for future generations.

7. *Under what authorities does NPS manage museums?*

Five laws provide the basic legal mandate for the NPS to manage museums. The laws are:

Antiquities Act of 1906
16 USC 431— 433; June 8, 1906, ch. 3060, 34 Stat. 225

National Park Service Organic Act
16 USC 1— 4; Aug. 25, 1916, ch. 408, 39 Stat. 535

Historic Sites, Buildings, Objects, and Antiquities Act (commonly known as the Historic Sites Act of 1935)
16 USC 461— 467; Aug. 21, 1935, ch. 593, 49 Stat. 666

Management of Museum Properties Act (commonly known as the Museum Act)
16 USC 18f— 18f- 3; July 1, 1955, ch. 259, 69 Stat. 242, PL 104- 333

Archaeological Resources Protection Act of 1979 (ARPA)
16 USC 470aa— 470mm; PL 96- 95

See Appendix A for a description of these and other relevant laws.

8. *What distinguishes NPS museums?*

NPS museums collect objects specific to the mission of the individual parks and interpret those collections in their original context. The collections are site-specific, that is, they pertain to that particular NPS site. With the exception of house museums, most other museums gather thematic collections from many different sites and house them in one place. By contrast, NPS museums collect and interpret many objects and specimens at the site of origin. For example, the furnishings and personal belongings at Harry S Truman National Historic Site are preserved and exhibited in the Truman Home as they were when the family occupied the house. The vast majority of holdings in NPS museums are derived either from within the park boundaries or from areas intimately associated with the parks.

Another distinguishing characteristic of NPS museums is that they are part of a larger NPS museum system. While park museums are site-specific, each is part of a greater system that sets policies and standards and guides their operation. No other museum network is so varied and dispersed, yet so administratively bound as a unit. The NPS museum system provides broad representation of the natural and cultural heritage of the United States. The scope of the system is wider than that of most public or private institutions. The NPS museum system is the largest such system in the world.

Although NPS museums may store their collections at another location, such as a NPS archeological center or a non-Federal museum, the park site retains ultimate responsibility for the collections.

National Park Service museums (and their collections):

- directly support the park mission
- aid understanding among park visitors
- advance knowledge in the humanities and sciences
- provide baseline data for NPS managers, scientists, and other researchers
- preserve scientific and historical documentation of the park's resources and purpose

Park collections range in size from fewer than 100 to over 6 million items.

9. *How are NPS collections used?*

National Park Service museum collections are used in a variety of ways. In keeping with the Service's public trust responsibilities, most uses of collections are educational. The dominant uses are:

- **Research** conducted by NPS and non-NPS scientists, historians, archeologists, ethnographers and other specialists.
- **Publications** that the park or others produce. Each year, photographs and/or descriptions of NPS museum objects appear in numerous articles, books, and other publications.
- **Exhibits** in NPS museums and visitor centers, as well as loans to non-NPS museums for special exhibitions.
- **Educational programs** at the park, schools, or other public venues.
- **Media products**, such as documentaries (motion picture, television, and radio), Web sites, "Web casts," and virtually any other new media format.

As society develops new media technologies, the opportunities to provide access to collections expand. Park visitors can view objects, specimens and archives in the museum or furnished historic structure at the site and gain the special understanding that comes with seeing the items "in context." New technologies, however, can reach previously underserved populations. For example, data and images in the NPS Web Catalog (http://www.museum.nps.gov) and Web exhibits featuring museum collections (http://www.cr.nps.gov/museum) are available worldwide in homes, schools, offices, and libraries. By effectively using these technologies NPS can greatly expand the audience served and the public benefit.

However you use the park's collection, remember that accurate interpretation and preservation of each object and the collection as a whole are primary considerations.

C. History of National Park Service Museums

1. *How did national park museums originate?*

For over a century, museums have been an integral part of America's national parks. From modest beginnings in 1904 to today's state-of-the-art park museums and visitor centers, visitors have encountered engaging museums in units of the National Park Service.

NPS museum operations chief Ralph Lewis observed that National Park Service "...museums did not grow from a single root, nor did any central authority decree their initial establishment. The first ones developed independently, created by local initiative to meet perceived needs," (1993). NPS Chief Curator Ann Hitchcock explained, "Initially, [museums in parks]...were rudimentary—a 1904 arboretum in Yosemite, a table of artifacts in the ruins at Casa Grande...even a museum in a tent at Sequoia. This strong association with place is a characteristic that continues to distinguish park museums and collections," (2004).

2. *How quickly did NPS develop museums?*

The National Park Service established new museums quite rapidly—Stephen T. Mather, the first NPS director, was an enthusiastic supporter who understood the importance of museums in the parks. In his 1920 annual report, he noted, "One of the most important matters to receive earnest consideration is the early establishment of adequate museums in every one of our parks."

Director Mather initiated numerous campaigns to encourage additional support for the parks, with the public and with government and business interests. These activities included special exhibitions of national park-themed art. Mather arranged an exhibition of paintings of national park scenes in January 1917 in conjunction with the Fourth National Park Conference. The Smithsonian Institution exhibited the works by Albert Bierstadt, Thomas Moran, Carl Rungius, and other noted artists for some time following the conference. The Director also developed a "...traveling exhibition intended for display in libraries [of]...24 framed photographs of park scenery packed in two reusable shipping boxes." The exhibition was so popular that Mather "...request[ed] funds to produce and circulate additional sets," (Lewis 1993).

A little more than a year later, Secretary of the Interior Franklin K. Lane established guidelines for the new National Park Service. The guidance included the statement that "Museums containing specimens of wild flowers, shrubs, and trees, and mounted animals, birds, and fish native to the parks, and other exhibits of this character will be established as authorized." Support for NPS museums was strong and that support was at the highest levels in Washington. At the same time, increased public and philanthropic interest in NPS museums provided additional opportunities for growth.

3. *How did NPS museums grow in the 1920s?*

In the early 1920s, Chauncey Hamlin of Buffalo, New York, (who had helped to endow the Buffalo Museum of Science) became a supporter of the national parks. As Hamlin's interest grew, he also supported the establishment of new museums in the parks. Following his election as president of the American Association of Museums (AAM) in 1923, Hamlin was able to procure funding from the Laura Spelman Rockefeller Memorial to help underwrite a new museum at Yosemite. By 1926, the new Yosemite Museum opened to the public (Lewis 1993).

Yellowstone opened its first museum in 1922. Over the following eight years, the park developed branch museums at Old Faithful, Madison Junction, and Norris Geyser Basin, all with the assistance of AAM. Meanwhile, the AAM, the Laura Spelman Rockefeller Memorial, and John C. Merriam of the Carnegie Institution supported the development of the Yavapai Point Museum at Grand Canyon National Park. Merriam, who actually oversaw the work "…created a museum where the canyon was the exhibit and the museum housed viewing instruments, labels, and guided interpretation. The model was so successful that a generation later it was deemed a classic example of interpretive planning in parks," (Hitchcock 2004).

Yellowstone naturalist Carl P. Russell was promoted to the new position of field naturalist-museum advisor in 1929. Russell relocated to California, and reported to Chief Naturalist Ansel Hall at the NPS Field Division of Education, located at the University of California, Berkeley.

4. *How did the 1930s and the Great Depression impact NPS museums?*

The 1930s brought tremendous change to the NPS. Shortly after taking office in 1933, President Franklin Roosevelt transferred the various historical areas managed by the War Department (primarily American Revolution and Civil War battlefields) to the National Park Service. Other parks, monuments, and memorials were transferred to the NPS as well—national monuments managed by the Forest Service and the National Capital Parks in Washington, DC. Many of these areas already managed museum collections, which also transferred to NPS stewardship.

NPS museums, like many other Federal projects in the 1930s, received increased support resulting from the economic recovery efforts of President Roosevelt's New Deal. One such windfall occurred in 1935, when $65,000 in Public Works Administration (PWA) funds became available to support new museums in the parks. In January of that year, Carl P. Russell was detailed from Berkeley to Washington to establish a new Eastern Museum Division. He also recruited a temporary staff of curators, artists, and craftsmen.

At the same time, funding and labor provided by the Civilian Conservation Corps (CCC) and Works Progress Administration (WPA) allowed for the construction of several new park museums. In workshops at Berkeley, California, and Fort Hunt, Virginia, "CCC boys" fabricated exhibits and park topographical map models (some of which are still in use at NPS visitor centers). The National Park Service's first curators (in title) were funded by the PWA. Curators, assistant curators, and museum assistants developed museum planning documents; planned, supervised, and constructed exhibits; and helped Russell carry out the multitude of tasks connected with the newly enlarged NPS museum program.

In 1935, Congress passed the Historic Sites, Buildings, Objects, and Antiquities Act. The new law declared that "…it is a national policy to preserve for public use historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States." This legislation empowered the Secretary of the Interior (working through the NPS) to preserve and maintain objects of national historical or archeological significance and to "establish and maintain museums in connection therewith."

5. *How did the NPS museum program fare in the 1940s and 1950s?*

The 1940s began with the NPS placing even greater emphasis on the development of museum standards. With strong support from Carl Russell, Ned Burns (who followed Russell as chief of the NPS museum division) prepared the National Park Service *Field Manual for Museums* in 1941. Intended as a guide to park museum development and operation, the field manual was available to other museums, institutions, and the general public through the Government Printing Office. Non-NPS museums as well as park museums used the publication.

World War II caused a virtual halt in park museum growth, as NPS budgets and personnel were transferred to the war effort. After the war, however, the museum program once again began to grow. The museum laboratory in Washington, DC, reopened in 1946. Four years later, NPS appointed its first conservator, Elizabeth Jones, a paintings conservator from the Fogg Art Museum at Harvard University. Jones quickly developed a new conservation laboratory and the first NPS conservation treatment program. Then, in 1954, following Ned Burns's death, Ralph Lewis became the Chief of the Branch of Museums. In 1956, NPS launched Mission 66, a ten-year program that planned to install ten new exhibits each year.

The decade of the 1950s also saw two other important events: Congress passed the Museum Act in 1955, and two years later, the Service issued the *Museum Records Handbook (*today's *Museum Handbook*, Part II: Museum Records*)*. (The *Museum Handbook*, Part I: Museum Collections, would debut in 1967.)

6. *How did the Museum Act affect NPS museum operations?*

During the early 1950s, the Service recognized the need for additional legislative guidance concerning its legal authority to acquire, preserve, and dispose of museum objects. In a number of past situations, the Service's authority to carry out some common museum practices was lacking or unclear. Congress passed the Museum Act to provide clear guidance to the Service in these matters. The law authorized the Secretary of the Interior through the National Park Service to acquire museum collections through donation and purchase and to loan and exchange collections "…in such manner as he shall consider to be in the public interest."

7. *What was the impact of Mission 66 on park museums?*

In 1956, in response to a growing number of park visitors, NPS launched a ten-year program, dubbed Mission 66, to build museums. Not since the New Deal of the 1930s did the parks experience such growth, renewal, refurbishment, new facilities, and corresponding staff to carry out the work. The Service constructed nearly 100 new visitor centers and museums during Mission 66. Mission 66 funded new visitor centers at Zion National Park, Dinosaur National Monument (Quarry Visitor Center), Everglades National Park (Flamingo Visitor Center), Booker T. Washington National Monument, Great Smoky Mountains National Park (Sugarlands Visitor Center), and the Museum of Westward Expansion beneath the Gateway Arch at Jefferson National Expansion Memorial in St. Louis. Although many parks have outgrown and replaced (or added to) their Mission 66 facilities, many others continue in use to this day. Mission 66 provided the parks with critical, needed improvements.

8. *What other initiatives and programs have influenced NPS museum operations in the decades since Mission 66?*

The 1970s

In the 1970s, NPS museum programs continued to grow. In 1974, the Branch of Museum Operations became the Division of Museum Services. The following year, NPS staff conducted the first Collection Management Plan, at Hubbell Trading Post National Historic Site. In 1976, the Service published the *Manual for Museums*, a bound version of the looseleaf *Museum Handbook*, which was available to the larger museum community (and the general public) through the Government Printing Office. Also, in the 1970s, the *Conserve O Gram* series of museum preservation technical leaflets debuted.

On the legislative front, Congress passed two new laws pertaining to archeological resources on Federal lands, the Archaeological and Historic Preservation Act of 1974, and the Archaeological Resources Protection Act of 1979 (ARPA) . Both acts mention museum collections resulting from archeological activities. (See Appendix A.)

Understandably, following the enactment of ARPA, NPS collections grew in both size and scope.

The 1980s and Beyond

NPS museum programs continued to expand in the 1980s, 1990s, and into the new millennium. In 1980, the Director appointed a Chief Curator, Ann Hitchcock. Three years later, key Washington and field curatorial staff met to develop a servicewide museum management strategy that stressed:

- Establishing minimum preservation standards
- Accountability of museum property
- Strengthening training and development opportunities for staff
- Incorporating curatorial review in the planning process
- Improving collections management policy guidance to the field

Over the next quarter century, these five goals have been the driving force behind the Service's museum programs. Minimum preservation and protection standards were established with Special Directive 80-1, its subsequent revision, and eventual replacement by the NPS Checklist for the Preservation and Protection of Museum Collections (Museum Checklist).

In the annual Collections Management Report (CMR), initiated in 1983, parks provided information on the number of items acquired, deaccessioned, cataloged, loaned and used in exhibits. Accountability was strengthened when, in 1984, and again in 2000, the *Museum Handbook*, Part II, was revised to reflect the latest, accepted museum practices for collections documentation. In 1985, a servicewide call was issued for every park to have an approved Scope of Collection Statement. Two years later, the NPS issued the Automated National Cataloging System (ANCS) to further the parks' accountability efforts. This program, augmented, improved, and modernized with a Windows platform in 1998, became ANCS+. No longer limited to accessioning and cataloging, the system covers documentation for all aspects of collections management, including loans, deaccessioning, housekeeping, Museum Checklist standards, annual inventories, and annual reporting.

In addition to the reissued Part II of the *Museum Handbook*, Part I: "Museum Collections," was reissued in 1990, with more revisions and additions issued nearly every year since 1999. *Museum Handbook*, Part III: "Museum Collections Use," was issued in 1998. The three-part *Museum Handbook* provides NPS staff not only with critical guidance concerning documentation, preservation, and access to and use of collections, but also with important collections management policy guidance to the field. The other preservation publication, the *Conserve O Gram* series, which was first issued in 1975, was revised and reissued in 1993, with additional leaflets added to the series annually.

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 USC 3001-3013) has had a profound impact on NPS museum collections. The law and associated regulations address the rights of lineal descendants, Indian tribes, and Native Hawaiian organizations to Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony. They require Federal agencies and institutions that receive Federal funds to provide information about Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony to lineal descendants, Indian tribes, and Native Hawaiian organizations and, upon presentation of a valid request, return these cultural items to them. NPS has repatriated items subject to NAGPRA and has consulted with traditionally associated groups when managing museum collections.

Implementation of the Government Performance and Results Act of 1993 (GPRA) presented new challenges to NPS museum programs. Performance management has increased annual reporting responsibilities for field, regional, and WASO staff. Yet, at the same time, programming, prioritization of work, and accountability were strengthened. The museum program applied the existing CMR and Museum Checklist data to meet the performance reporting requirements of GPRA. The ANCS+ collections management software program includes the Museum Checklist and CMR, which enable park staff to quickly produce annual museum reporting data.

The advent of the Web provided new ways to make park collections accessible to the public through Web exhibits and the Web Catalog. In 2004, NPS initiated the Teaching with Museum Collections program, which introduced object-based lesson plans for teachers to use Web-accessible NPS museum collections resources in the classroom. See http://www.cr.nps.gov/museum/.

Communication across division, park, regional, and servicewide lines is vital to the success of park museum programs. Facility management, resource management, interpretation and education, administration, and resource and visitor protection—virtually every park function is in some way supportive of, a user of, or a collector or creator of museum collections. The superintendent delegates responsibility for the park collection to the park curator or collateral-duty curator, but many offices collaborate to provide effective collections management.

In 2004, the Service observed the NPS Museum Centennial—the first century of museums in the parks. This history began with several small, independently established park museums created on shoestring budgets, without the assistance of professional curators. Early on, these programs received additional attention, funding, and professional assistance. Although not every park has a curator on site, each park has a curatorial contact and a qualified curator must have oversight for each park's museum operations.

From these humble beginnings over a century ago, the NPS museum system has become the world's largest. As of 2005, more than 350 park units preserve over 115 million museum objects, specimens and archival items to tell the stories of the places where many of the most exciting events of American history, cultural experiences, and natural phenomena have taken place.

D. Types of Collections

The National Park Service is one of the primary Federal entities that preserves cultural and natural resources. NPS museum collections include diverse disciplines and represent a significant portion of the resources that the Service is charged to preserve and protect. The collections are characterized as cultural, natural, and archival. The documentation system further classifies the items. The broad categories are divided into general disciplines as follows:

- Archival Collections
  - Personal papers and manuscripts
  - Resource management records

- Cultural Collections
  - Archeology
  - Ethnology
  - History

- Natural History Collections (also called natural resource collections)
  - Biology
  - Geology
  - Paleontology

E. Archival Collections

1. *What do NPS archival collections include?*

Archival holdings are the largest component of servicewide collections by item count. At the park-level, archives form a key part of the park's resources. In many cases, archives are original to the site and date to the historic period. For example, archives at Edison National Historic Site greatly expand our understanding of Thomas Edison's business as well as his private life.

Park archival collections contain information essential for understanding the park's past, natural and cultural interrelationships, events, and changes over time, as well as the human impact (including NPS management) on the park. Personal papers illuminate our understanding of the individuals whose lives are documented and interpreted at park sites. Resource management records that park staff and researchers create become part of the archival collections. Resource management records address:

- Management of cultural and natural resources over time
- Scientific research

2. *What types of archival materials are in NPS collections?*

NPS archival collections include:

- Personal papers, organizational archives, and assembled manuscript collections that NPS receives from non-Federal sources.
- Copies of records (formerly sub-official records). Occasionally, selected copies of Federal records may be kept for purposes of reference or convenience. For example, selected copies of superintendent correspondence that is particularly relevant to a resource management issue may be kept.
- Resource Management Records. Records associated with resource management typically include field notes and catalogs, daily journals, drawings and maps, photographs and negatives, slides, sound recordings, raw data sheets, instrument charts, remote sensing materials, collection inventories, analytical study data, computer documentation and data, as well as reports and any other documents generated through the resource management activity. Oral histories created by NPS employees are a special type of resource management record. Although these records are created by a Federal employee, contractor, or partner, the Service retains and manages them in the museum collection because ready access is critical to the ongoing interpretation, management, and preservation of other park natural and cultural resources. Resource management records are identified on the NPS records schedule for retention and management in the museum collection.

Other than resource management records, Federal records should not be included in the museum collection without specific authorization from the National Archives and Records Administration (NARA). These records are the original or "record copy" documents created or received in the course of performing the daily work of the NPS. Examples of records that do not belong in the museum collection include audit records, budget materials, central files, contracting files, financial records, law enforcement records, legal records, museum and project administrative records, permits, personnel records, and superintendent's correspondence files. By law, NARA

See *Museum Handbook,* Part II, Appendix D: Museum Archives and Manuscript Collections, for additional information concerning NPS archival collections.

Examples of archival collections include:

- The Edison Archives, Edison National Historic Site
- John R. Fordyce Archival Collection, 1897-1912, documenting Fordyce's engineering activities and the dealings of the Thomas-Fordyce Manufacturing Company, as well as personal correspondence, Hot Springs National Park
- Archeology Project Records, Mesa Verde National Park
- Albright Manuscript Collection, papers of Horace Albright pertaining to conflict over Mineral King, Sequoia and Kings Canyon National Parks
- Shenandoah National Park Resource Management Records, 1880-1996, Shenandoah National Park

F. Cultural Collections

Cultural collections are human-made objects or natural history specimens collected because of their human cultural context.

1. *What are archeological collections?*

Archeological collections are material remains that are recovered using archeological methods. Associated records (resource management records), such as maps, logs, research notes, laboratory analyses, and photographs, are classified as archival collections, although they remain connected to their related archeological collections. (See section E.2.) Archeological collections may represent any period in human history as long as the material was recovered by archeological methods. These collections help us to understand past cultures and their natural world. By preserving and studying these collections, we gain insight into the lives and worlds of those individuals and groups who previously inhabited park areas.

Archeological collections are created through authorized NPS undertakings, including Archaeological Resources Protection Act (ARPA) violation cases. NPS archeological collections include materials generated by researchers working under Antiquities Act or ARPA permits and by professional or avocational archeologists using a valid scientific methodology before the establishment of the park. Both surveys and excavations can generate archeological materials and associated records.

2. *What methods does an archeologist use to recover and interpret archeological resources?*

Archeological methods recover materials from the ground surface or subsurface using systematic procedures and documentation. Whenever an archeologist investigates a site and removes materials, the site is altered, perhaps even destroyed. At the very least, the original context, "the way artifacts and other material lay in relation to one another" is destroyed. Archeological procedures ensure thoroughness and regularity in data recovery. One goal is to have a systematic collection—a unified collection of objects and associated records and data (resource management records). These data play a key role in the ongoing management of the excavated site and other archeological resources.

Once the site is altered and objects are removed, the records that document the archeological investigation become the basis for understanding the site and the meaning of the objects in context. These documented collections are available for research and exhibit. For new research projects, the NPS encourages use of these well-documented systematic collections rather than excavation in order to preserve and protect remaining archeological sites, which are non-renewable resources.

3. *Does NPS keep all materials recovered from archeological investigations?*

Most, but not all. Archeological materials excavated or removed from NPS lands remain the property of the United States (see 43 CFR 7.13) except human remains, associated funerary objects, and cultural patrimony subject to NAGPRA, which specifies conditions for their recovery and disposition to lineal descendants, Indian tribes, or Native Hawaiian organizations (see 43 CFR 10). With the exception of the items subject to NAGPRA, artifacts and specimens recovered from archeological resources, along with associated records and reports, are maintained together in the park museum collection (Management Policies, 5.3.5.1). Human remains, associated funerary objects, and cultural patrimony subject to NAGPRA, but in park collections prior to passage of the Act in 1990, were included in summaries and inventories and are available for deaccessioning and repatriation in accordance with 43 CFR 10. Other archeological collections may be deaccessioned under limited conditions, such as approved destructive analysis; when the park lands from which the items come are deauthorized; or when the materials are hazardous (see *Museum Handbook*, Part II, Chapter 6, Deaccessioning).

Human remains, associated funerary objects and cultural patrimony subject to NAGPRA and discovered inadvertently or intentionally excavated after the passage of the Act are held in suitable conditions until appropriate and legal disposition occurs. They are not accessioned into the museum collection, but the park must ensure inventory control. Any resource management records concerning such remains and objects become part of the museum collection.

4. *What types of archeological materials are in NPS collections?*

Archeological material remains are artifacts, cultural objects manufactured by humans in the past, intact or fragmentary natural objects, by-products, organic materials, paleontological specimens found in physical relationship with prehistoric or historic resources, specimens (or *ecofacts*) associated with cultural activity (such as shells, seeds, floral remains, and soil samples), and environmental and chronometric specimens.

Examples of archeological collections include:

- Adze, Bering Land Bridge National Preserve
- Arrow Shaft Smoother (750-1150 AD) and a Puerco Black-on-White Bowl (1030-1200 AD), Chaco Culture National Historical Park
- Copper falcon effigy (1-350 AD), Hopewell Culture National Historical Park
- Civil War minié balls, Stones River National Battlefield
- Soil sample, Conways Brigade, Valley Forge National Historical Park
- Sherd, slip-decorated red earthenware, Narbonne House, Salem Maritime National Historic Site

5. *What are ethnological collections?*

Ethnology is the comparative and analytic study of cultures. Ethnography is the scientific description of individual societies and cultures. Ethnological collections may be from any contemporary culture or from the historical and traditional culture from which the contemporary culture and people are descended. Ethnological collections are usually comprised of objects from many different cultures. Generally, but not always, NPS ethnological collections are from cultures considered indigenous to the park, to the surrounding geographic area, or to a large geographic area addressed in the park's mission. In addition, most NPS ethnological collections are Native American, Alaska Native, Native Hawaiian or Polynesian.

Most ethnological objects in NPS collections are traditionally manufactured. They range from utilitarian objects to works of art. Raw materials collected for use in the production of ethnological objects, such as pigments, fibers, and foodstuffs are classified as ethnological although they might otherwise be considered natural history collections.

When ethnographers and others make collections they usually will have associated records, such as field notes and photographs. These associated records go into the park's archival collection.

6. *What are some of the types of ethnological items that make up park collections?*

Examples of NPS ethnological collections:

- Yokut baskets at Sequoia and Kings Canyon National Parks
- Oglala headdresses at Badlands National Park
- Teak box with inlaid abalone shell decoration, Samoan, at San Francisco Maritime National Historical Park
- Navajo blankets and rugs at Hubbell Trading Post National Historic Site

7. *Are there any special considerations when managing archeology and ethnology collections?*

Yes. Be sure to engage in proper consultations with traditionally associated peoples well before you begin any new initiatives regarding archeology and ethnology collections. Some examples of initiatives include exhibits, relocation of collections, and changes to collections-use policies. Native peoples who are culturally affiliated with a park's ethnological collections may want to consult regarding the preservation, care and use of these collections. NPS policy mandates that the Service consult with traditionally associated peoples when developing such policies and initiatives.

In addition, NAGPRA requires that NPS provide information about Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony to lineal descendants and culturally affiliated Indian tribes and Native Hawaiian organizations and, upon presentation of a valid request, return these cultural items to them. NPS has repatriated items subject to NAGPRA and, since passage of the Act in 1990, has carried out consultations with traditionally associated groups when managing museum collections. (See *Cultural Resource Management Guideline*, Appendix R, Guidance for National Park Service Compliance with NAGPRA, and *Museum Handbook*, Part II, Chapter 6, Deaccessioning.)

In accordance with NPS *Management Policies* (2006), Chapters 5 and 7, the Service will not exhibit Native American, Alaska Native, and Native Hawaiian human remains or photographs of those remains. Drawings, renderings, or casts of such remains will not be displayed without the consent of culturally affiliated Indian tribes and Native Hawaiian organizations. Parks must consult with culturally affiliated or traditionally associated peoples to determine the cultural significance and the culturally appropriate treatment of any object whose cultural importance is suspected but not confirmed, such as a sacred object. These consultations must occur before such an object is exhibited and before any action that might affect the resource.

8. *What are NPS history collections?*

NPS history collections reflect the entire spectrum of materials made and used during recorded times by humans residing in what today is the United States. They include cultural collections that are neither archeological nor ethnological. These collections may document individual or community life and social, cultural, political, economic, and technological trends and events. They also include art, such as paintings and sculpture. As a whole, the diverse assemblages of NPS history collections document continuity and change over time in the nation.

Some history collections reflect elite lives and activities of well-known individuals; others evidence everyday lives and actions of working men and women. The owners of some objects were Presidents; the owners of others are unknown. The significance and value of both is that they document American social, cultural, political and economic histories. Documenting and interpreting those objects to the public in the context of their original settings enhances the public's understanding.

To fill minor interpretive gaps, especially in exhibits and furnished historic structures, parks may acquire items that are of the same period and are documented to be similar to items originally at the site. Parks may also add reproductions to the collections to fill gaps or to substitute on exhibit for a fragile original. Both period pieces and reproductions must be clearly documented so that they are not confused with objects original to the site.

9. *What types of objects make up NPS history collections?*

History collections range from high style furnishings at Hampton National Historic Site, to simple furnishings and books at Carl Sandburg Home National Historic Site, to tools of the 19^{th} century textile industry at Lowell National Historical Park. They include inventions at Thomas Edison National Historic Site and medals and sculptures at an artist's home (Saint-Gaudens National Historic Site). Civil War military armaments and artifacts at Gettysburg National Military Park and collections as diverse as architectural fragments and portraits by the famous Peale family at Independence National Historic Site are in NPS history collections.

Additional examples include:

- Personal Items:
  - Frederick Douglass's top hat, Frederick Douglass National Historic Site
  - George Washington's dress sword, which he wore during his Inauguration, April 30, 1789, from Morristown National Historic Park
  - Ranch hand Jack Peters's cowboy boots (circa 1930), Grant-Kohrs Ranch National Historic Site
  - Joseph Hopkins's carpentry and blacksmithing tools, used by Hopkins to help construct the fort at Pipe Spring, 1870, Pipe Spring National Monument
- Historic Furnishings:
  - Mahogany furniture, antebellum era, from the collection of William Johnson, a free African-American, from Natchez National Historical Park
  - "Fruit case furniture" made from left-over and recycled wood, by Japanese Americans imprisoned in World War II internment camps, at Manzanar National Historic Site
  - The Lincoln Family's mahogany and horsehair upholstered sofa, Lincoln Home National Historic Site
- Religious artifacts:
  - The nineteenth century "Icon of St. Innocent of Irkutsk," in the Russian Bishop's House, Sitka National Historical Park
  - Eleanor Roosevelt's *Book of Common Prayer*, Eleanor Roosevelt

National Historic Site

- Vehicles:
  - Truck, "The Booker T. Washington Agricultural School on Wheels," manufactured by the White Motor Company in 1930, at Tuskegee Institute National Historic Site
  - President Harry S Truman's automobile, a 1972 Chrysler Newport Royal, still parked in the garage of the Truman Home at Harry S Truman National Historic Site
- Artwork
  - "Cathedral Rock, Yosemite," Albert Bierstadt, 1870, oil on canvas, Marsh-Billings-Rockefeller National Historical Park
  - "Yellowstone Canyon, 1871," Thomas Moran, watercolor, Yellowstone National Park

G. Natural History Collections

NPS natural history collections are diverse, including plant, animal, geological, and paleontological specimens associated with the lands that today are under NPS stewardship. NPS natural history collections are primarily specimens collected from within park boundaries. Because ecosystems, both living and fossil, and geological features extend beyond park boundaries, some specimens may originate outside park boundaries and be acquired by means other than field collection.

1. *Why does NPS collect and maintain natural history collections?*

The National Park Service maintains natural history collections primarily to voucher, or document, the presence of plants, animals, fossils, rocks and minerals in the park at a particular place and time. Researchers and resource managers use this information for science and resource management decisions. In addition, the results of the research and the specimens may be used in exhibits and as the basis for education and interpretive programs in parks. Natural history collections and their associated records, which are managed as archival collections, document the park's natural environment—its geological history, current conditions, and changes over time. For example, the collections can be the basis for resource management decisions, such as eradication of an exotic or restoration of native species; or provide evidence of environmental change, such as in water or air quality; or document the occurrence of environmental toxins such as DDT or mercury.

For more information on collecting and natural resource management, see *Management Policies*, Chapter 4, Natural Resource Management, and *Reference Manual 77, Natural Resource Management*.

2. *How does NPS authorize the collection of natural history specimens and determine their*

Parks encourage and permit scientists to conduct research, including collecting specimens, to further the park mission of encouraging science and provide the scientific basis for resource management decisions. Specimen collection is governed by 36 CFR 2.5 (see *Museum Handbook*, *disposition?*

Part II, Chapter 4, section VI) and the Research Permit and Reporting System (see http://science.nature.nps.gov/research/ac/ResearchIndex). Specimens collected on park lands and not consumed in analysis or otherwise destroyed are permanently retained, remain federal property, and become part of the park museum collection, as stated in the servicewide General Conditions for Scientific Research and Collecting Permit (General Conditions).

Superintendents may authorize park employees and non-NPS researchers to collect specimens in parks. Non-NPS researchers must have a permit. Both NPS and non-NPS researchers must comply with the General Conditions. Park curators are part of the permitting process, reviewing permit applications that involve specimen collection, including providing advice on where the specimens will be housed (in a NPS or non-NPS repository), and providing guidance to researchers on the collection, documentation, preparation and mounting, cataloging, and submission of specimens. Curators also manage loans of specimens to other institutions for research and repository purposes.

3. *What kinds of specimens are in NPS natural history collections?*

Typical specimens in NPS collections include but are not limited to:

- Biological Collections: vascular and non-vascular plant, fungus, insect, arachnid, other invertebrate (such as snail), reptile, amphibian, fish, bird, and mammal specimens.
- Geological Collections: rocks, minerals, surface process samples, and soils.
- Paleontological Collections: plant, animal, and trace fossils.

These collections are preserved using methods and conditions that vary from dry to fluid to low-temperature to microscopic. For additional information, refer to Appendix Q: Curatorial Care of Natural History Collections; Appendix T: Curatorial Care of Biological Collections; Appendix U: Curatorial Care of Paleontological and Geological Collections; and *Museum Handbook*, Part II, Appendix H, Natural History.

4. *Why are natural history collections important?*

Natural history collections provide:

- Baseline documentation over time for science, resource management and interpretation
- Vouchers for research, documenting the existence of a physical or biological component at a given place and time
- Holotype specimens used to formally describe a new taxon
- Specimens of special historical value
- Specimens indicating ecological condition
- Specimens that may be used for future destructive sampling

- Specimens that may be used in exhibits or interpretive and education programs

- Documentation of change in natural conditions over time and response of physical and biological components to that change

- Evidence of human-caused environmental changes (such as variations in land use patterns or road building) and response of physical and biological components to those changes

- Documentation of the effects of NPS management decisions

- Indication of gaps in knowledge of park natural resources

Natural history collections are integral to resource management, science, and education in the parks.

5. *What characterizes NPS biological collections?*

Park biological collections consist of Monera, Fungi, Plantae, Protista, and Animalia specimens, generally collected within park boundaries. Collections of plant, fungi, monera, and protista that are separately assembled and managed are called herbaria. Most parks have a herbarium as part of their museum collection.

The collections document the non-human biology of the park at a given time and place. When researchers make observations about the park environment, they often collect voucher specimens to vouch for, or testify to, their observations. If these specimens are not destroyed or consumed in analysis, they become part of the park's collection. NPS has an ongoing program to inventory and monitor living resources in the parks that generates many specimens for the museum collections. Parks may manage collections on site or off site in collaboration with another park, an NPS center, or a partner repository, such as a regional or university museum. Many park biological collections are on loan to partner repositories for management.

Over time, NPS biological collections can help document changes in the park environment and changes in species thus helping to inform park planning, natural resource management, cultural landscape management, and interpretive programs. For example, the Yosemite National Park collection has 50 specimens of the foothill yellow-legged frog, *Rana boylii*, which were collected in the 1930s by the Yosemite Field School. This frog has now been extirpated from the region (Hitchcock 1994).

Major park herbaria are listed in the Index Herbariorum, which the New York Botanical Garden maintains at http://sciweb.nybg.org/science2/IndexHerbariorum.asp. Such listing increases worldwide awareness of and access to park herbaria.

6. *What are some examples of NPS biological collections?*

Examples of biological collections include:

- pressed plants mounted on herbarium sheets

- specimens mounted on microscope slides (such as algae and pollen)
- seeds
- bones (osteological collections)
- eggs
- animal skins
- animal tissues or whole animals preserved in liquid
- mounted or freeze-dried animal specimens
- marine and fresh water shells
- insects mounted on pins
- casts of tracks and tunnels
- nests
- live strains of microorganisms, such as bacteria, fungi, and protozoa

Examples of park biological collections include:

- Herbarium at Yellowstone National Park
- Microbial strains developed from specimens from multiple park collections at a repository that makes them available for laboratory research (see http://www.atcc.com/common/specialCollections/NPS.cfm)
- Tree snail collection at Everglades National Park
- Specimens from Great Smoky Mountains National Park documenting the park's All Taxa Biodiversity Inventory

7. *What disciplines collect and study biological collections?*

The disciplines that study biological collections are many. The most common in parks are:

- Botany (plants)
- Entomology (insects)
- Herpetology (reptiles and amphibians)
- Ichthyology (fish)
- Limnology (study of inland waters, saline and fresh)
- Malacology (mollusks)

- Mammalogy (mammals)

- Ornithology (birds)

8. *What characterizes NPS geological collections?*

Geological specimens document the presence of geological materials and the processes that influenced them. For example, in a rock specimen, the mineral composition, structure and texture reveal the origin of the unit from which the specimen came (such as a granitic pluton). The surface may show the physical processes of its most recent history (such as glacial striations). Its chemical alteration may record the weathering process it has experienced through the breakdown of feldspars and oxidation and hydration of other minerals.

We can learn about a rock's	**By looking at**
Origin	Mineral composition
	Structure
	Texture
History	Physical processes, such as glacial striations
	Weathering processes, both mechanical and chemical, such as oxidation
Age	Direction and strength of the earth's magnetic field when it formed, breakdown of radioactive elements

Geological collections can include:

- rocks
  - igneous (volcanic rocks, such as obsidian, lava, and tephra; or intrusive rocks such as granite)
  - sedimentary (rocks formed by deposition via wind and water, such as shale, sandstone, limestone)
  - metamorphic (rocks transformed under heat and pressure, such as schist, gneiss, marble)
- mineral specimens (such as quartz, malachite, and calcite)
- surface process materials, such as evidence of desert varnish or glacial action
- ores (often associated with historical mines in parks)
- samples of cave formations
- soils

- building stone samples
- extraterrestrial materials, such as meteorites
- environmental samples (such as air and water)

Geological collections can inform park planning and development (for example, knowledge of rock types helps planners select sites for buildings); natural and cultural resources management (for example, a soil analysis may suggest reasons for the prehistoric abandonment of an archeological site); and interpretation.

9. *What are some examples of geological specimens in NPS collections?*

Examples of geological specimens in NPS collections include:

- Agate, chalcedony, and quartz specimens at Badlands National Park
- Sandstone and basalt specimens at Zion National Park
- Slate, quartz, and schist specimens at Bering Land Bridge National Preserve
- Calcite, gypsum, and limestone specimens at Mammoth Cave National Park
- Granite, marble, and ore sample specimens at Sequoia and Kings Canyon National Parks.

10. *What characterizes NPS paleontological collections?*

Paleontology specimens are fossils of plants and animals and naturally occurring tracks, impressions and casts. They record past life on earth. In addition, the collections often include human-made molds and casts of specimens. In size, fossils range from microscopic pollen and spores studied with scanning electron microscopes to dinosaurs 100 feet in length.

Although the primary NPS paleontological collections reflect the resources in parks that were established specifically for their paleontological significance, paleontological resources occur in parks throughout the system. NPS paleontological collections cover the entire span of geological time and represent all five kingdoms of life (Monera, Protista, Fungi, Plantae, and Animalia), but most park paleontological collections are identified as:

- vertebrates
- invertebrates
- plants

Fossils can be divided into two main categories—body fossils and trace fossils—as follows:

Body Fossils	Trace Fossils
Petrified wood Fossil bones Fossil plants Fossil tissue Fossil pollen	Tracks Trails Burrows Borings Gnaw or bite marks Casts Coprolites (fossilized feces)

11. *What are some examples of paleontological specimens in NPS collections?*

Examples of fossils in NPS collections include:

- Sauropod (the largest land animal) specimens at Dinosaur National Monument
- Fish at Fossil Butte National Monument
- Insects and leaves at Florissant Fossil Beds National Monument
- Fossilized logs at Petrified Forest National Park
- Camel, rhinoceros, and sloth specimens at John Day Fossil Beds National Monument
- Mastodon, saber-toothed cat, and horse specimens at Hagerman Fossil Beds National Monument
- Sponges, brachiopods, and trilobites at Guadalupe Mountains National Park

These examples illustrate the diversity of NPS paleontological collections. For additional information, refer to Appendix U: "Curatorial Care of Paleontological and Geological Collections."

12. *What specialties are represented in the discipline of paleontology?*

The discipline of paleontology has several subdisciplines. For example:

- Paleobotany (the study of fossil plants)
- Vertebrate paleontology (the study of animals with backbones)
- Invertebrate paleontology (the study of animals without backbones)
- Palynology (the study of pollen and spores, both living and fossil)
- Paleoclimatology or paleoecology (the study of past climates and ecology)
- Ichnology (the study of fossil tracks, trails, and footprints)
- Micropaleontology (study of microscopic fossils)
- Taphonomy (study of the processes of decay, preservation, and the formation of fossils)

13. *How have park natural history collections developed over time?*

The development and organization of park natural history collections has reflected park needs related to interpretation and education, management, and research. The parks that were established primarily for their natural resources developed scientific collections early in their history. These nonrenewable collections document change in conditions, species, and habitat over time. For example, soon after Great Smoky Mountains National Park was established in 1934, the superintendent gave priority to forming a study collection to document park resources.

Many park naturalists (today's interpretive rangers) started collecting specimens for use in public education programs and those collections have subsequently become important for science and resource management. For example, at Everglades National Park, a Florida cougar skull, collected solely for exhibit in the 1960s, later became important for its scientific value in helping to resolve taxonomic questions regarding the description of the subspecies *Felis concolor coryi* (now *Puma concolor coryi*), (Hitchcock 1994). Although some park collections started around the turn of the century, many natural history collections were begun in the 1920s and 1930s. These collections now form important baseline data for the parks.

Park naturalists and associated researchers (primarily those with government agencies, universities, or large museums) have long collected specimens from parks. In many cases these collections pre-date the establishment of the park. For example, the Jepson Herbarium at the University of California, Berkeley, has early collections from Yosemite and Sequoia National Parks. Because research on park collections furthers the mission of the parks, parks welcome researchers and often assist with funding or in-kind contributions to the research effort.

14. *What has driven recent growth of NPS natural history collections?*

In the latter part of the 20th century, NPS became concerned that it lacked good documentation, vouchers, and results from the many research projects on park lands. These projects had collected important baseline data, yet parks often did not know where or how to access it. In response, NPS promulgated a new regulation that became effective April 30, 1984, requiring that all specimens collected in parks and retained in museum collections have NPS labels and be cataloged in the NPS National Catalog. This regulation and standardization of the permitting system in 2001 have contributed significantly to the ability of parks to track and use research information and specimens, whether the collections and associated records are managed at the park, at another park or NPS center, or on loan to a non-NPS repository, such as a university or a natural history museum.

In 2000, under the Natural Resource Challenge, NPS initiated the NPS Inventory and Monitoring Program to provide NPS managers with the information and expertise needed to maintain ecosystem integrity. For example, NPS scientists are currently conducting baseline inventories of basic biological and geophysical natural resources for all natural resource parks. These inventories result in collections of both specimens and corresponding data, in various forms. This initiative has accelerated the growth of park natural history collections. Currently, natural history collections represent two percent of the total NPS museum collections.

15. *What determines how NPS natural history collections are used?*

Collections use depends on:

- available documentation and access venues, such as ANCS+, Web Catalog, Index Herbariorum
- the specimens or parts available
- available expertise
- methods of preservation
- preservation quality

H. Introduction to NPS Museum Collections Management

1. *What are the main elements of NPS Museum Collections Management?*

Collections management is a process, not a product. It is a systematic approach to the proper documentation, preservation and use of museum objects—one that allows for public and research access while at the same time providing preventive care and long-term stewardship of these resources.

Collections management includes any activity associated with the acquisition, accountability, documentation, conservation, protection, disposition, and use of museum objects. It involves:

- assessing and prioritizing both short and long-term curatorial needs
- effective short-term and long-range planning to address those needs
- carrying out the daily activities necessary to properly care for the collection

The goal of collections management is to make museum collections available for exhibit and research use while simultaneously preserving them for future generations.

2. *What policy guidance is available on managing NPS museum collections?*

The following documents, which are available at http://data2.itc.nps.gov/npspolicy/index.cfm, provide guidance that is particularly relevant to NPS museum collections.

- *Management Policies*—key chapter citations are
  - 3. Land Protection (specifically 3.3 Land Protection Plans)
  - 4. Natural Resource Management (especially 4.2 Studies and Collections [all sections]; 4.8.2.1 Paleontological Resources and Their Contexts)

  - 5. Cultural Resource Management

  - 7. Interpretation and Education (especially 7.3.2 Non-personal Services; 7.5.5 Consultation; 7.5.7 Historic Weapons)

  - 8. Use of the Parks (especially 8.6 Special Park Uses; 8.10 Natural and Cultural Studies Research and Collection Activities; 8.11.3 Independent and Commercial Studies)

  - 9. Park Facilities (especially 9.3.1.3 Visitor Centers; 9.4.2 Museum Collections Management Facilities)

  - 10. Commercial Visitor Services (specifically 10.2.4.9 Natural and Cultural Resource Management Requirements; 10.2.4.6 Artifacts and Specimens)

- Director's Order #6: Interpretation and Education

- Director's Order #19: Records Management

- Director's Order #20: Agreements

- Director's Order #21: Donations and Fundraising

- Director's Order #24: NPS Museum Collections Management (DO #24)

- Director's Order #28: Cultural Resource Management

- Director's Order #28A: Archeology

- Director's Order #28C: Oral History

- Director's Order #29: Ethnography Program (in process)

- Director's Order #44: Personal Property Management

- Director's Order #53: Special Park Uses

- Director's Order #58: Structural Fire Management

- Director's Order #84: Library Management (in process)

- Records Disposition Schedule and *Records Management Handbook*

- NPS-28 *Cultural Resource Management Guideline*

- *Museum Handbook*, Parts I-III

- *Property Management Handbook*

- *Reference Manual 77: Natural Resource Management*

3. *What are the levels of responsibility for NPS collections management?*

Every park with a museum collection is part of the larger NPS museum system. Although responsibility for managing these collections is shared among the Washington Office, the regional offices, parks, centers, and park partners, the superintendent is the accountable official for the park's museum collections regardless of the location of the collection. All individuals with responsibility for museum collections must follow the Code of Ethics (see *Museum Handbook*, Part I, Appendix D).

4. *What are the museum management responsibilities of the Washington Office?*

As described in DO #24, the Associate Director, Cultural Resources, with the assistance of the Chief Curator and the Park Museum Management Program, has the following responsibilities:

- Develop and oversee policies and procedures for NPS museum collections.
- Develop, issue, and periodically update the NPS *Museum Handbook*.
- Develop strategic plans and goals to improve and maintain the management of NPS museum collections servicewide.
- Maintain the National Catalog of Museum Objects and its automated version, ANCS+ (and its successor).
- Maintain, analyze, and report on annual data that parks, centers, and regions, submit including:
  - Collections Management Report
  - NPS Checklist for Preservation and Protection of Museum Collections
  - Annual Inventory of Museum Property
  - Funding distributions and accomplishments
- Research products and facilitate park and center acquisition and use of appropriate supplies, forms, equipment, and technologies for management of museum collections.
- Develop and coordinate servicewide initiatives and funding to improve museum management.
- Publicize and disseminate technical information on museum management, such as the *Conserve O Gram* series.
- Develop and maintain access to servicewide information about NPS museum collections through various media, including ANCS+ and the Web.
- Evaluate and coordinate servicewide professional competencies and training needs and develop strategies, guidelines, and curricula to meet those needs. Coordinate training to address new technologies,

programs, and initiatives.

- Review draft park plans that receive WASO review, such as General Management Plans, for appropriate coverage of museum management.

- Provide technical assistance and advice to park and center managers regarding museum collections management.

5. *What are the museum management responsibilities of the Regional Offices?*

As described in DO #24, regional directors, assisted by the regional curator and other museum management staff, have the following responsibilities:

- Conduct plan and performance reviews to ensure that superintendents and center managers meet their responsibilities to manage museum collections according to NPS requirements.

- Provide technical assistance and advice to park and center managers regarding museum collections management.

- Evaluate museum management staffing and training needs, and develop and provide training to park and center staff.

- Develop plans and set priorities (including funding priorities) for managing museum collections based on all approved planning documents and information provided through servicewide reports and requirements.

- Review park and center annual inventories, take any necessary corrective actions, and annually certify to the Associate Director, Cultural Resources, that parks and centers have completed their annual inventories.

- Approve destructive analysis and consumptive use of museum collections. After careful review, if the benefits can be clearly shown to outweigh the resulting or potential damage or loss, the Regional Director may approve destructive analysis of rare or highly significant objects, specimens, and archival items, and consumptive use of museum collections.

- Grant exceptions to the unconditional gift policy on a rare and case-by-case basis, when justified.

6. *What are the museum management responsibilities of the parks and centers?*

As described in DO #24, park superintendents, center managers, and others who manage collections (with the assistance of the curator and other museum management staff) have the following responsibilities. See DO #24 for additional detail and submission and reporting requirements.

- Meet the museum management standards and follow the procedures outlined in the NPS *Museum Handbook*.

- Provide ongoing funding for recurring museum management functions.

- Identify, prioritize, and correct preservation, protection, documentation, and access and use deficiencies, including programming for funding to correct such deficiencies.

- Complete Project Management Information System (PMIS) project statements that identify all preservation, protection, documentation, access, and use needs.

- Evaluate and address museum management staffing and training needs according to established personnel qualifications standards and servicewide professional competencies.

- Approve and keep current a Scope of Collection Statement. Ensure acquisitions are consistent with the Scope of Collection Statement and deaccession those objects that are inconsistent with the statement.

- Approve, keep current, and implement the following plans:

  – Collection Management Plan

  – Housekeeping Plan

  – Integrated Pest Management Plan

  – Museum Collections Emergency Operations Plan (part of the park's Emergency Operations Plan)

- Ensure that staff is practiced and prepared for emergency response.

- Prepare a job hazard analysis for all museum jobs that have an associated history of injury, illness, or death; or that require the use of personal protection equipment; or that involve activities that are clearly dangerous.

- Monitor and record information about the environment in spaces housing collections and manage the environment to maximize preservation and complete Collection Condition Surveys, as needed.

- Accession collections upon acquisition to establish basic accountability.

- Catalog collections immediately following acquisition, or program to catalog them in the near future.

- Survey, appraise, rehouse, arrange, and describe archival and manuscript collections and prepare finding aids. Develop park archival duplication and reference procedures.

- Maintain a complete and current backup of all electronic accession and catalog records at a second, separate location. Submit a complete annual backup to the National Catalog in Harpers Ferry, WV.

- Accept only unconditional gifts and bequests and obtain applicable copyrights and releases with acquisitions.

- Require all project budgets to include funding for the preparation, documentation and initial storage of collections that are project-generated.

- Add collections made through systematic research to the museum collection. As appropriate, lend these collections for exhibit, research, conservation, and other approved uses.

- Annually complete the following reports:

  – Collections Management Report

  – Annual Inventory of Museum Property

  – NPS Checklist for Preservation and Protection of Museum Collections

- Document treatment of collections, and record that information in ANCS+.

- Promote access to cataloged collections for research and interpretive purposes through a variety of means, such as exhibits, interpretive programs, loans, publications, Web exhibits, and the Web Catalog. Post finding aids and repository level-guides for archival collections in the National Union Catalog of Manuscript Collections (NUCMC).

- Ensure that access and use are consistent with all laws and NPS policies.

- Document access and use of collections.

- Consult with affiliated groups in managing collections, including Native American groups when managing collections subject to the Native American Graves Protection and Repatriation Act.

- Manage objects to preserve their condition, including using reproductions when originals may be damaged by use. When appropriate, approve destructive analysis, except for rare or highly significant items.

- Exhibit collections according to an approved exhibit plan, accompanied by maintenance instructions. Ensure that all exhibits meet the standards in the NPS Checklist for Preservation and Protection of Museum Collections.

- Document furnishings that are exhibited in their associated historic structures with an approved Historic Furnishings Report. Consider the preservation requirements of both objects and historic structures when objects are on exhibit or in storage in historic structures.

- Never exhibit Native American human remains or photographs, drawings or renderings, or casts of the remains. Exhibit non-Native American human remains and photographs, drawings or renderings, or casts of the remains only in consultation with traditionally associated groups.

- Ensure that approved museum plans are entered in the Cultural Resource Management Bibliography (CRBIB).

7. *What additional roles do the servicewide centers have?*

The **Harpers Ferry Center** (HFC) coordinates the planning, design, production, and rehabilitation of museum exhibits and exhibits of historic furnishings. It also coordinates publications, wayside exhibits, and audiovisual programs. It provides conservation services for exhibit production and, on a reimbursable basis, provides other conservation services for parks, such as collection condition surveys, advising on environmental conditions and storage techniques, providing treatments, and training park staff in preventive conservation. Other services are interpretive planning, audiovisual equipment repair, graphics research, replacement of wayside exhibits, and the revision and reprinting of publications. The center also maintains the NPS history collection with documents, photographs and objects representing NPS administrative history. See http://www.nps.gov/hfc/.

The **Denver Service Center** (DSC) provides major planning, design, and construction services to parks, regions, architecture/engineering firms, and other partners. DSC provides these services jointly with private industry. DSC's projects are worldwide—ranging from designing a mass transit system in Zion National Park in Utah, to planning and designing the FDR Memorial in Washington, DC, to assisting Sri Lanka and other countries with their emerging park systems.

I. Planning for Park Museum Collections

1. *What general park plans are relevant to planning for park museum collections?*

The following integrated planning framework, as described in *Management Policies*, Chapter 2, guides park decisions and management.

- Foundation Statement

- General Management Plan

- Program Management Plans

- Strategic Plans

- Implementation Plans

- Annual Performance Plans and Reports

2. *What does the Foundation*

The Foundation statement is a succinct statement describing the park

Statement say about the museum collection?

purpose, significance, fundamental resources (including the museum collection) and values, and primary interpretive themes. It is based on the park's establishing legislation or Presidential Proclamation.

3. *How does the General Management Plan relate to the museum collection?*

The General Management Plan (GMP) is a park's primary planning document. It sets the long-term goals for the park based on the Foundation Statement. It clearly defines the desired natural and cultural resource conditions, including the museum collection, the conditions necessary to support the desired visitor use, and the management actions and standards to maintain these conditions. The management prescriptions identified in a park's General Management Plan are applied parkwide by resource topic and by specific geographic area as a management zone. All subsequent park planning documents flow from the GMP.

4. *What program management plans are specific to the museum collections?*

Program management plans describe program-specific measures or strategies to achieve and maintain the desired resource conditions and visitor experiences. Program-specific plans that address museum collections documentation, preservation, access, and/or use include but are not limited to:

- Scope of Collection Statement
- Collection Management Plan
- Park Resource Stewardship Plan
- Comprehensive Interpretive Plan

5. *How does the park Strategic Plan address museum collections?*

Strategic planning addresses performance management and accountability. NPS policies require that the National Park Service as a whole, and every park, program, and central office have its own strategic plan.

A park's strategic plan is based on the park's mission goals, GMP, and the NPS and Department of the Interior strategic plans.

The two servicewide goals that measure performance specific to museum collections are:

- Ia6 Museum Collections: Percentage of preservation and protection standards for park museum collections met
- Ib2D Museum objects cataloged

All parks with museum collections must include these servicewide goals in their strategic plans. Parks may include additional park-specific goals related to their museum collections.

6. *What is an implementation plan for*

An implementation plan focuses on activities and projects needed to achieve the desired conditions identified in the GMP, strategic plan, and *museum collections?*

program management plan. Examples of implementation plans for museum collections include:

- Collection Management Plan
- Housekeeping Plan
- Museum Emergency Operations Plan
- Integrated Pest Management Plan
- Collection Condition Survey
- Historic Furnishings Report
- Exhibit Plan
- Museum Security Survey
- Museum Fire Protection Survey
- Storage Plan

Implementation plans may also be project-specific plans, such as a plan to catalog the backlog of uncataloged collections, or a plan to install data loggers in all museum spaces.

7. *What are Annual Performance Plans and Reports?*

Each park prepares an Annual Performance Plan that is tied to its Strategic Plan. The Annual Performance Plan includes:

- Annual goals (the outcomes expected to be achieved). For example: "In FY2007, the park will catalog 2000 geology specimens."
- An annual work plan, which allocates budget and personnel needed to accomplish the work.

Each park also prepares an Annual Performance Report that documents progress in meeting the annual goals.

8. *What are the requirements for museum-specific planning documents?*

DO #24 requires all parks to have the following planning documents specific to museum collections:

- Scope of Collection Statement (SOCS). The SOCS is a stand-alone museum planning document that succinctly defines the scope of the park's museum collection holdings at the present and for the future. The SOCS derives from the park's mission, as well as laws and regulations mandating the preservation of collections. See Chapter 2: Scope of Museum Collections for additional information.
- Collection Management Plan (CMP). All parks must have an up-to-date, approved, and implemented Collection Management Plan (CMP). A park's CMP:

- evaluates issues of preserving, protecting (including security and fire protection), documenting, accessing, and using collections.

- addresses issues specific to archival and manuscript collections (appraising, arranging, describing, producing finding aids, and providing reference and duplication services).

- proposes a strategy to address the issues, including staffing and cost estimates.

• Housekeeping Plan. Every space that houses museum collections must have an approved, current, and operational Housekeeping Plan. A current Housekeeping Plan that the staff consistently follows ensures that housekeeping routines are sensitive to museum collections preservation needs.

• Museum Emergency Operations Plan (MEOP). Parks must have an operational, approved, and current MEOP. The MEOP is part of the park's Emergency Operations Plan (EOP). The MEOP identifies:

  - museum collection vulnerabilities to events (such as fire, earthquakes, and floods)

  - responses that will protect resources without endangering human health and safety

  - strategies to implement appropriate pre-plans and carry out scheduled and unscheduled drills, exercises, briefings/meetings, and training opportunities to ensure that all park employees are prepared for emergency response

For additional information, refer to Chapter 10: Emergency Planning, *Conserve O Grams* 21/9 – 21/11, and the National Fire Protection Association's publication *NFPA 1600: Standard for Disaster/Emergency Management and Business Continuity Programs*.

• Museum Integrated Pest Management Plan (IPM Plan). Parks must have an approved, current, and implemented IPM Plan that specifically addresses the museum collections. The museum IPM Plan can be either a stand-alone document or part of the recognized parkwide IPM program.

• Collection Condition Survey. DO #24 requires parks to monitor and record information about the environment in spaces housing collections, manage the environment to maximize preservation, and complete Collection Condition Surveys (CCS), as needed, to assess conditions in spaces housing museum collections.

• Historic Furnishings Report (HFR). The HFR documents furnishings exhibited in associated historic structures. The HFR documents the history of a structure's use and interior appearance, and, if appropriate, provides a plan for recreating and/or maintaining the historic interior. The furnishings plan addresses interpretive objectives, operating plans that include recommendations for staffing and visitor circulation, and detailed plans for furnishing. Guidelines for furnishings installation and maintenance are included. The HFR must consider the preservation requirements of both objects and historic structures.

- Exhibit Plan. The Exhibit Plan provides the label copy and detailed design and construction plans. It must also address the preservation and security needs of exhibited objects. The plan and design must include specifications for environmental needs (for example, relative humidity, temperature, light, and dust control), security, and access to exhibit cases for maintenance and management. The plan ensures that all exhibits meet the standards in the Museum Checklist.

Other museum-specific plans that are included as a standard on the Museum Checklist are:

- Museum Security Survey. All parks must implement a Museum Security Survey and ensure that it remains current. It can be either a stand-alone document or part of a parkwide security survey. The regional curator and park chief ranger may assist in arranging for this specialized survey. See Chapter 9: Security and Fire Protection, for more information.

- Museum Fire Protection Survey. All parks must implement a Museum Fire Protection Survey and ensure that it remains current. It may be a stand-alone document or part of a parkwide fire protection survey. *Reference Manual 58: Structural Fire Management*, requires annual fire inspections of all NPS structures. Annual inspections do not assess the structure with the same level of detail as a complete fire protection survey; however, the annual inspections are an important part of the National Park Service's ongoing fire prevention and safety efforts. Consult the park structural fire coordinator, regional curator, and regional structural fire management officer for assistance. See Chapter 9: Security and Fire Protection, for more information.

- Collection Storage Plan. The park may require a stand-alone Collection Storage Plan (CSP) if this need has been identified on the park's Museum Checklist, in consultation with the regional curator. Not all parks need a CSP, as the Collection Management Plan addresses museum storage issues.

9. *Are there any other park planning documents that may impact museum collections?*

Yes, there are a number of other park program management and implementation plans that may impact museum operations. Examples include:

– Development Concept Plan (for the development of facilities)

– Vital Signs Network Monitoring Plan

– Fire Management Plan

- Cultural Landscape Report
- Historic Structure Report
- Archeological Overview and Assessment
- Ethnobotanical Study
- Other resource management plans

Many park planning efforts, when implemented, may impact museum operations. For example archeological compliance preliminary to or during construction may generate new objects and associated records; the construction of new facilities may provide space for museum operations; and the installation of new exhibits may increase visitation and staff responsibilities. Other park initiatives may similarly impact museum operations.

Effective communication is vital. So that you won't have any surprises (such as large unexpected accessions from park construction work, field projects, or upcoming exhibits planned around objects that aren't in the park's collection), be sure to keep inter-divisional lines of communication open. Involve other divisions in museum planning efforts. Likewise, make curatorial staff available to contribute to other planning efforts.

Planning teams composed of individuals with varied jobs, backgrounds, experience, and skill sets help to ensure that the team considers multiple perspectives, strategies, and methods and delivers an appropriate, well-considered product.

J. Ethics, Standards and Professional Associations

Professional associations have played an important role in the NPS museum program from its inception. Non-NPS museum professionals helped to create the vision for NPS museums (see sections C.2 and C.3) and professional associations and their members have provided ongoing support and guidance to NPS museums. Professional associations establish ethical guidance and standards that guide the actions and decisions of all museum employees, volunteers and board members. The associations offer training, publications, Web sites, conferences and professional development opportunities and work with government and foundations to gain recognition and funding for museums. The American Association of Museums (AAM) operates an accreditation program for museums in which the NPS participates (see *Museum Handbook*, Part I, Appendix B). NPS museum professionals have individual memberships in national and regional professional museum associations and support their associations by serving on councils and committees, presenting papers at conferences, and contributing to publications.

1. *What standards of ethical conduct apply to NPS museum professionals?*

As Federal employees, NPS museum professionals look first to the Standards of Ethical Conduct for Employees of the Executive Branch (5 CFR 2635), Employee Responsibilities and Conduct (43 CFR 20), the Supplemental Standards of Ethical Conduct for Employees of the

Department of the Interior (5 CFR 3501), and the criminal conflict of interest statutes (18 USC 201, 203, 205, 207-209) for guidance. The Code of Ethics for NPS Museums (see *Museum Handbook*, Part I, Appendix D) guides the decisions of employees and volunteers who manage NPS museum collections and museum functions. In addition, NPS employees with museum responsibilities are guided by the codes of ethics of professional associations, such as the Society of American Archivists and American Institute for Conservation. See a list of professional organizations and applicable codes of ethics in Appendix D, section D. As civil servants NPS employees work for and are responsible to the American public and have an obligation to act according to the law and the highest ethical standards.

2. *What other professional museum standards apply to NPS museums?*

Museum-related guidance in *Management Policies*, Director's Orders and related reference manuals, and the NPS *Museum Handbook* provides NPS staff with standards and procedures for preservation, protection, documentation, and access to and use of NPS collections. These documents adopt and promulgate the generally accepted standards of the museum profession, and, in some cases, incorporate the codes of ethics of other organizations by reference. The *Museum Handbook* provides guidance on and reference to the code of ethics, standards, and required and recommended procedures that employees and volunteers with responsibility for NPS museum collections follow. Each chapter and appendix contains a selected bibliography.

Park planning documents (see section I) provide park-specific guidance for management of the museum collections, consistent with professional standards and NPS standards and procedures. An up-to-date CMP provides information on the collection's current status, recommendations for improvements, prioritization strategies, and suggestions concerning long-range and short-term planning, programming, funding, and training. If the CMP is out-of-date, note this deficiency on the Museum Checklist, prepare a PMIS Project Statement to fund this work, and coordinate with the regional curator.

If the park's CMP is out-of-date, ask the regional curator to provide a recent example from another park. Use that document to gain ideas for the park's museum program.

3. *How can the park and I benefit from what professional associations offer?*

NPS parks and offices may be institutional members of professional associations and NPS museum employees may be individual members. Membership establishes a lasting partnership that serves to enhance the mission, goals, and operations of the museum and the career of the individual. Professional associations provide not only codes of ethics and standards, but opportunities for growth, inspiration for change, and guidance and support in challenging situations. Each association has a different focus. You will need to decide which associations best match the park's and your needs.

Selected professional museum-related associations are described below. Additional associations and contact information are in Appendix D, NPS Code of Ethics.

- **American Association for State and Local History** - The American Association for State and Local History (AASLH) is a national non-profit organization that serves organizations and people who work to preserve and interpret history, including historical societies, museums, historic sites, parks, libraries, archives, historic preservation organizations, and schools and colleges. The association has adopted and published the "AASLH Statement of Professional Ethics." Publications include a quarterly magazine, *History News*, and a monthly newsletter, *Dispatch*. The association produces and sells publications and educational materials (such as books, technical leaflets, reports, and video programs) on the documentation, preservation, and interpretation of history, including the care and conservation of museum objects. The association sponsors seminars, workshops, and an annual meeting.

  Contact: American Association for State and Local History
  1717 Church Street
  Nashville, TN 37203
  (615) 320-3203
  www.aaslh.org

- **American Association of Museums** - The American Association of Museums (AAM), founded in 1906, addresses the concerns of the country's museum community. The association represents art and natural history museums, zoos, botanical gardens, arboretums, planetariums, science and technology centers, nature centers, children's museums, and history museums, historic sites, and historical societies. Members include museum directors, curators, registrars, educators, marketing and development directors, public relations personnel, and others. It offers institutional, individual, and commercial memberships.

  The AAM's Accreditation Program (see *Museum Handbook*, Part I, Appendix B) is a leader in establishing professional standards for museums and museum professionals. Publications include a bi-monthly journal, *Museum News*, and a monthly newsletter *Aviso*. The AAM bookstore stocks publications that address topics such as collections management, museum ethics, conservation, marketing, and fundraising. The association holds an annual meeting.

  Contact: American Association of Museums
  1575 Eye Street, NW, Suite 400
  Washington, DC 20005
  (202) 289-1818
  http://www.aam-us.org

- **American Institute for Conservation of Historic and Artistic Works** - The American Institute for Conservation of Historic and Artistic Works (AIC) addresses the concerns of the conservation profession. Members include conservators who practice in all of the material specialties (such as, paintings, books and paper, textiles, wood, photographic materials, architecture, electronic media, and objects of leather, ceramic, glass, metal, and stone) and conservation scientists. Librarians, archivists, and curators may also be members. This organization has adopted and published the "AIC Code of Ethics and Guidelines for Practice" for the conservation profession in the United States. Publications include the *Journal of the American Institute for Conservation* (published three times a year) and the bimonthly newsletter, *AIC News*. The newsletter includes information from the various specialties, health and safety updates, preventive conservation information, and a list of conferences, courses, and seminars. The association sponsors an annual meeting, including a pre-meeting workshop. The association also publishes an annual directory of its membership. It offers institutional and individual memberships.

Contact: American Institute for Conservation of Historic and Artistic Works
1717 K Street, NW, Suite 200
Washington, DC 20006
(202) 452-9545
http://aic.stanford.edu/

- **Society of American Archivists** - The Society of American Archivists (SAA), founded in 1936, promotes the preservation and use of archival materials (such as, documents, manuscripts, films, maps, photographs, sound recordings, and machine-readable records). This organization provides a wide range of educational workshops, maintains an active publications program, and promotes cooperation, growth, and development in the archival field. The society has adopted and published "A Code of Ethics for Archivists with Commentary." Publications include a semi-annual journal, *American Archivist*, and a bimonthly newsletter, *Archival Outlook*. The SAA's publication program offers basic manuals on the arrangement, description, access, conservation and care, and exhibition of archival collections. The society sponsors an annual meeting. It offers institutional and individual memberships.

  Contact: Society of American Archivists
  527 South Wells Street, 5th Floor
  Chicago, IL 60607
  (312) 922-0140
  http://www.archivists.org

- **Society for the Preservation of Natural History Collections** - The Society for the Preservation of Natural History Collections (SPNHC) represents the interests of natural history collections and the people associated with the management and care of these collections. Membership includes individuals from the fields of anthropology, botany, geology, paleontology, zoology and others interested in the development and preservation of natural history collections. Publications include a journal, *Collection Forum*, a newsletter, *SPNHC Newsletter*, and the "Guidelines for Care of Natural History Collections." The journal, published twice a year, provides up-to-date technical and documentary information on the care of natural history collections. The society conducts annual meetings that include formal presentations and workshops. It offers individual, library, and institutional (associate/corporate) memberships.

Contact: Society for the Preservation of Natural History Collections
PO Box 797
Washington, DC 20044
(202) 786-2426
http://www.spnhc.org

- **International Council of Museums** - The International Council of Museums (ICOM) is an international non-governmental organization (NGO) which is "…committed to the conservation, continuation and communication to society of the world's natural and cultural heritage, present and future, tangible and intangible," (2004). ICOM is affiliated with the United Nations Educational, Scientific and Cultural Organization (UNESCO) and carries out part of UNESCO's program for museums.

  ICOM initiatives include: "…professional cooperation and exchange, dissemination of knowledge and raising public awareness of museums, training of personnel, advancement of professional standards, elaboration and promotion of professional ethics, [and] preservation of heritage and combating the illicit traffic in cultural property," (2004).

  To raise global awareness of museum issues, ICOM sponsors "International Museum Day" each May 18. The organization has adopted the "ICOM Code of Ethics for Museums." It offers institutional and individual memberships.

  Contact: ICOM Secretariat
  Maison de l'UNESCO
  1, rue Miollis
  75732 Paris Cedex 15
  France
  Tel: 011+33 (0) 1 47.34.05.00
  http://icom.museum

- **State and Regional Museum Associations** - Regional museum organizations are good resources for professional standards, training, and networking. Many states have statewide museum associations as well. The American Association of Museums has six affiliated regional museum associations (see http://www.aam-us.org/aboutaam/councils/region/index.cfm). Consult the NPS regional curator for additional information on such organizations serving your area.

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Chapter 2: Scope of Museum Collections

List of Figures

CHAPTER 2: SCOPE OF MUSEUM COLLECTIONS

A. Overview

1. *What information will I find in this chapter?*

In this chapter you will find answers to these questions:

- What is a museum collection?
- Who can accept a museum collection?
- What is a Scope of Collection Statement (SOCS)?
- Why does my park need a SOCS?
- How do I write a Scope of Collection Statement?
- Why should I include an Executive Summary (Scope of Collection Statement Summary)?
- How do I write a Scope of Collection Statement Summary?
- How do I implement a museum collection acquisition program?
- What criteria can I use to justify acceptance or rejection of museum objects?
- What is a Collections Advisory Committee?
- Who serves on a Collections Advisory Committee?

2. *What other resources can help me prepare and implement my park's Scope of Collection Statement?*

For additional information, see the:

- **Sample Scope of Collection Statement** in Appendix E: Scope of Collection Statement
- **Checklist for Evaluating a Scope of Collection Statement** in Appendix E
- **Bibliography** in Section L., at the end of this chapter

B. Museum Collections

1. *What is a museum collection?*

A museum collection is a group of artifacts (including archives) and/or scientific specimens that are relevant to the park's mission, mandates, history, and themes, and which the park manages, preserves, and makes available for access (through research, exhibits, and other media) for the public benefit.

The Departmental Manual (411 DM 1.3) defines museum property (museum collections) as:

"an assemblage of museum objects collected according to some rational scheme and maintained so they can be preserved, studied, or interpreted for public benefit. Museum objects include prehistoric and historic objects, artifacts, works of art, archival documents [historical and/or scientific documents collections as defined in the Departmental Museum Property Handbook, 411 DM Volume I, Appendix A, Section A.2.d.] and natural history specimens that are a part of museum collections. Elements, fragments, and components of structures are objects if they are no longer a part of the original structure. Museum property does not include those items necessary to display a collection such as exhibit cases, dioramas, special lighting, graphics, etc."

Consult with your regional/SO curator and regional historical architect for guidance concerning accessioning structural components and historic fabric into your park's collection.

Note: In rare instances, museum dioramas or exhibit cases may be considered museum property (such as dioramas constructed by the Civilian Conservation Corps) or historic fabric.

NPS *Management Policies* (2001), 5.3.5.5 "Museum Collections" states:

"The Service will collect, protect, preserve, provide access to, and use objects, specimens, and archival and manuscript collections (henceforth referred to collectively as 'collections,' or individually as 'items') in the disciplines of archeology, ethnography, history, biology, geology, and paleontology to aid understanding among park visitors and to advance knowledge in the humanities and sciences."

2. *Why should parks acquire and manage museum collections?*

Chapter 9 of *Cultural Resource Management Guideline*, Release No. 5 (1997), which implements Director's Order #28: Cultural Resource Management (June 1998), states:

"Museum collections (objects, specimens, and archival and manuscript collections) are important park resources in their own right as well as being valuable for the information they provide about processes, events, and interactions among people and the environment. Natural and cultural objects and their associated records provide baseline data, serving as scientific and historical documentation of the park's resources and purpose. All resource management records that are directly associated with museum objects are managed as museum property. These and other resource management records are preserved as part of the archival and manuscript collection because they document and provide an information base for the continuing management of the park's resources. Museum objects used in exhibits, furnished historic structures, and other interpretive programs help visitors gain better understanding of the events, activities, and people commemorated by parks."

Museum collection records such as accession records, catalog records, loan records, conservation records, and inventory records are not included in the museum collection. They are official records that are generated in the course of doing government business. You must retain these records in association with museum collections. Do not catalog or include them as part of the park's museum collection. The management of these records is governed by Director's Order #19: Records Management (Jan 2001). Because they are used in the day-to-day management of the park collection, they are listed on the Records Disposition Schedule as being permanently retained in association with museum collections. See Museum Handbook, Part II (MH-II), Museum Records.

3. *Who can accept museum collections?*

By delegation, your park's superintendent represents the Director and the Secretary of the Interior in accepting title to and responsibility for museum collections. (See *MH-II*, Museum Records, Chapter 1, for guidance on delegation of authority and museum property management.)

Each park superintendent is responsible for ensuring that all collections acquired are in keeping with the Scope of Collection Statement before accepting the items as part of the permanent collection.

C. The Scope of Collection Statement

1. *What is a Scope of Collection Statement?*

A Scope of Collection Statement is a stand-alone museum planning document that succinctly defines the scope of the park's museum collection holdings at the present and for the future. The SOCS derives from the park's mission, as well as laws and regulations mandating the preservation of collections. It is:

- the critical basis for managing museum collections
- referenced in each park's General Management Plan, Resource Management Plan, Long-Range Interpretive Plan, and other planning documents that may affect the collection of museum objects or their management and use

2. *Does every park require a Scope of Collection Statement?*

Yes, all parks must have a Scope of Collection Statement. Although some parks may not intend to acquire a "typical" museum collection, each park will, at a minimum, possess archives documenting the history and management of the park, as well as objects and specimens generated from resource management activities. Other NPS organizational units (such as conservation centers, regional offices, or support offices) that acquire and maintain museum collections must also have a fully developed SOCS.

3. *Why does my park need a Scope of Collection Statement?*

A Scope of Collection Statement guides your park in the acquisition and management of those museum objects that contribute directly to the park's mission, as well as those additional collections that the Service is legally mandated to preserve. A SOCS:

- defines the purpose of the park's museum collection

- sets agreed-upon limits that specify the subject matter, geographical location, and time period to which the collection must relate

- evolves from legislation and planning documents specific to each park, and from laws, regulations, and NPS policies governing research and specimen collection conducted within park boundaries

- states what types of objects will be acquired to fulfill the park's mission

- considers collection use and restrictions

Director's Order #24: NPS Museum Collection Management, 4.3.6 "Scope of Collections" states that NPS units with museum collections must:

"Approve and keep current a Scope of Collection Statement to identify the scope of collecting activities and define the purpose of the collection. Ensure acquisitions are consistent with the Scope of Collection Statement. Deaccession objects inconsistent with the Scope of Collection Statement."

4. *How do I determine the scope of my park's museum collection?*

To determine the scope of your park's museum collection, you should:

- study the mission of the park as stated in its enabling legislation, presidential proclamation, executive order, or subsequent legislation that may revise a park's mission.

- determine what cultural evidence and scientific information is needed to document and support the park's resource management and interpretive programs.

- include archeological collections, certain natural history collections, and associated records that are mandated by law, regulation, and policy to be a part of the park's museum collection.

5. *What is a park Collections Advisory Committee?*

A Collections Advisory Committee is chaired by the curator or collections manager and includes park staff who represent relevant disciplines (interpretation, natural resource management, archeology, and others). Committee members may also include subject matter specialists from neighboring parks and/or the regional office. The roles of the committee members are to:

- determine which of the park's missions and programs are relevant to museum collections

- determine which types of museum objects the park will maintain to support those missions, programs, and mandates

- draft a new or revised SOCS for the park

- review and make recommendations to the superintendent concerning all potential additions by gift, purchase, transfer, exchange, and loan to the museum collection

- review and make recommendations to the superintendent concerning all potential deaccessions of objects determined to be outside the Scope of Collection

- review and make recommendations to the superintendent concerning all potential deaccessions of objects that involve voluntary destruction or abandonment

6. *Are parks required to have a Collections Advisory Committee?*

No, a Collections Advisory Committee is optional. However, you should consider establishing one. A committee with good representation from different park divisions and across various disciplines will allow for enlightened discussions reflecting diverse viewpoints, and eliminate any appearance of curatorial self-interest unduly influencing the park's acquisitions policies. Most professional museums have a Collections Advisory Committee. The guidance provided by this committee, combined with a well-written SOCS, should ensure that the museum collection is clearly relevant to your park's mission.

7. *Who prepares and approves a Scope of Collection Statement?*

The curator, collections manager, or other park staff responsible for the collection (ideally with the assistance of the Collections Advisory Committee) prepares the Scope of Collection Statement. Be sure to coordinate the development of your SOCS with your regional/SO curator, as s/he can provide help. Following review by appropriate park staff (such as archeologists, interpreters, scientists, naturalists, historians, archivists, and other resource management staff) and your regional/SO curator, the superintendent approves the document.

8. *What is the distribution of an approved Scope of Collection Statement?*

The park or other NPS unit maintains the original approved Scope of Collection Statement. A copy of the approved SOCS should be forwarded to the regional/SO curator.

9. *How often should I review and revise my park's Scope of Collection Statement?*

Review your park's Scope of Collection Statement at least every five years. Revise it whenever changed conditions clearly alter the mission of your park or when priorities in a specific collecting category have been met. Your superintendent must review and approve any changes made to the SOCS. See Appendix E, for a checklist that you can use to prepare or review your park's Scope of Collection Statement.

10. *What are the parts of a Scope of Collection Statement?*

Include the following sections in your Scope of Collection Statement:

- Title Page
- Table of Contents
- Executive Summary
- Introduction
- Types of Collections
- Museum Collections Subject to the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990
- Acquisition

- Uses of Collections
- Restrictions
- Management Actions

The Introduction and Types of Collections sections are the most important components of the document. These two sections establish the purpose of the park's museum collection and describe the types of objects that the park will collect. The information in these two sections ensures the collection's logical growth while guarding against the acquisition of objects that are not clearly relevant to the park. See Appendix E, for an example of a Scope of Collection Statement.

11. *What is the Executive Summary (Scope of Collection Summary)?*

The Executive Summary (or Scope of Collection Summary) is one or a few paragraphs that summarize the park's collections and highlight the most significant aspects or individual items. The Executive Summary should be located at the beginning of your Scope of Collection Statement. You also may wish to include this same information in a single stand-alone document that you can distribute to park staff, visitors, the press, and other interested parties. Figure 2.1 includes an example Scope of Collection Summary document. This example is available in electronic format. Contact your regional/SO curator to get an electronic copy to use as a template when preparing your park's Scope of Collection Summary.

12. *When should I use the Scope of Collection Summary?*

Use the Scope of Collection Summary when you need a description of the collection for:

- park planning documents
- entries in directories
- press releases
- web sites
- other publications

> ***You can use the Scope of Collection Summary to update your park's "Collection Summary" on "About Museum Collections" on InsideNPS. Go to <http://inside.nps.gov/documents/museum> and follow the instructions under "Edit Park Data."***

D. Writing the Introductory Section of the Scope of Collection Statement

1. *What should I include on the Title Page?*

Prepare a title page that spells out the full name of the park (for example, Zion National Park, Fort Clatsop National Memorial). The Title Page also serves as the review and approval page. See Appendix E, for the Scope of Collection Statement Title Page format.

2. *What should I include in the Executive Summary?*

Prepare an Executive Summary that consists of one to a few paragraphs that succinctly outlines the park's collections and highlights the most significant aspects or individual items. The Executive Summary is a useful resource for providing concise collections information to park management, planning staff, and others. You may wish to include this same information in a single stand-alone document (or Scope of Collection Summary) that you can distribute to park staff, visitors, the press, and other interested parties (see Figure 2.1). Use the Scope of Collection Summary when you need a description of the collection for park planning documents, entries in directories, press releases, public inquiries, web sites, or publications. The Scope of Collection Summary can also be made available via the web. See Appendix E, for the Scope of Collection Statement Executive Summary format.

3. *What should I include in the Table of Contents?*

Prepare a Table of Contents that lists all of the sections and sub-sections of the SOCS with page numbers. See Appendix E, for the Scope of Collection Statement Table of Contents format.

4. *How do I prepare the Introduction?*

The Introduction defines the purpose of your park's museum collection. Justify the collection's significance and include pertinent elements from the park's enabling legislation, other mandates, mission statement, and approved park planning documents. When writing your Introduction, you should state the purpose of the park's Scope of Collection Statement. Sample wording for this section is as follows:

> *This Scope of Collection Statement defines the scope of present and future museum collection holdings of Lewis Mountains National Park that contribute directly to the understanding and interpretation of the park's purpose, themes, and resources, as well as those objects that the Service is legally mandated to preserve. It is designed to ensure that the museum collection is clearly relevant to the park.*

5. *What legal authorities should I reference?*

Reference the legal authorities for the Service to acquire, document, preserve, and provide access to museum collections:

- Antiquities Act of 1906 (16 USC 431-433)
- Organic Act of 1916 (16 USC 1 et. seq.)
- Historic Sites Act of 1935 (16 USC 461-467)
- Management of Museum Properties Act of 1955, as amended (16 USC 18f)
- Reservoir Salvage Act of 1960, as amended (16 USC 469-469C)
- National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.)
- Archeological and Historic Preservation Act of 1974, as amended (16 USC 469-469l-2)
- Archaeological Resources Protection Act of 1979, as amended (16 USC 470aa-mm)

- National Parks Omnibus Management Act of 1998 (16 USC 5901)

See Appendix A for a summary of these laws.

Sample wording for this section is as follows:

> *The National Park Service's (NPS) legal mandate for acquiring and preserving museum collections is contained in the Antiquities Act of 1906 (16 USC 431-433); the Organic Act of 1916 (16 USC 1 et. seq.); the Historic Sites Act of 1935 (16 USC 461-467); the Management of Museum Properties Act of 1955, as amended (16 USC 18f); the Reservoir Salvage Act of 1960, as amended (16 USC 469-469c); the National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.); the Archeological and Historic Preservation Act of 1974, as amended (16 USC 469-469l-2); the Archaeological Resources Protection Act of 1979, as amended (16 USC 470aa-mm); the National Parks Omnibus Management Act of 1998 (16 USC 5901).*

6. *What information should I include about the park's mission?*

State the park's mission. Cite the park's enabling legislation and any relevant subsequent legislation. Include excerpts. If applicable, note that the legislation for the park requires the establishment and maintenance of a museum collection. Be sure to mention any litigation or judgements relating to the collection as well.

7. *What information should I include about the purpose of the collection?*

State the purpose of the park's museum collection. A park's museum collection:

- provides valuable information about processes, events, and interactions among cultures, individuals, and the environment
- places objects and specimens within a broader context, through research, analysis, and documentary records
- provides for the greatest benefit and enjoyment by the public
- provides baseline data, serving as scientific and historical documentation of the Service's resources, and of the purpose for which the park was established
- may document important events or people in the nation's history, technological processes, or artistic endeavors

8. *What park documents should I reference?*

Refer to your park's General Management Plan (GMP) (in lieu of a GMP, refer to the park's current Government Performance Results Act [GPRA] Strategic Plan), Resource Management Plan, Long-Range Interpretive Plan, Historic Furnishings Reports, Historic Structure Reports, exhibit planning documents, or other relevant planning documents in defining the purpose of your park's museum collection.

Study your park's interpretive planning documents, and relate how the museum collection supports the interpretive program. List the interpretive themes and periods. If they exist, cite the park's Long-Range Interpretive Plan and other interpretive plans. Include title(s) and approval date(s).

Study your park's resource management planning documents, and, where relevant, state how the museum collection supports the park's resource management program. List pertinent resource management goals and objectives. If they exist, cite the park's Resource Management Plan, Natural Resources Network Inventory and Monitoring Study Plan, Fire Management Plan, and other resource management plans. Include title(s) and approval date(s).

9. *What should I include about mandated collections?*

Identify mandated collections. The purpose for the park's museum collection also includes managing objects that the Service is mandated to preserve.

43 CFR 7.13, "Custody of Archeological Resources," and NPS *Management Policies* (2001), mandate that archeological collections (including associated records) acquired as a result of systematic investigation within a park's boundary must be managed intact as part of the park's resources and, therefore, never can be outside a park's approved Scope of Collection Statement.

Certain natural history specimens that are not consumed in analysis and are determined to be appropriate for long-term preservation are included in a NPS museum collection in compliance with 36 CFR 2.5, "Research Specimens."

Sample wording for this section is as follows:

> *Archeological collections, except inalienable and communal property (as defined by the Native American Graves Protection and Repatriation Act of 1990 [25 USC 3001-13]), recovered from within park boundaries through systematic collection are Federal property and must be retained in the park's museum collection in accordance with 43 CFR 7.13 and NPS Management Policies (2001).*
>
> *In accordance with the NPS Research Permit and Reporting System, permits to collect natural resource specimens state that retained specimens remain Federal property, are incorporated into the park museum collection and, as required by 36 CFR 2.5g, must bear official National Park Service museum labels and their catalog numbers will be registered in the National Park Service National Catalog.*

10. *Should I include information on the significance of the collection?*

Yes. Be sure to discuss the significance and history of your park's museum collection. This is an important part of every SOCS, as it:

- details the development of your park's collection
- ensures that important collections history information is not lost due to staff turnover
- documents the significance of the museum collections in text that can also be used in PMIS project justifications and other funding requests

Note: You also may want to include information concerning your park's past curators and managers, as well as past management priorities. Such information may prove helpful as you attempt to develop solutions to various museum management issues.

11. *What other references should I include in the Introduction?*

List other laws, regulations, directives, and conventions that are pertinent to the acquisition of museum collections. See Appendix A, for a list and summary of these documents. Suggested wording for this section is as follows:

Other laws, regulations, directives and conventions pertinent to the acquisition of museum collections at the park include: the Lacey Act of 1900 (18 USC 43-44); the Migratory Bird Treaty Act of 1918 (16 USC 703-711); the Bald Eagle Protection Act of 1940, as amended (16 USC 668-668d); the Federal Property and Administrative Services Act of 1949, as amended (40 USC 483[b]); the Federal Records Act of 1950, as amended ("Records Management by Federal Agencies" [44 USC 3101 et. seq.]); the Freedom of Information Act of 1966, as amended (5 USC 552); the Marine Mammal Protection Act of 1972 (16 USC 1361-1407); the Endangered Species Act of 1973, as amended (16 USC 1531-1543); the Privacy Act of 1974 (5 USC 552a); the Copyright Act of 1976 (17 USC 101 et seq. [1988 & Supp. V 1993]); the American Indian Religious Freedom Act of 1978 (42 USC 1996); the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 USC 3001-3013); Federal Property Management Regulations (FPMR), 41 CFR 101; 410 Departmental Manual, Interior Property Management Regulations (IPMR); 411 Departmental Manual, "Managing Museum Property," Chapters 1-3; "Curation of Federally-Owned and Administered Archeological Collections," 36 CFR 79; NAGPRA Final Regulations, 43 CFR 10; "Disposition of Federal Records," 36 CFR 1228; "Protection of Archeological Resources", 43 CFR 7; "Preservation of American Antiquities", 43 CFR 3; "Preservation, Arrangement, Duplication, Exhibition of Records" (44 USC 2109); "Disposal of Records" (44 USC 3301 et seq.); Director's Order #19: Records Management; Director's Order #24: NPS Museum Collections Management; Director's Order #28: Cultural Resource Management; Director's Order #44: Personal Property Management; the 1983 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); the 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property (implemented in the United States by P.L. 97-446 in 1983, 19 USC 2601).

Identify any special designations (such as Biosphere Reserve, National Historic Landmark, World Heritage Site) that may be relevant to the park's museum collection. At the same time, be sure to note if the park is part of a larger (but local) heritage area designation or historic preservation district.

Refer to the sample Scope of Collection Statement in Appendix E, for additional help when drafting the Introduction section of your SOCS.

E. Writing the Types of Collections Section

1. *What should I include in the Types of Collections section?*

In the Types of Collections section, identify the specific types of museum collections that your park acquires to meet the purpose(s) stated in the Introduction. Describe what should be collected to meet the park's enabling legislation, any subsequent legislation, and approved resource management and interpretive goals and objectives, as well as mandates relevant to archeological and natural history collections. You should:

- State that the Introduction defines the purpose of the park's museum collection.

- Note the two major categories of museum collections: Natural History and Cultural Collections.

  - **Natural History Collections.** Your park's natural history collection may include specimens from the disciplines of biology, geology, and paleontology.

  - **Cultural Collections.** Your park's cultural collection may include objects from the disciplines of archeology, ethnography, and history (including archives and manuscripts).

- Subdivide each appropriate discipline into collecting categories that reflect the purposes of the park. Establish the collecting categories based on classification, time period, themes, or other criteria. Examples may include types of biological collections (birds, mammals, and fungi), archeological materials recovered during pre-construction compliance work, archival materials associated with certain individuals related to the park.

- Briefly describe current representation of object types under each collecting category.

  - Discuss strengths of the existing collection.

  - Identify any current deficiencies to help define acquisition priorities.

  - Provide sufficient detail to distinguish the various types of items that may be considered for acquisition.

  - Establish quantitative or qualitative limits on the size of the collection when possible.

- Include all archeological materials and natural history specimens collected within park boundaries that the park is mandated to maintain in park collections.

  - These items are Federal property and must be retained in the museum collection according to law, regulation, and policy.

  - State the requirement to retain all resource management records prepared or assembled as a result of archeological survey, excavation, or other study. State the requirement to retain resource management records generated by natural resource studies that the NPS initiates. When these records are associated with collected artifacts or specimens they are known as associated records. In accordance with NPS *Management Policies* (2001), 4.2.2. Independent Studies, and the NPS Research Permit and Reporting

System, parks may require researchers doing independent (non-NPS) studies to provide the park with copies of field notes, final reports, or other documentation related to the project. If the park has this requirement, include it in the SOCS. See *MH-II*, Appendix D, for information concerning associated records.

2. *What do I need to know about natural history collections to help me prepare the Types of Collections section?*

Parks generate natural history collections in relation to the size and complexity of natural resources within the park, the number of research and monitoring projects, and for multiple uses. Natural history collections contain materials from the disciplines of biology, paleontology, and geology. Your park's collection may include:

- **Reference Collections.** Many living organisms, fossils, and minerals are difficult to identify. Reference collections allow identification by comparison with actual specimens.

- **Synoptic Collections.** Synoptic collections contain multiple representatives of a particular group from the park. They are generated to document presence and distribution, to establish baseline inventories, for monitoring, or to illustrate the morphological variations within a genus or a species.

- **Voucher Collections.** Studies and projects generate voucher specimens that document by date and locality species identity, age classes, genetic variations, and other information that may be reviewed in the future by other investigators.

- **Type Collections.** A type specimen is the specimen used to describe a new species for the first time. The definitions and procedures for type specimens are tightly controlled by international codes (such as the *International Code of Botanical Nomenclature*). Type specimens have extremely high scientific value. They are managed as NPS controlled museum property and must be afforded appropriate storage and security.

- **Tissue Samples**. Viable tissue samples are rare in NPS collections, as the specimens must be stored within specialized equipment that can maintain ultracold (about -80°C) or cryogenic temperatures (below -130°C) for their preservation. The exact temperature is usually determined by the sensitivity of the specimens. -130°C is the maximum temperature for long-term stability of plant and animal cells and -150°C or lower is considered to be optimum for preservation. See *MH-I*, Appendix T, for additional information on tissue samples.

Natural history collections can result from ongoing park projects such as Fire Effects projects, Inventorying and Monitoring projects, Cultural Landscape Reports, Ethnobotanical Studies, and other activities. These collections can also result from research conducted by non-NPS scientists working in the park under permit. Be sure to develop your park's natural history collection in close coordination with your park's Research Coordinator, resource management and interpretive staff, scientists, your regional/SO curator, and Native American and other cultural groups associated with the park.

3. *What other information concerning natural history collections should I include in the Types of Collections section?*

Your discussion of natural history collections should include a brief paragraph that describes a program for the selective acquisition of natural history specimens for the collection. Base this paragraph on appropriate resource management and interpretive goals and objectives of your park. Be sure to state that:

- Specimens must be collected scientifically, so that only well documented and appropriate specimens are retained in the collection.

- No non-NPS collector can work in the park without first obtaining a permit. The permit's "Collections Section" must also be completed, documenting where collections of specimens and associated records will be housed.

Note: You may want to encourage park staff to obtain a permit for projects that they undertake in the park as well. Consult with your park's research coordinator concerning this and other related matters.

Neither the Collections Advisory Committee nor the museum staff decide what research will be conducted in the park. The superintendent, with the input of your park's research coordinator, makes that decision. Both the committee and the museum staff advise the superintendent on what objects and specimens should be (or must be, according to statute) accessioned into the park's museum collection.

In some parks, curatorial and natural resource staff work together to review collection permit requests, advising the superintendent to reject certain requests that are duplicative of existing collections and re-direct the researcher to the existing park collections. This policy is particularly valuable to support park goals of protecting rare species and limiting/preventing duplicative collecting.

Other information that you should mention in this section includes:

- The collecting category "Associated Records" under each discipline. (See *MH-II*, Appendix D: Archival and Manuscript Collections and Question 6. below, "What do I need to know about Archival and Manuscript Collections…" for information concerning associated records.)

- A statement that addresses the park's program to curtail uncontrolled collecting of natural resources by staff and visitors.

Note: Many parks maintain teaching collections of herbarium, mammal, bird, and other specimens. Such collections are usually managed by the park's interpretive division and are typically located in an environmental education center, visitor center "hands-on displays," or are included within a "traveling trunk" used for off-site programs. Such specimens do not result from authorized scientific research in the park, but rather from road kills, collecting outside park boundaries, and illegally possessed flora, fauna, and other specimens seized by state and Federal authorities. Since these collections are truly interpretive in nature and were not a product of scientific research, do not accession these materials into the museum collection. If your park has such a teaching collection, it is useful to note this fact in the SOCS to differentiate it from the museum collection.

> ***<u>Except for specimens that the Service is mandated to preserve</u>, a natural history collection may not be applicable to your park's enabling legislation, interpretive themes, and resource management goals and objectives. If your park does not currently possess or intend to acquire a natural history collection (other than mandated collections resulting from resource management activities), include a short statement in this section to that effect.***

See Appendix E, for an example Scope of Collection Statement that includes sample language and content concerning natural history collections.

4. *What do I need to know about cultural collections to help me prepare the Types of Collections section?*

Your park's cultural collection may contain materials from the disciplines of archeology, ethnology, and history (including, but not limited to, fine and decorative arts, architectural materials, and archival and manuscript collections).

Develop your park's cultural collection in close coordination with park resource management and interpretive staff, your regional/SO curator, historians, archivists, archeologists, ethnographers, and Native Americans and other groups who have a personal or cultural affiliation with the collection.

> ***Limiting the growth of history and ethnographic collections may be an important concern. Consider your park's interpretive and resource management goals and objectives, as well as your capability to properly manage and preserve these collections. If appropriate, indicate the types of objects that should not be part of the collection. History and ethnographic collections may be limited to types and quantities sufficient to implement exhibit planning documents and/or a Historic Furnishings Report.***

5. *What other information about cultural collections should I include in the Types of Collections section?*

Your discussion of cultural collections should include:

- An introductory paragraph that indicates the purpose of these collections.

- Information concerning archeology collections:

  - Artifacts and Specimens. Include a statement that addresses the park's program to curtail uncontrolled surface collecting by staff and visitors.

- Associated Records. See *MH-II*, Appendix D: Archival and Manuscript Collections and Question 6. below, "What do I need to know about Archival and Manuscript Collections…" for information concerning associated records.

- Your park's collection priorities. State that:

  - An object from the site or directly associated with person(s) or event(s) commemorated by the park is more desirable than a similar object without such association.

  - Priority must be given to the best-documented site-related objects. When a large quantity of an object type is available, priority will be given to acquiring the best-preserved examples (unless there is greater value in the assemblage of a whole set rather than simply of individual items).

- A brief listing of those types of object currently in the collection.

- Information concerning history and ethnographic collections.

  - If a history or ethnographic research/study collection is deemed to be important to fulfilling the park's mission, make such a statement.

  - Justify this collection by referencing appropriate resource management and interpretive goals and objectives.

See Appendix E, for a sample Scope of Collection Statement that includes language and content concerning cultural collections.

6. *What do I need to know about Archival and Manuscript Collections to help me prepare the Types of Collections section?*

Never include official records in the museum collection without specific authorization from the National Archives and Records Administration (NARA). Official records are defined under the Federal Records Act. They are also described in guidelines issued by NARA, and in NPS Director's Order #19: Records Management. Official records include original or "record copy" documents created or received in the course of performing the daily work of the NPS. Examples of official records include audit records, budget materials, central park correspondence files, contracting files, financial records, law enforcement records, legal records, museum administrative records, permits, personnel records, project files, and similar types of materials. By law, the NARA has authority over these materials, and they must be transferred to that agency or otherwise disposed of according to NARA guidelines.

The museum collection may include several categories of archival and manuscript materials that do not meet the statutory definition of official records, as well as official records that the National Archives has authorized NPS to retain. These materials include:

- **Personal Papers or Organizational Archives** donated to the NPS by non-Federal sources. Because these materials are non-Federal in origin and because the NPS obtained them as museum objects rather than as records of NPS activity, they are not considered to be official records.

Note: Acquiring such collections without also acquiring the copyrights can severely limit the park's use of the items. NPS acquisition policy requires parks to:

- determine who owns the copyright

- if possible, have the owner transfer the copyrights to the NPS

See Section E: Acquiring Copyrights, in *MH-II*, Chapter 2: Accessioning, for additional information.

- **Sub-Official Records**. These include ***copies*** of official records, such as bibliographies, desk files maintained by individual NPS employees, park handouts, and other documents kept for purposes of reference or convenience.

- **Resource Management Files**. These records are defined in the Departmental Manual (411 DM 1, Policy and Responsibilities for Managing Museum Property), and include site forms, field notes, drawings, maps, photographs, video tapes, sound recordings, oral histories, inventories of artifacts, laboratory reports, and "Associated Records" that are created in connection with specific sites, objects, and specimens. Although these are official records created by a Federal employee, contractor, or partner, the Service has permission from the NARA to keep them because they relate directly to museum collections and park resources, and because they are critical for the interpretation, management, or preservation of the nation's natural and cultural heritage. See 36 CFR 79 for additional information concerning associated records related to archeological resources.

Archival documents can be in any format: paper, film, audio or video recordings, or electronic (computer-based) media, to name but a few.

Also, except for materials compiled by NPS staff into "assembled collections," it is seldom appropriate to acquire or maintain archival materials on a document-by-document basis. Instead, archival materials usually are kept in their original groupings, following the filing schemes developed by the person or organization that created them. Therefore, it is preferable to acquire archival materials on a collection-by-collection basis. See *MH-II*, Appendix D: Museum Archival and Manuscript Collections for additional information.

See *MH-I*, Appendix E, for a sample Scope of Collection Statement that illustrates sample language and content for this collecting category.

7. *How do I determine if material belongs in the park library or the museum collection?*

Library Collections. As a general rule, place publications that are not rare or assembled by an eminent figure related to the park's mission in the park library. See *Conserve O Gram* 19/1, "What Makes a Book Rare" for the definition of a rare book.

Museum Collections. In addition to the excepted publications noted above, place all original archival documents, whether in audio-visual, electronic, textual, or visual format, in the museum collection. These original materials include such items as audiotapes, correspondence, graphic prints, manuscripts, motion picture film footage, photographs, reports, and videotapes, plus all other original documentary formats.

Books associated with a significant individual (such as Frederick Douglass) or acquired in response to a deficiency identified in a Historic Furnishings Report or Exhibit Plan should be placed in the museum collection.

F. Writing the Museum Collections Subject to NAGPRA Section

1. *What is NAGPRA?*

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 USC Chapter 32) recognizes the rights of lineal descendants, culturally affiliated Indian tribes (including Native Alaskan villages or corporations), or Native Hawaiian organizations to control or own Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony that are held by federal agencies and museums that receive federal funds. In addition to its other provisions, the law requires these agencies and museums to:

- conduct inventories and produce written summaries of such items in their collections
- repatriate (return) identified NAGPRA associated items to the appropriate lineal descendants, culturally affiliated Indian tribes, or Native Hawaiian organizations in compliance with the law, if requested to do so by these groups

For additional information concerning NAGPRA, see Appendix A: Mandates and Standards and *MH-II*, Chapter 6: Deaccessioning.

2. *What do I include in the SOCS about NAGPRA?*

If applicable to your park, include information on the written summary and inventory.

Written Summary. If applicable to your park, state that the NPS met the legal requirement by distribution of the Servicewide Summary, listed by park, to all Indian Tribes, Alaskan Native villages or corporations, and Native Hawaiian organizations on October 27, 1993. In accordance with *Cultural Resource Management Guideline* (1997), Appendix R, NAGPRA Compliance, superintendents must periodically review and update summaries to reflect new acquisitions and newly recognized Indian tribes. State that an updated copy of this summary is on file at your park. If your park has no museum objects in the NAGPRA defined categories of unassociated funerary objects, sacred objects, or objects of cultural patrimony, make a statement to that effect. Suggested wording for this section is as follows:

> *The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), 25 USC 3001-13, requires, in addition to other actions, a written summary of unassociated funerary objects, sacred objects, and*

objects of cultural patrimony. The park's holdings that fall into these NAGPRA categories are listed in the Servicewide Summary that was distributed to all Indian Tribes, Alaska Native villages, and Native Hawaiian organizations on October 27, 1993. An updated copy of this summary is on file at the park.

Inventory. If applicable, state that your park has human remains or associated funerary objects subject to NAGPRA in its collection. State as of **[note date]** the park completed the inventory of Native American human remains and funerary objects. In accordance with *Cultural Resource Management Guideline* (1997), Appendix R, NAGPRA Compliance, superintendents must periodically review and update the inventory to reflect new acquisitions and newly recognized Indian tribes. State that an updated copy of this inventory is on file at your park. If the park has no human remains or associated funerary objects, make a statement to that effect. Suggested wording for this section is as follows:

> *NAGPRA requires a written, item-by-item inventory of human remains and associated funerary objects to be completed no later than November 16, 1995. The park has human remains and associated funerary objects subject to NAGPRA in its museum collection. A detailed listing of these items is contained in the park's NAGPRA Inventory, completed* **[note date]**. *An updated copy of this inventory is on file at the park.*

Note: You must keep all NAGPRA summaries and inventories up-to-date. If your park has acquired NAGPRA related items since 1993, be sure to amend your park's summary and inventory to reflect this. For additional information, see *Cultural Resource Management Guideline*, Appendix R, NAGPRA Compliance, pp. 325-326.

G. Writing the Acquisition Section

1. *How do I prepare the Acquisition section?*

When writing the Acquisition section, be sure to:

- Describe the various types of acquisition sources.
- State that museum objects must be acquired, accessioned, and cataloged in accordance with *Museum Handbook*, Part II, Museum Records.
- State that the acquisition of museum objects is governed by the park's ability to manage, preserve, and provide access to them according to:
  - NPS *Management Policies* (2001), Chapter 5
  - Director's Order #28, Cultural Resource Management (1998)
  - *Cultural Resource Management Guideline* (1997)
  - Director's Order #24: NPS Museum Collections Management (2000)
  - NPS *Museum Handbook*, Part I, Museum Collections, Part II,

Museum Records, and Part III, Access and Use

- State that the park will not be a partner to, or encourage in any way, the trafficking in illicitly collected materials. Be sure that all acquisitions were collected, exported, imported, transported, or otherwise obtained and possessed in full compliance with the laws and regulations of:

    - the country of origin

    - the United States federal government (including NAGPRA)

    - the individual states within the U.S.

See *MH-II*, Chapter 2: Accessioning, Section D. Special Considerations for Accessions, for information on the illicit trade of collections.

- State that the acquisition of firearms included on the Bureau of Alcohol, Tobacco, and Firearms (ATF) list of prohibited/restricted weapons requires concurrent review by the regional/SO curator and the regional/SO law enforcement specialist.

- State that NPS policy requires superintendents to accept only unconditional gifts. This includes acquiring all copyrights at the time of acquisition. Only the regional director has the authority to approve conditional gifts for rare exceptions, on a case-by-case basis. See Director's Order #24: NPS Museum Collections Management (2000), 4.3.15 Unconditional Gifts and *Museum Handbook*, Part II: Museum Records, Chapter 2, Section E. "Acquiring Copyrights."

- Make a statement regarding delegation to the park superintendent of the responsibility for accepting title to museum collections and for their subsequent management. As appropriate, outline any park-specific acquisition procedures that supplement the Servicewide requirements.

2. *What is some suggested wording for the Acquisition section?*

Suggested wording for the Acquisition section is as follows:

> *The park acquires objects for its museum collections by gift, purchase, exchange, transfer, field collection, and loan. Museum objects must be acquired, accessioned, and cataloged in accordance with Museum Handbook, Part II, Museum Records. Acquisition of museum objects are governed by the park's ability to manage, preserve, and provide access to them according to NPS Management Policies (2001), Chapter 5; the standards for managing museum objects in Director's Order #28: Cultural Resource Management (1998), Cultural Resource Management Guideline (1997), and Director's Order #24: NPS Museum Collections Management (2000); the NPS Museum Handbook, Part I, Museum Collections and Part III, Access and Use.*
>
> *In accordance with NPS policy, the park will prohibit the acquisition of gifts with restrictions or limiting conditions. Such restrictions include copyrights; the park will acquire copyrights to all incoming accessions. Incoming loans will be acquired only for a particular purpose such as research or exhibition, and for a specified period of time. Museum objects are acquired, accessioned, and cataloged in accordance with*

the NPS Museum Handbook, Part II, Museum Records.

The park will not be a partner to, or encourage in any way, the trafficking in illicitly collected materials. All acquisitions must be collected, exported, imported, transported, or otherwise obtained and possessed in full compliance with the laws and regulations of the country of origin, the United States federal government (including NAGPRA), and the individual states of the United States.

The acquisition of firearms included on the Bureau of Alcohol, Tobacco, and Firearms (ATF) list of prohibited/restricted weapons requires concurrent review by the regional/SO curator and the regional/SO law enforcement specialist.

The park superintendent, by delegation, represents the Director of the National Park Service and the Secretary of the Interior in accepting title to and responsibility for museum objects. The superintendent bears the ultimate responsibility for the acquisition and proper care and management of the museum collection. The superintendent has delegated the day-to-day care of the collection to the museum curator.

All acquisitions must receive formal approval from the superintendent before they can be accepted into the museum collection. Upon receipt, all newly acquired objects and related documentation must be turned over to the museum curator. The museum curator prepares, for the superintendent's signature, all instruments of conveyance, and letters of thanks, acceptance, or rejection, and transmits them as appropriate, to the donor, lender, vendor, or other source of acquisition.

Refer to the Acquisition section of the sample Scope of Collection Statement in Appendix E, for additional help when drafting this section of your SOCS.

H. Writing the Uses of Collections Section

1. *How do I prepare the Uses of Collections section?*

When writing the Uses of Collections section, you should:

- Briefly describe the desired and acceptable uses of the museum collection and establish the limits of such uses. Possible uses include exhibits (including web features), interpretive programs, research, and other interpretive media (such as publications).

- State that the primary consideration in all uses of museum objects is the preservation of each object in question and of the museum collection as a whole.

- If applicable, state that the park may consult with local and/or affiliated Native American tribes, Native Hawaiian organizations, or Alaskan Native villages and corporations about providing access to certain items of concern.

- State that in accordance with NPS *Management Policies* (2001), Chapters 5 and 7, the park will not exhibit Native American human remains or photographs of those remains. You should also include language concerning the NPS management policies regarding the display of Native American grave goods or other objects considered sacred. See NPS *Management Policies* (2001), 5.3.4 "Stewardship of Human Remains and Burials," 5.3.5.5 "Museum Collections," and 7.5.5 "Consultation."

- State that any interpretive use defined as consumptive must be authorized in advance, as outlined in Director's Order #28: Cultural Resources Management (1998) and Director's Order #6: Interpretation and Education (Draft, 2003).

> ***The NPS prefers the use of reproductions to the consumptive use of original objects.***

2. *What is some suggested wording for the Uses of Collections section?*

Suggested wording for Uses of Collections section is as follows:

The park's museum collection may be used for exhibits, interpretive programs, research, publications, or other interpretive media. The primary considerations for the use of museum objects are the preservation of each object in question and of the collection as a whole, and accurate interpretation.

In accordance with NPS Management Policies (2001), Chapters 5 and 7, the park will not exhibit Native American human remains or photographs of those remains. Drawings, renderings, or casts of such remains will not be displayed without the consent of culturally affiliated Indian tribes and Native Hawaiian organizations. The park will consult with culturally affiliated or traditionally associated peoples to determine the religious status of any object whose sacred nature is suspected but not confirmed. These consultations will occur before such an object is exhibited or any action is taken that may have an adverse effect on its religious qualities.

Researchers and other specialists may examine objects and archival materials under the conditions and procedures outlined in Director's Order #24: NPS Museum Collections Management (2000), Director's Order #28: Cultural Resource Management (1998), Cultural Resource Management Guideline (1997), and in the park's written "Museum Collections Access Procedures." Outside researchers must submit a research proposal to the superintendent for review by the park's Research Committee. If applicable, the research proposal may be presented for review during consultation with the **[list all local and/or affiliated Native American tribes, Native Hawaiian organizations, or Alaskan Native villages and corporations with whom you should consult]** *before access to certain items in the collection is granted.*

Any interpretive use defined as consumptive must be authorized in advance, as outlined in Director's Order #24: NPS Museum Collections Management (2000), Director's Order #28: Cultural Resource Management (1998), Cultural Resource Management Guideline (1997), and Director's Order #6: Interpretation and Education (Draft, 2003). The use of reproductions is preferred to the *consumptive use of original objects.*

Destructive analysis is a legitimate use of museum collections for approved research purposes when the impact is minor or when the object is common, in which case approval by the superintendent is required. If an object is rare or significant, a request for destructive analysis should be reviewed by the regional/SO curator and may be approved only by the regional director, as outlined in Director's Order #28: Cultural Resource Management (1998) and Cultural Resource Management Guideline (1997).

Objects may be loaned out to qualified institutions for approved purposes in accordance with NPS Museum Handbook, Part II, Chapter 5: Outgoing Loans. Institutions must meet accepted museum standards for security, handling, and exhibition of NPS museum objects. Sensitive materials may require additional conditions prior to a loan commitment. Expenses related to loans of museum objects, including shipping and insurance, will normally be assumed by the borrower.

Refer to the Uses of Collections section of the sample Scope of Collection Statement in Appendix E for additional help when drafting this section of your SOCS.

I. Writing the Restrictions Section

1. *How do I prepare the Restrictions section?*

You should list any restrictions on the museum collection. Restrictions that you should mention include:

- requirements for consultation with culturally affiliated and traditionally associated peoples and other cultural and community groups for whom the collection has significance in accordance with NPS *Management Policies* (2001) 7.5.5 "Consultation" and 5.3.5.5 "Museum Collections," and DO #24: NPS Museum Collections Management (2000)

- limited public disclosure of sensitive information concerning the following NPS resources in compliance with the National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.), the Archaeological Resources Protection Act of 1979, as amended (16 USC 470aa-mm), the National Parks Omnibus Management Act of 1998 (16 USC 5937) and NPS *Management Policies* (2001) 4.1.2. "Natural Resource Information" and 5.2.3 "Confidentiality":

  - rare, threatened, or endangered species
  - commercially valuable resources
  - minerals
  - paleontological resources
  - archeological resources

- objects of cultural patrimony and sensitive ethnographic information

- intellectual property rights limitations on publication of archival and manuscript materials, works of art, and other objects (see *MH-III*, Chapter 2: Legal Issues)

- restrictions on the disposition of type specimens

- limited conditions under which endangered, threatened, or rare animals and plants may be collected in accordance with 36 CFR 2.5

- restrictions to ensure an object's preservation

- limited access to certain objects for security purposes

- any limiting conditions placed on objects when they were acquired

2. *What is some suggested wording for the Restrictions section?*

Suggested wording for this section is as follows:

In accordance with NPS Management Policies (2001) 7.5.5. "Consultation" and 5.3.5.5 "Museum Collections," and DO #24: NPS Museum Collections Management, curatorial staff should consult with traditionally associated peoples and other cultural and community groups for whom the collection has significance. Archeological objects in the museum collection shall be made available to persons for use in religious rituals or spiritual activities in accordance with 36 CFR 79, Section 79.10(c), "Curation of Federally-owned and Administered Archeological Collections." Requests to borrow non-archeological material for religious ritual or spiritual activities will be addressed on a case-by-case basis.

The park will not approve research on human remains and associated funerary objects without the consent of the affected group(s).

In accordance with the National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.), the Archaeological Resources Protection Act of 1979, as amended (16 USC 470aa-mm), the National Parks Omnibus Management Act of 1998 (16 USC 5937), and NPS Management Policies (2001) 4.1.2. "Natural Resource Information" and 5.2.3 "Confidentiality," the park may withhold from the public sensitive information concerning: rare, threatened, or endangered species; commercially valuable resources; minerals; paleontological resources; archeological and other cultural resources; objects of cultural patrimony and sensitive ethnographic information; information provided by individuals who wish the information to remain confidential; the identities of individuals who wish to remain anonymous. Inquiries of this nature will be referred to the regional Freedom of Information Act (FOIA) and Privacy Act Officer for consultation and possible review.

Restrictions may be placed on the publication of images or manuscripts in the museum collection if these materials are subject to copyright, and the National Park Service does not hold the copyright.

All endangered, threatened, or rare plants and vertebrate and invertebrate animals will be collected only when accidentally killed or when dead from natural causes. The collection of threatened, endangered, or rare plant and animal species will comply with NPS Management Policies (2001), be in accordance with the provisions of the Endangered Species Act of 1973, as amended, and will be strictly limited according to the applicable rules of the U.S. Fish and Wildlife Service.

Final disposition of type specimens will be determined at the Servicewide level and will adhere to recognized conventions established for specific disciplines.

Refer to the Restrictions section of the sample Scope of Collection Statement in Appendix E for additional help when drafting this section of your SOCS.

J. Writing the Management Actions Section

1. *How do I prepare the Management Actions section?*

When you prepare the Management Actions section, you should:

- State that the park must review the Scope of Collection Statement at least every five years and revise it when necessary, to remain supportive of and consistent with the park's mission.
- Note that appropriate park staff (such as archeologists, interpreters, scientists, naturalists, and other resource management staff) and your regional/SO curator should review any revisions to the Scope of Collection Statement. The superintendent must approve any revision to the SOCS.
- Identify the need for a Collection Management Plan (CMP), if appropriate. Document this need in the park's Resource Management Plan. If this plan has already been prepared, state that fact and give the completion date. See Chapter 3 for information concerning a CMP.
- Identify any park collections that are stored in a repository outside of the park's boundaries (such as a NPS archeological or preservation center, another park, or a non-NPS repository). If this situation exists, list the name of the repository and its location.

2. *What is some suggested wording for the Management Actions section?*

Suggested wording for this section is as follows:

This Scope of Collection Statement must be reviewed every five years, and when necessary, must be revised to remain supportive of and consistent with any changes in the park's mission. Any revision to this document requires the approval of the superintendent.

The park has an approved Collection Management Plan. The plan was approved on **[note date]**.

A number of objects from the collection are housed at repositories *outside of the park* **[note item type, quantity, institution name, and location]**.

Refer to the Management Actions section of the sample Scope of Collection Statement in Appendix E for additional help when drafting this section of your SOCS.

K. Implementing the Scope of Collection Statement

1. *Does my park need to develop an acquisition strategy?*

Yes. You should develop an acquisition strategy to fully implement your park's approved Scope of Collection Statement. An acquisition strategy will help you to:

- understand the disciplines and object types represented in the existing collection
- discover gaps in the collection
- identify excess objects not relevant to the scope of your park's collection
- limit acquisitions to only those items identified as mission-related or those deemed necessary to fill pre-determined gaps in the collection

2. *Is there a standard format for an acquisition strategy?*

No, there is no standard format. However, you should consider the following steps in developing an acquisition strategy:

- Assess the types of objects in the museum collection. Include objects, specimens, and archival and manuscript collections on loan to other institutions.
- Identify gaps by comparing the classes of objects identified in the assessment with the types of objects identified in the Scope of Collection Statement.
- Compare objects in the existing collection with object needs identified in an Exhibit Plan or a Historic Furnishings Report. These plans help you to identify objects that are required for the park's interpretive program.
- Develop a prioritized list of items needed for your park's museum collection. One method is to list specific types of collections needed under the disciplines identified in the Scope of Collection Statement. Use the following criteria in prioritizing needs:
  - Acquire objects to replace those borrowed from other parks or institutions.
  - Acquire only those objects that have a strong relationship to the mission of the park and the purpose of the collection as stated in the Scope of Collection Statement. This includes priorities established by an Exhibit Plan or a Historic Furnishings Report.

Note: In order to preserve your collection's original site-specific objects, you should mention a strategy to acquire "duplicates" (similar objects without site association) or reproductions. You can periodically rotate the "originals" and "duplicates" or reproductions between storage and exhibit to address preservation and security concerns.

- Focus on objects associated with events and activities that took place inside your park's boundaries.

- Study the park museum files to determine if there are any known sources available to fill identified gaps in the collection. Keep records of potential sources of objects and their locations for future acquisition by the park.

Visitors may express interest in donating or selling museum objects to your park (or they may know of items of interest). See Figure 2.2 for an example Potential Museum Acquisitions sheet that staff can use to record this information. Contact your regional/SO curator to obtain an electronic copy. You also may develop your own park-specific format for recording this information. Provide copies to staff at all visitor contact locations and be sure to train all staff in the purpose, proper use, and disposition of this information sheet.

3. *What other factors should we consider when developing our park's acquisition strategy?*

Take into account the following issues as well:

Mandated Collections. Include archeological and certain natural history collections in your acquisition strategy. These collections are generated in response to a park's cultural or scientific resource management requirements and research projects authorized under the Archaeological Resources Protection Act of 1979 (ARPA), 43 CFR 7.13, 36 CFR 2, and the NPS Research Permit and Reporting System. You may not be able to predict the size and scope of these collections, so be sure to work closely with park/center/regional archeologists and scientists to stay informed of the needs, including potential growth, of these collections.

Ability to Manage. Consider any deficiencies (such as the lack of a proper storage facility or inadequate staffing levels) that limit your park's capability to properly manage additional collections.

4. *What criteria should my park use to acquire collections?*

If the acquisition of an object or objects is justified by your park's Scope of Collection Statement, you and your superintendent may reserve the right to accept or reject objects on the basis of the following criteria:

- **Site-Specific Objects.** Give first priority to acquiring objects original to a park, as determined by the Scope of Collection Statement, over non-site-specific objects.

- **Objects that are not Site-Specific**

- Consider objects related to the themes or periods of a park, but not original to the site, as your next priority.

- Make decisions concerning the acquisition of non-site-specific objects based on their significance to the park's interpretive and resource management programs. You should also consider such factors as authenticity and their potential for use as comparative collections.

- Reproductions are considered non-site-specific objects.

• **Physical Condition.** In some cases, damage that is the result of historic use or neglect may enhance the intrinsic value of an object (such as the clock from the USS *Arizona* that was damaged in the December 7, 1941 attack on Pearl Harbor). However, a park should consider carefully the acquisition of an object whose integrity has been significantly compromised by deterioration or abuse. In general, the following questions are helpful when evaluating an object:

  - Is the object intact?

  - Are all parts present?

  - Is there evidence of deliberate or accidental damage (such as paint spilled on the object)?

  - Does the object show signs of abuse or neglect (for example, an axe that was used for prying or hammering)?

  - Is the object made of materials that are inherently unstable (such as cellulose nitrate negatives)?

• **Rarity.** If an object is considered rare, it may be advisable for the park to accept a donation regardless of defacement, damage, incompleteness, or the quantity of a class of object already in the collection. **This criterion is particularly important when considering site-specific objects.**

• **Part of a Set**. Individual items that are part of a complete set or assemblage may not be individually important, but when taken together possess importance, and should be acquired as a set.

• **Availability.** Except for objects original to the park, you should take advantage of the availability of proposed donations to augment or replace like objects already in the collection that are in poorer condition or of lower quality.

• **Authenticity.** You need to determine that the object is authentic and that the owner acquired it legally. If you aren't sure about an item's authenticity, consult appropriate subject matter experts (historians, curators, archeologists, scientists, appraisers, and others) or staff at institutions with similar collections.

- **Collections Management Issues.** You must ensure that your park has the proper resources (funding, staffing, facilities, and equipment) to properly manage and preserve the object(s).

5. *Where can I find additional information concerning acquisitions?*

Consult your regional/SO curator and refer to *MH-II*, Chapter 2: Accessioning, Section C: Acquisition Policies, for additional information.

6. *What should I do if the collection includes museum objects that are not relevant to our park?*

Use your park's approved Scope of Collection Statement as the basis for determining what objects in the current collection may not be relevant to the park. Prepare a list of these objects for deaccessioning. See *MH-I*, Part II, Chapter 6, for guidance on deaccessioning museum objects.

L. Selected Bibliography

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National Park Service
U.S. Department of the Interior

[Park name here]
National Park

[Address Line 1]
[Address Line 1]
(123) 555-1234 phone
(123) 555-2345 fax

[Park Name Here] National Park

Scope of Collection Summary

The museum collection includes both natural history and cultural collections. The natural history collection includes: mammal and bird collections; the park herbarium; paleontological collections from the Bear Valley Shale Formation; geological specimens from the Bear Valley Shale and Lewis Granite Formations. Other natural history collections within the museum collection include: fungi; reptiles and amphibians; fish; insects and arachnids. At present, these collections are relatively small, as little research pertaining to these disciplines has been conducted in the park to date.

The cultural collection includes: archeological materials systematically excavated from within the park's boundaries and associated field records (circa 1000 BCE – circa 1940); an ethnology collection of Paiute and Shoshone basketry, watercolors, beadwork, and textiles; historic objects associated with the area's 19th century miners, railroad workers, and homesteaders, and items related to the Civilian Conservation Corps and President Franklin D. Roosevelt's 1938 park vacation; archival and manuscript collections such as the Joseph Jakes papers, oral histories, photographs, and scientific and resource management records.

For additional information on the museum collection contact:

Museum Curator
[Park Name Here]
[Address Line 1]
[Address Line 2]
(123) 555-1236 phone
(123) 555-2345 fax
[museum email address here]

EXPERIENCE YOUR AMERICA
The National Park Service cares for special places saved by the American people so that all may experience our heritage.

Figure 2.1. Example Scope of Collection Summary

National Park Service
U.S. Department of the Interior

[Park name here]
National Park

[Address Line 1]
[Address Line 1]
(123) 555-1234 phone
(123) 555-2345 fax

[Park Name Here] National Park- Potential Museum Acquisitions

To Park Staff: Use this sheet to note information from visitors concerning collections that the park may wish to acquire. Complete Section A. and forward to the Curator's Office. Use the reverse or attach additional sheets if necessary. **DO NOT ACCEPT ANY ITEMS ON APPROVAL**, only the Superintendent can accept acquisitions for the collection.

A. Basic Information to be Collected by Park Staff

Contact made by: ____

Name Title Division Telephone/Radio Call #

Contact Method: ____In Person ____Letter ____Telephone ____Email

Contact Date: ___________________ Check One: __Objects ___Natural History Specimens __Archival Materials

Describe the item or collection (discipline(s), quantity, type of item, time periods, condition). Use the reverse if more space is needed: ____

Estimated size of collection (cubic feet, boxes, quantity, as appropriate): ______________________

Background history of the item/collection: ______________________

Name, address, telephone number, and email of owner: ______________________

Current location of collection: ______________________

Is owner willing to donate, sell, lend, or make the collection available for reproduction and on what terms: ______________________

B. To be completed by the Collections Advisory Committee

Should Park seek future acquisition of items: __Yes __No

Native American or other associated group or individual to be consulted: ______________________

Other Comments: ______________________

Figure 2.2. Example Potential Museum Acquisitions Sheet

Chapter 3: Preservation: Getting Started

Chapter 3: Preservation: Getting Started

A. Overview

This chapter provides an introduction on how to develop park procedures and programs to achieve one of the main goals of the National Park Service (NPS) museum program: the preservation of museum objects, specimens, and archival collections. These cultural and natural collections are significant resources that are integral to the park's mission. They provide baseline information about the park and are essential for on-going and future study and use. Historic objects and archival collections document the lives and history of eminent Americans, various groups and significant events important to the nation. Natural history specimens and their associated documentation record evolving park ecosystems and provide information that help parks manage natural resources. Archeological collections and their associated documentation record human activity and preserve collections and data for future investigation. Both archeology and natural history collections rely on reports, photographs, maps and other associated records for analysis and understanding of the resource.

The NPS uses the terms **preventive conservation** or **preventive care interchangeably** to describe the range of activities that preserve museum collections. These include collections management, preventive care for collections in storage and on exhibit, as well as the examination, documentation, and treatment of individual objects. The activities are supported by research, the application of best museum practices, and the education of those who come into contact with collections, such as park interpretation, maintenance, and protection staff. Refer to definitions of these and other terms in the glossary at the end of this chapter. NPS policies for the treatment of museum objects, excerpted from the NPS *Management Policies,* are in Appendix A.

This chapter provides information on:

- preventive care and treatment for museum collections
- NPS resources for preventive care
- how to plan for object conservation
- the role of a collection management plan (CMP) in conservation planning
- the role of a collection condition survey (CCS) in preservation and conservation planning
- balancing the preservation of historic structures and museum objects housed in these structures

Museum collections care and conservation facilitates object preservation by slowing chemical and physical change. This is an ongoing process of **preventive care** for the collections as a whole and is supplemented by object **conservation treatment.**

1. *What is preventive care?*

The role of preventive care, also known as preventive conservation, is to avoid, block, or minimize the **agents of deterioration**. By using preventive care techniques, the imperceptible deterioration that occurs on a daily basis (cumulative over time) and the occasional catastrophic damage can be limited. Object conservation treatment is necessary when damage results from the absence of, or inappropriate application of preventive care techniques, other catastrophes, or if objects are inherently unstable.

The **agents of deterioration** are forces that act upon objects and cause chemical and physical damage. The Canadian Conservation Institute's [CCI] definitions of the agents of deterioration are listed below. Refer to the CCI web site for detailed information on the agents of deterioration.

- **Direct physical forces**, such as shock, vibration, and abrasion that can break, distort, puncture, dent, and scratch all types of objects. Damage from these forces may be *cumulative,* such as damage from improper handling or support or *catastrophic,* such as earthquake, war, or shelf collapse.

- **Thieves, vandals, or careless individuals** who misplace objects. Some of these agents are *intentional,* such as criminals who steal or disfigure objects. Others are *unintentional,* such as staff or users who misfile objects.

- **Fire** that destroys, chars, embrittles, scorches, or deposits smoke on objects.

- **Water** that causes efflorescence in porous materials, stains, swells organic materials, corrodes metals, delaminates and/or buckles layered components, and loosens joined components.

- **Pests,** such as *insects* that consume, perforate, cut, graze, tunnel and/or excrete and destroy, weaken, disfigure, or etch organic materials. Pests include *vermin* such as birds and other animals that gnaw organic materials and displace small objects, foul objects with feces and urine, and *mold and microbes* that weaken or stain objects.

- **Contaminants** that disintegrate, discolor, or corrode all types of objects, especially reactive and porous materials. This includes *gases* (such as pollution, ozone, formaldehyde, nitric acid, sulfur dioxide), *liquids* (such as plasticizers, grease), and *solids* (such as dust, soot, salt).

- **Light levels** including both ultraviolet radiation and visible light. *Ultraviolet* radiation disintegrates, fades, darkens, and/or yellows the outer layer of organic materials and some colored inorganic materials. *Visible light* fades or darkens the outer layer of paints and wood.

- **Incorrect temperature** that can be *too high* causing gradual disintegration, discoloration or embrittlement of organic materials; *too low* causing embrittlement, which results in fractures of paints and other polymers; or *fluctuating* causing fractures and delamination in brittle, solid materials. Fluctuations in temperature also cause fluctuations in relative humidity [RH.]

- **Incorrect relative humidity** that can be *damp*, causing mold and corrosion, or *above or below a critical value*, hydrating or dehydrating some minerals and corroding metals that contain salts or cause embrittlement of other materials. Organic materials will gradually disintegrate, become brittle or discolor, especially materials that are chemically unstable at any RH level. *Fluctuating* RH will shrink and swell unconstrained organic materials, crush or fracture constrained organic materials, cause layered organic materials to delaminate and/or buckle, and loosen joints in organic components.

Most objects are affected by a variety of these agents of deterioration simultaneously. By addressing each agent of deterioration through the implementation of policies and procedures outlined in this handbook, the preventive care of your collections will improve.

The park curator has primary responsibility for preventive care of the museum collections. This requires ongoing vigilance and attention to ensure that damage does not occur. To carry out a proper preventive care program, you should:

- know the causes and recognize the symptoms of object deterioration
- inspect collections on a regular basis
- monitor and control the museum environment (relative humidity, temperature, light, pests, dust, and other pollutants)
- practice proper techniques for the handling, storing, exhibiting, packing, and shipping of objects
- provide appropriate security and fire protection for collections
- prepare and be able to implement emergency preparedness plans for collections

This introductory chapter describes how to identify preventive care needs, and develop a strong program using a Collection Management Plan (CMP). It also provides guidance on how to plan for object conservation treatment and Collection Condition Surveys (CCS).

2. *What is conservation treatment?*

Conservation treatment is the deliberate alteration of the chemical and/or physical aspects of an object (including specimens and archival materials) from a museum collection, in order to prolong the object's existence. Treatment may consist of stabilization and/or restoration. **Stabilization** constitutes treatment procedures that maintain object integrity and minimize further deterioration. For example, when a conservator washes paper, the washing removes acidic by-products of deterioration. **Restoration** consists of treatment procedures intended to return a museum object to a known or assumed state, or to improve its appearance. This may involve the addition of non-original material.

Consider conservation treatment in the following cases:

- when preventive care measures are not enough to reduce the rate of deterioration to a tolerable level, such as actively corroding metals

- when deterioration has proceeded to a point where the object is extremely fragile and is in danger under any circumstances, such as paint flaking from a painting
- when stabilization or restoration is required for exhibit
- when stabilization or restoration is required for research

Work with your regional curator to decide whether conservation treatment is required.

Note: In accordance with NPS Management Policies, conservation treatments are done as a last resort, kept to a minimum, and should be reversible. This approach reduces the chances of compromising the aesthetic, archeological, cultural, historical, physical, religious, or scientific integrity of objects. The NPS emphasizes preserving original materials as completely as possible and minimizing invasive treatments or modifications or restoration.

Any person who performs conservation treatments for the NPS must agree to adhere to the American Institute for Conservation of Historic and Artistic Works (AIC) Code of Ethics and Guidelines for Practice. Include this requirement in all requests for proposals (RFQs) and contracts with conservators. A copy of this Code of Ethics is included in Appendix D.

B. Planning for Object Conservation

1. *Who is responsible for museum object conservation?*

Preventive conservation and collections care is the responsibility of all who work in and around museum collections, including collection managers, registrars, conservators, curators, museum technicians, archivists, archives technicians, interpreters, maintenance personnel, preparators, and researchers.

The **collection management specialist (curator, collections manager, or archivist)** has primary responsibility for the day-to-day management of the museum collection. The duties of these professionals include:

- acquisition and deaccession
- documentation
- preventive care (preventive conservation)
- interpretation, exhibits and education
- research and publication

A curator has expertise in material culture studies and is trained and skilled in the history and philosophy of museums, as well as the practical aspects of preventive conservation and collections care.

The **conservator** is trained and skilled in the theoretical and practical aspects of preventive conservation and object conservation treatment. Most conservators specialize in the treatment of specific groups of objects (such as archeological or ethnographic objects, books, natural history specimens, fine and decorative art objects, photographic materials, paintings, paper, sculpture, textiles, or wooden artifacts). There is overlap among these groups, so one conservator may work on a range of these materials.

The collection management specialist (such as curator, collections manager, or archivist) and the conservator work together and with other professionals to develop a successful conservation program. Conservators are responsible for recommending and carrying out conservation treatments. **Untrained staff should NOT attempt to do treatments.** However, the collection management specialist has the ultimate responsibility for deciding on the care and management of the collections.

The roles of the collection management specialist and the conservator are illustrated in Figure 3.1.

Preventive Care	
Curator/Collections Manager/Archivist	***Conservator***
• Monitors and assesses condition of collections • Monitors and evaluates museum environment, including signs and causes of deterioration. • Takes preventive actions to minimize causes of deterioration • Practices proper methods and techniques for storing, exhibiting, handling, packing and shipping of objects, and pest management • Develops and implements ongoing Integrated Pest Management (IPM), and housekeeping/maintenance program for collections • Prepares emergency operation plan for museum collections often working with an outside expert • Implements the Collections Management Plan (CMP) recommendations	• Assesses condition of objects; conducts Collection Condition Surveys • Alerts staff to signs and causes of deterioration • Provides technical guidance on museum environment, storage, exhibits, handling, packing and shipping, and pest management • Assists in development of Integrated Pest Management (IPM) and housekeeping/maintenance programs • Assists in development and preparation of emergency operation plans

Conservation Treatment	
Curator/Collections Manager/Archivist	***Conservator***
• Documents history, significance, value, and proposed use of each object to be treated • Determines what should be treated • Develops and monitors contracts for conservation services • Assesses, in consultation with conservator, the suitability of written treatment proposals and authorizes treatments • Monitors progress of treatment for each object • Incorporates results of conservation treament into the catalog record • Ensures continuing care for treated objects	• Examines and documents conditions and problems of individual objects and collections • Prepares treatment proposals for curatorial review and approval • Performs suitable treatments • Documents treatments performed • Recommends methods for the future maintenance and care of treated objects • Performs analysis for research and interpretation

Figure 3.1. Comparison of Roles of Curator/Collections Manager/Archivist and Conservator in Object Conservation Management in the Museum

2. *How are systematic field collections prepared?*

Scientific collections, such as natural history and archeology collections recovered in the field are often prepared by the collector with expertise in an academic discipline such as archeology, botany, herpetology, paleontology, etc.). Depending on the discipline, different techniques are used in the field to uncover, clean, sample, identify, stabilize, and preserve materials so that the collections can be used for research and exhibit, and to ensure their long-term preservation.

Some specimens such as certain marine invertebrates, soft-bodied insects, amphibians, reptiles, and fish may be preserved in ethanol. Initial preparation may include fixing the specimen with formaldehyde (or formalin) in the field prior to storing them in alcohol, so that decomposition does not occur. However, the use of formaldehyde to fix biological specimens makes the recovery of DNA more difficult and may compromise future research. Archeological collections may be washed and sometimes treated with chemicals to remove soil and/or mineral deposits so surfaces can be examined. However, washing ceramics and lithics, and treatment with chemicals may remove or contaminate protein residues present. For that reason, a subset of the sample should be stored without preparation. Within the museum, preparators often continue to work on collections, most notably with paleontology and biology collections. Many are responsible for collections care, as well as the fabrication of specimen mounts and supports.

All techniques used before accessioning an object or specimen, and later in the museum, directly affect its long-term preservation. Therefore, all work done on the object or specimen must be documented. There are also many health and safety concerns associated with certain preparation techniques. The curator and conservator must work with field researchers and preparators so that from the time the specimens and objects are collected, thoughtful choices are made to their long-term preservation, and that work is done in a safe environment. This collaboration should start before the collections are made. (See the NPS *Conserve O Gram* technical leaflet series for information on many of these concerns.)

3. *What are the NPS information resources for conservation?*

NPS museum resources on conservation and preventive care include the publications below and are available at www.nps.gov/history/museum:

- NPS *Museum Handbook,* Part I *(MH-I)* contains extensive information on the essential components of a preventive-care program. Review the chapters on techniques for setting up your preventive maintenance programs, including security and fire protection, pest management, emergency planning, environmental monitoring, storage, and handling, packing and shipping. Appendices contain specific information on the preventive care of a variety of materials, such as archeological or natural history objects, metals, ceramics, and glass.

- *NPS Conserve O Gram (COG)* leaflets are short technical leaflets on specific topics in collection care and planning intended for collections management staff. They expand and update the information contained in the *MH-I*. These leaflets cover a wide range of subjects including:

    - General museum collections care

- Security and fire protection
- Emergency preparedness planning
- Curatorial health and safety
- Museum collections environment
- Biological Infestations
- Museum collections storage
- Various object types, such as archeological objects, archival items, metal, natural history specimens, paper, and others
- Handling, packing and shipping
- Museum exhibits
- Historic house museums and historic furnished structures
- Creation, care, and storage of digital materials

• NPS *Tools of the Trade* is a listing of curatorial supplies and equipment. It includes museum record keeping materials~~,~~ storage containers, specialty curatorial items, natural history supplies, museum cabinetry, shelving and racks, and environmental monitoring and control apparatus. *Tools of the Trade* provides instruction-on how to obtain museum supplies and equipment and source information for purchasing supplies or equipment. The NPS Park Museum Management Program (PMMP) updates this list periodically and makes it available to regional offices, parks, and centers.

• Interior Collections Management System (ICMS), formerly ANCS+, is the collection management documentation system provided to all parks for cataloging and other documentation purposes. It contains associated modules and supplemental records that allow you to incorporate information provided by a conservator. This includes condition description, treatment reports and maintenance recommendations. The conservation associated module (conservation module) allows park staff and conservators to efficiently incorporate survey, treatment, and analysis information into object documentation.

• Several NPS conservation laboratories work on park museum objects. Conservators from these labs can assist with surveys, carry out treatments and provide advice on conservation and conservation contracting. The labs are at:

  - Harpers Ferry Center, Harpers Ferry, West Virginia
  - Northeast Cultural Resources Center, Lowell, Massachusetts
  - Western Archeological and Conservation Center, Tucson, Arizona

4. What are some other sources for conservation information?

There are many conservation information resources outside the NPS. Refer to the bibliography and web sources section, Chapter 8, Conservation Treatment of this handbook, and the *Conserve O Gram* bibliography. Consult with your regional curator and NPS conservators if you need more information.

5. What do I need to do to develop a preservation program for my park?

There are a variety of actions to take in planning and carrying out your preservation program.

Remember: *Museum preservation is an ongoing process, not a one-time effort.*

A well-planned program makes for a more efficient use of staff time and funding. Your program should include the following actions:

- Document the collection as required by the NPS *Museum Handbook*, Part II: Museum Records *(MH-II).*

- Conduct a self-evaluation to identify deficiencies using the NPS Checklist for Preservation and Protection of Museum Collections (see Appendix F.) Use the Automated Checklist Program (ACP), one of the utilities in ICMS, to complete and submit your Checklist. You must keep the Checklist up-to-date. The Checklist is also used for NPS Servicewide and Department of the Interior (DOI) reporting requirements. Use reports from the ACP to provide the "number of standards met" and the "percentage of standards met" to report accomplishments. For more information, see the ICMS *User Manual*, Appendix G: The Automated Checklist Program.

- Start your preventive care program by correcting as many deficiencies as possible. As you correct each deficiency, your preventive care program will begin to take shape. Next, develop program documents to implement the recommendations in your Collection Management Plan and other surveys. The program includes:

  - monitoring, evaluating, and controlling the museum environment in storage and on exhibit
  - using proper techniques for the handling, storage, exhibit, and packing and shipping of objects
  - implementing a housekeeping plan
  - implementing a housekeeping plan
  - providing security and fire protection
  - planning for emergency operations
  - inspecting objects on a regular basis
  - applying for conservation treatment when necessary

- Complete a Collection Management Plan (CMP) to assess your park's collection management program and to provide specific guidance on improving the care of the collections

- Complete a Collection Condition Survey (CCS) of the collection after examining the objects and assessing condition and treatment needs. Based on this report and available information regarding use and significance of each object, develop a prioritized object conservation treatment list.

- If you have a historic structure housing museum objects, assess the condition and preservation needs of the structure. Make sure that the actions you take to preserve the museum objects don't harm the historic structure. See Section E for more discussion about preservation of collections in historic structures.

- Prepare budget documents to improve and maintain the collections care program. See Chapter 12: Programming, Funding, and Staffing, for information on programming and budgeting.

- Develop and implement training sessions or obtain external training for park staff who handle and work with museum objects.

Use this handbook together with the CMP and CCS to establish and implement a long-term, ongoing program for the preventive care and treatment of your collection. These documents will help you budget time, funds, and staff to address preservation needs.

C. The Collection Management Plan

A Collection Management Plan (CMP) is a review of your park's collection management program. It identifies problems, captures current conditions and practices, and makes recommendations on the management and care of the collections. To prepare the plan, use consultants from outside the park that have expertise in different areas. They can advise on how to improve your program efficiently and effectively. A Collection Management Plan provide guidance on issues such as:

- Scope of Collection Statement (SOCS)
- museum records and documentation
- different types of collections, including archival and manuscript collections
- preventive care issues, including environmental conditions, storage, fire and security protection, and emergency management
- collections accessibility and use
- staffing and funding needs

Refer to Appendix F for an example outline of a CMP.

1. *Why should my park have a CMP?*

A CMP provides recommendations for improving collection management at your park. Use it as a prioritized planning document to identify and prioritize tasks and to identify long-range curatorial staffing needs, including:

- documenting your collections
- caring for them in a way that will best preserve them
- making them available for use

A CMP provides the framework to help you organize the variety of collections management tasks for which you are responsible.

2. *What is the process for having a CMP done at my park?*

Follow these steps to have a CMP done for your park:

Request the plan.
Include a project statement describing the need for a CMP in the Project Management Information System (PMIS). Consult the regional curator for assistance in requesting a CMP. Refer to Chapter 12 for guidance on programming and budgeting for museum collection management

Select a planning team.
To ensure objectivity and diversity of views, select a team of NPS or contract museum professionals with expertise appropriate to the nature and needs of the park's collections. The team is made up of curators or collections managers and may include an archivist and conservator. The regional curator may assist with the plan. The CMP team visits your park and collects information from park staff, the regional curator, and other regional specialists, as appropriate.

Prepare and review the plan.
Assign a team coordinator from outside the park. The coordinator's duties include:

- coordinating selection of team members
- planning the site visit
- coordinating pre-visit activities, such as preparing a pre-visit questionnaire for park staff and collecting previous planning documents
- coordinating on-site activity to ensure the team collects adequate and appropriate information
- preparing a briefing for the superintendent at the opening meeting and a summary of findings for the close-out meeting
- as requested, writing a trip report for the park and the region outlining the general findings and recommendations, including those that should be implemented prior to the completion of the CMP
- reviewing and editing the draft plan and forwarding it to the park for review and approval

Individual team member duties include:

- reviewing all relevant park documents ahead of the visit

- participating in the site visit
- evaluating collections, facilities, park procedures and record keeping
- writing assigned sections and submitting them to the team coordinator by the deadline
- revising sections as necessary based on comments

The coordinator submits a review draft of the CMP to the park and region. A draft may be submitted to PMMP and other WASO offices as appropriate. A revised draft addresses and incorporates comments as appropriate. The superintendent approves the final document upon recommendation by the regional curator and concurrence of the regional deputy director.

Distribute the final plan.
Distribute your CMP to all offices and repositories listed in Director's Order #28: NPS-28 *Cultural Resources Management Guideline, Appendix D: Distribution/Availability of Final Cultural Resource Reports*. There may be other offices designated by your park or region for distribution.

Note: Sensitive information, such as security systems, is considered restricted information and must be kept secure. **Do not release** to any individuals or offices, other than the superintendent and the facility manager.

Implement the plan.
The plan lists a variety of tasks that take time and often money to implement. Use these tasks to develop a strategic plan of accomplishable goals. Some tasks can be completed quickly; others require long-term planning and effort. Review the plan regularly to be sure you are completing necessary actions.

It may be necessary to update the plan as your situation changes; for example, as you add new collections or build new facilities. Consult with your regional curator about options for updating your plan.

3. *What other kinds of surveys and plans will help me preserve collections?*

There are several other useful planning tools. Each focuses on one aspect of **preventive care** and provides in-depth information. Some are requirements on the Checklist for Preservation and Protection of Museum Collections. Refer to the associated chapters in this handbook, the checklist in Appendix F and the ACP in ICMS unless otherwise specified. These documents include:

- security survey, which assists in planning for appropriate security systems (Checklist question H.2). See Chapter 9: Security and Fire Protection.
- fire protection survey, leading to a structural fire management plan (Checklist question H.3). See Chapter 9: Security and Fire Protection.
- storage survey, leading to a Collection Storage Plan (CSP) (Checklist question H.7). See Chapter 7: Museum Collections Storage.

- archival survey, to identify records that should be considered for inclusion in the park archives, provide a collection level description of materials, develop a draft processing plan, review legal issues, identify preventive care issues for the archival and manuscript collections, and provide planning advice for future work. See *MH-II*, Appendix D: Archives and Manuscript Collections.

- general condition survey, to evaluate the overall condition of collections and make recommendations about how to improve preventive conservation and care practices. This survey may be part of a CMP or a stand-alone document.

- written recommendations by an appropriately qualified professional, for improving the museum environment (temperature, relative humidity and light) based on ongoing park environmental monitoring (Checklist question H.1). See Chapter 4: Museum Collections Environment.

- The Collection Condition Survey (CCS) **identifies condition and treatment needs** and may include preventive care recommendations (Checklist question H.6.).

- Museum Housekeeping Plan that provides a **framework for routine and special housekeeping tasks** to ensure consistent care of collections. See Chapter 13: Museum Housekeeping.

D. The Collection Condition Survey

A Collection Condition Survey (CCS) is a report on the status of the condition of groups of like objects in a park's museum collection.

Select a conservator with the appropriate expertise for the segment of your collection to be surveyed, such as photographic conservator to survey your historic photographs to determine treatment needs and record baseline data for future assessment of deterioration. Another conservator may examine and evaluate the objects on exhibit for signs of deterioration, as well as the mounts, lighting, case design, and construction. The survey report may also include recommendations about preventive care needs, such as storage techniques, environmental conditions, and pest control.

Your goal is to achieve a comprehensive evaluation of the entire collection. Over time, you may need several different surveys by conservators who specialize in different types of materials. Your needs will depend on the size and type of your collections, and park programs and priorities.

> ***You must use a qualified professional conservator to do a Collection Condition Survey.***

You can work with a National Park Service conservator or an outside contractor. If you contract with a conservator from outside the NPS, consult with your regional curator and get recommendations and descriptions of previous work to be sure the individual is qualified.

1. *How do the CCS and the CMP overlap?*

The CMP and the CCS both contain information on preventive care. Recommendations on preventive care included in a CMP usually focus on general conditions in exhibit and storage areas. Curatorial specialists other than conservators may make these recommendations. The preventive care recommendations made by a conservator in a CCS provide guidance on how to slow or minimize deterioration outlined in the object-by-object survey. Generally, the CCS is requested once the CMP is completed. Conservation treatment is only appropriate once the collections are documented and preventive care programs are in place.

2. *What are the steps involved in the survey process?*

Request the survey.
To request a CCS, consult the regional curator for assistance. Refer to section C.2 and Chapter 12 for guidance on programming and budgeting. Be sure to include the need for a conservation survey in PMIS.

Select the conservator(s).
A NPS or contract conservator or team of conservators will visit your park to observe, analyze and collect information that goes into the CCS. The team size depends on the types of materials to be examined at one time. Conservators conducting a CCS must be specialists in the treatment of the specific class of objects they are examining (such as, furniture, textiles, metals, archeological objects, paper, books, paintings, ethnographic objects, or natural history specimens). To ensure the conservator you select has appropriate knowledge and experience to evaluate your collection, ask for a written response to the following questions:

- What kind of training do you have? Conservators get training both through academic departments and internships. They should be willing to describe to you how their training is appropriate to your park's needs.
- How long have you been a conservator? You want to work with conservators who have finished their training and worked professionally for at least five years.
- What percentage of your business is conservation? The conservator should spend most of his/her time doing conservation work.
- Have you worked on this type of material/done this kind of survey before and how many times [separate occasions] you done this work?
- Can you give me references and contacts of previous clients?
- What museum conservation organizations do you belong to?
- Are you a member of AIC at the Professional or Fellow level?
- Do you agree to follow the AIC Code of Ethics and Guidelines for Practice?
- Are you available when I need you?

You are looking for a knowledgeable, experienced conservator who has considerable experience in working on the type of material that you have in your collection. If a conservator agrees to follow the AIC Code of Ethics and Guidelines, they are agreeing to follow current and generally accepted standards and practices of the conservation profession.

See Figure 3.2 for an sample Scope of Work (SOW).

Conduct the survey.
The conservator needs to evaluate all your collections in storage and on exhibit in order to evaluate both the objects and the conditions in which they are housed. Each conservator will conduct the survey a little differently, but you should expect to provide:

- a staff member to work with the conservator to:
  - access collection storage rooms, vaults, cabinets, shelves, and other locations where objects are stored
  - assist in moving heavy or unwieldy objects
  - answer questions and provide data about environmental monitoring, IPM programs, preventive maintenance, collection use, housekeeping, object storage, storage plans, potential exhibit use, plans for future acquisition and deaccessioning and other information as necessary
- a suitable workplace near the objects
- catalog, accession, and previous conservation (treatment and survey) records when required
- access to Interior Collections Management System (ICMS) or pertinent collection documentation

Note: Access to ICMS is only necessary if the SOW requires the conservator conducting the survey to enter information from the survey directly into ICMS. Alternatively, the conservator can prepare the information using compatible software such as Microsoft Excel for park staff to enter into ICMS. Conservation documentation can also be scanned and attached to the pertinent ICMS record.

Prepare and review the CCS report.
Develop a written schedule outlining specific tasks at the start of the project, and agree when a draft report will be available for review. A one to three month period is a reasonable amount of time to produce a draft report. Review the draft carefully and request additional information and clarification where necessary. Multiple review drafts may be necessary. The conservator should be able to finalize the report within another month, once all NPS reviews have been incorporated.

Note: The CCS has a limited lifespan. Park staff should make sure that cost estimates are current.

Distribute the report.
Distribute the CCS to the park and the regional curator and to others designated by the park and region.

Implement the recommendations of the Collection Condition Survey report.
The CCS report documents the condition of the objects that the conservator examined, identifies treatment needs, and sets priorities for treatment based solely on physical condition and risk. Evaluate this information in terms of curatorial priorities, such as significance, interpretive programs, and research needs in deciding which objects to treat. Balancing preservation with access and use allows you to develop a conservation treatment program. Implement the preventive care recommendations from the CCS and engage a conservator to provide treatments.

Add CCS data on individual objects to collection records.
Section D.5 discusses how to incorporate this information into ICMS records. Adding this information to ICMS ensures that it will be retained with other information about the object for the long-term.

3. *What format should the CCS have?*

CCS reports will vary in the information they provide. Because they may give general preventive care recommendations in addition to object-by-object condition assessments, the structure will reflect the information they contain. The CCS **must** include the following information:

- *Introduction*: Narrative introduction that gives general information about the park visit (for example, park name, dates, name of conservator(s), and explanations of all technical terms).

- *General recommendations*: General recommendations and preventive care tasks as appropriate.

- *Object-by-object assessments*: Individual object assessments with a narrative (text format) and an optional checklist format of conditions. Include information to complete the ICMS condition field on the catalog record. See a description of this field below.

- *Summary wording*: Language that can be incorporated into Resources Management Plan (RMP) and/or Performance Management Information System (PMIS) statements. See Figure 3.3 for examples.

The conservation module in ICMS allows the incorporation of information on condition and maintenance collected in conservation surveys directly into ICMS collection management records. The ICMS *User Manual* provides guidance on how to use the Conservation Module. See Chapter 4, section II, *Associated Modules*.

4. *What is the Condition Field in ICMS?*

Have the conservator supply standard NPS abbreviations for the Condition field on the Collection Record for each object examined for the CCS. Incorporating this information into your ICMS catalog records will help parks, centers, and the Park Museum Management Program make better estimates of the condition of park collections Servicewide. It also allows you to track change in condition over time.

For objects, use one term from each of the two criteria groups below:

Group I		**Abbreviation**
Complete:	100% of object present	COM
Incomplete:	more than 50% and less than 100% of object present	INC
Fragment:	less than or equal to 50% of object present	FRG
Group II The following descriptions are for the object in hand regardless of whether it is complete, incomplete, or fragmentary. Note that an object can be incomplete, yet still be in excellent or good condition.		
		Abbreviation
Excellent:	No damage or deterioration. No treatment needed; no change will occur with good preventive conservation practices in place (such as a pristine porcelain plate).	EX
Good:	Minor damage and no active deterioration. No change will occur with good preventive conservation practices. Minor cosmetic treatment may be needed before exhibit (such as heavily used historic objects)	GD
Fair:	Some damage and/or slow but active deterioration. Treatment may be needed to stabilize or before object is exhibited (such as a decorative ceramic object with losses to the rim, or slowly rusting iron objects).	FR
Poor:	Significant damage and/or active deterioration. Treatment is needed to prevent additional damage or deterioration (such as a table with one leg missing, making it structurally unstable or an archeological copper alloy object with “bronze disease”).	PR

Make entries using a slash between each term, such as INC/FR. Examples include:

- An unbroken drinking glass with no surface deterioration and no deposits would be COM/EX.

- A single archeological painted ceramic sherd that had been abraded during burial would be FRG/GD.

- A chest of drawers with lifting and lost veneer would be INC/FR.

- A leather saddle with red rot would be COM/PR.

5. *What other information can I add to the ICMS collection management program?*

The ICMS Conservation Module provides a way for parks to easily extract data from the condition assessments and include that data in the collection management records. The conservator doing the survey can enter data directly into the conservation module or use compatible software, such as Microsoft Excel that will allow the park staff to import the data into the appropriate fields in ICMS. The *ICMS User Manual* includes instructions for using the conservation module and importing data. See Chapter 4: II for use of the Conservation Associated Module and Chapter 8: IV for importing data into ICMS.

Condition description: The Condition Description (Cons Descrip) field appears in two places in ICMS; the catalog record and the conservation module. If there is existing data in this field, append it with the new data from the current condition description and include the conservator's name and date.

Conservators may use terms that are different from ICMS field names. Have the conservator identify the equivalent ICMS field names in their documentation. See Figure 8.1 in this handbook for a listing of equivalent terms that will allow you to copy and paste information from the conservator’s documentation into the catalog record. Be sure to incorporate it as a requirement in your SOW and contract.

Some conservators use a narrative form that is readily copied and pasted into the field, others use a checklist. The curator can also scan conservation reports into the catalog record.

Preservation Supplemental Record: Use the Preservation supplemental record in ICMS to record the treatment priority determined by the conservator, see the NPS *ICMS User Manual*, Chapter 3: Supplemental Records, XIV Preservation Supplemental. Record that the object was surveyed as well as any treatment priority indicated by the conservator.

Maintenance Associated Module: Use this module to record regular maintenance recommended by the conservator. This module will help you develop schedules for carrying out and documenting maintenance treatments. For example, if a conservator recommends monthly vacuuming of all upholstered furniture on display, record it here. For information, see the NPS ICMS *User Manual*, Chapter 4: Associated Modules, VI Maintenance Associated Module.

E. Preservation of Historic Structures Housing Park Collections

Museum collections may be housed in a historically significant structure. Historic structures have their own preservation needs that may differ from the needs of the museum objects. Be aware that the environment that best preserves museum objects may differ from the best environment that preserves the structure. This requires balancing the needs of managing museum objects housed in a historic structure with the preservation needs of the historic structure itself.

Certain conditions that are optimal for museum collections may cause more wear on the structure than its original use. These include:

- Installation of museum exhibits or storage areas may impose loads or require physical design changes to the structure in conflict with its original design and historic integrity.

- Controlling and maintaining certain relative humidity levels may cause serious damage to the structure such as condensation within walls and spalling of exterior finishes.

- Installation and operation of modern mechanical, electrical, plumbing, security, and fire detection and suppression systems will require changes that impact and may damage the historic and structural integrity of the structure.

Find passive ways to control climate and light levels whenever possible

Rather than installing a complex mechanical system that may damage the structure and be hard to maintain, find passive and sustainable ways to control temperature, relative humidity and light. This includes using historically sympathetic methods such as installing appropriate period blinds or shutters.

To improve collections care in the historic structure, first do a systematic assessment of risks. By identifying, quantifying and prioritizing risks and appropriate actions, you will be able to make an informed decision that ensures the long-term preservation of both the collections and the historic structure. Consult with the regional curator, historical architects and preservation engineers familiar with these issues. Seek the assistance of other curators, conservators, historical architects, and preservation engineers who have done similar projects. Consider the following factors in your decision-making process:

- nature, condition, and preservation needs of the museum collection

- nature, condition, and preservation needs of the historic structure housing the museum collection

- effects of the planned use (for example, interpretive programs) on the historic structure and the museum collections

The concerns for preserving objects and historic structures that house them are outlined in the New Orleans Charter for Joint Preservation of Historic Structures and Artifacts. (http://www.apti.org/resources/charters1.cfm).

Use these principles when developing your own preventive care projects for museum collections in historic structures in your park.

You must have a Historic Structure Report (HSR) completed prior to a major intervention (such as an intrusion detection system, fire detection/suppression system). Any project, activity, or program that can result in changes in the character or use of historic properties that meet

National Register criteria are subject to Section 106 review (36 CFR 800). Consult with your park or regional office historical architect and preservation engineer, and refer to D.O. #28: Cultural Resource Management Guideline for guidance.

When structures cannot be conditioned to ensure proper collection storage, consider centralized storage.

F. Glossary

Agents of deterioration – those agents that act upon museum objects to cause physical and/or chemical changes that limit their lifespan due to deterioration or damage. The agents are listed in Section A.1.

Archivist – a professional responsible for managing and providing access to archival and manuscript collections

Collections Manager – a professional responsible for managing and providing access to museum collections

Conservator (museum objects) – a person trained in the theoretical and practical aspects of preventive conservation and care, and in performing treatments to prolong the lives of museum objects. Most conservators specialize in specific classes of collections. They formulate and implement conservation activities in accordance with an ethical code such as the AIC Code of Ethics and Guidelines for Practice.

Curator –in the NPS, a person professionally responsible for the management, preservation, and use of museum collections. Collection management responsibilities include acquisition and disposal, documentation and cataloging, preventive conservation and care, storage, access, interpretation and exhibition, and research and publication. The curator is a discipline or material culture specialist (such as archeology, history, biology, or fine arts). Curators on park staffs who work directly with collections are known as museum curators; curators in other offices are known as staff curators. In the absence of archivists, curators are responsible for archival collections.

Object Conservation – measures taken to prolong the life of a museum object and its associated data

Preservation – the act or process of applying measures to sustain the existing form, integrity, and material of an object by activities that minimize chemical and physical deterioration and damage and prevent loss of information; primary goal of preservation is to prolong the existence of cultural property

Preventive Conservation (or *Preventive Care*) – non-interventive actions taken to prevent damage to and minimize deterioration of a museum object. Such actions include monitoring, recording, and controlling environmental agents; inspecting and recording the condition of objects; establishing an integrated pest management program; practicing proper handling, storage, exhibit, housekeeping and packing and shipping techniques; and incorporating needed information and procedures about objects in emergency operation plans.

Reformatting – for preservation, producing a copy of an original item or copy in the same or a different format to preserve the information it contains. Making a copy negative or digital copy of an original photographic negative is an example of reformatting.

Restoration – interventive treatment action taken to bring an object as close as possible to its original or former appearance by removing accretions and later additions and/or by replacing missing elements

Stabilization – interventive treatment action taken to increase the stability or durability of an object when preventive conservation measures fail to decrease its rate of deterioration to an acceptable level or when it has deteriorated so far that its existence is jeopardized

Treatment – the deliberate alteration of the chemical and/or physical aspects of museum objects, aimed primarily at prolonging their existence; treatment may consist of stabilization and/or restoration

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_____ *Conserve O Gram COG* 1/2 *Bibliography* Washington, D.C.: National Park Service, 2011.

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Rose, Carolyn L., Catherine A. Hawks, and Hugh H. Genoways, eds. *Storage of Natural History Collections: A Preventive Conservation Approach.* Iowa City, Iowa: Society for the Preservation of Natural History Collections, 1995.

Thompson, John M.A. *Manual of Curatorship: A Guide to Museum Practice*. Oxford, UK: Butterworth-Heinemann, 1992.

H. Web Resources

American Institute for Conservation of Historic and Artistic Works (AIC): www.conservation-us.org/
_____ 'Find A Conservator' database

______ AIC Code of Ethics and Guidelines for Practice.

Canadian Conservation Institute (CCI): www.cci-icc.gc.ca/index-eng.aspx
_____ Agents of Deterioration

Conservation On-Line

Heritage Preservation. http://www.heritagepreservation.org/

National Park Service

_____Harpers Ferry Center Conservation:
_____Park Museum Management Program.
_____NPS *Museum Handbook*
_____NPS *Conserve O Gram* Technical Leaflet Series
_____National Center for Preservation Technology and Training

J. List of Figures

SCOPE OF WORK (Sample)

Collection Condition Survey

[Park Name]

I. Background Statement

Provide information on the size and breadth of collections and why a Collection Condition Survey is needed.

The park requesting a Collection Condition Survey of collections is:

[Name - Address - Telephone number - Email Address]

II. Purpose/Objectives

A. The purpose of the work is to 1) conduct an on-site Collection Condition Survey (CCS) at **[PARK]** and 2) produce a report identifying the conservation and preservation needs of individual objects stored and exhibited at [**PARK**]

The survey will focus on material stability to determine object conservation treatment needs; including determining and recording the condition of individual objects or groups of objects in the collection in need of professional conservation treatment. The survey will also include recommendations for preventive care, and improvements to museum storage and exhibit conditions.

The results of the survey will provide guidance to (**PARK)** and regional curatorial staff in setting priorities for object stabilization and/or treatment, and preservation management of the park collections. The survey will also facilitate budgeting, scheduling, and subsequent communications with conservators regarding treatment. Object-specific data, using a compatible documentation or software format that identifies equivalent ICMS data fields from the survey will be entered into ICMS, the park's automated collections management system. The survey will indentify ICMS compatible

B. The conservator must comply with the *Code of Ethics and Guidelines for Practice* of the American Institute for Conservation of Historic and Artistic Works (AIC) in all work performed.

C. A time will be set for the site visit in conjunction with the park Superintendent and the Conservator when it is convenient for both parties.

D. Prior to the visit the park will provide:

- a copy of the Scope of Collection Statement (SOCS),
- copies of any previous surveys or reports that may assist the conservator in understanding the history of park collections including:
  - Collection Management Plan
  - Collection Storage Plan
  - Environmental monitoring records
  - Fire protection survey
  - Emergency Operation Plan (EOP)
  - Structural Fire Plan
  - Intergrated Pest Management
  - Facility Checklist
  - Housekeeping Plan

Figure 3.2. Sample Scope of Work for Requesting a Collection Condition Survey (CCS)

E. Approved in advance by the Superintendent, the park staff will provide on-site:

- a suitable work space
- supervised access to collection storage rooms, vaults, cabinets, shelves, and other locations of museum objects
- opening and closing of storage cabinets and vault or other containers that may be locked
- assistance with moving heavy or unwieldy objects
- access to museum property accountability (catalog and accession) and conservation (treatment and survey) records when required
- answers to questions about existing environmental monitoring and control, preventive care of objects, uses of objects, plans for future acquisition and disposition of objects, plans for future exhibition of objects, and the park's pest management program
- other information as needed

F. Prior to the visit the Service Provider/Conservator will provide:

- A vitae that clearly demonstrates an expertise in the conservation of museum objects and a history of completing work of this scope and character. Qualifications must include a comprensive work history showing specialized training in the field of conservation.
- A list of references from museum professionals with first hand knowledge of work performed.
- Condition Worksheet, blank and completed
- Final report of work completed

III. Tasks

The conservator will

A. Conduct an entrance interview with the Superintendent and designated park staff (curatorial, maintenance and other resources staff) upon arrival at the park. The purpose of the interview is to explain to the staff the conservator's methodology and anticipated survey schedule and to detail any local support that may be needed.

B. Conduct a hands-on survey of collections by examining each object individually, or, as appropriate, by examining representative samples of large groups of similar objects.

The following factors will be considered in determining the object condition and conservation treatment needs of groups of similar objects in storage and on exhibit:

- The nature of the environment in which collections are stored or exhibited including building structure, temperature, relative humidity, dust, natural and artificial light sources, pests, air pollution, and other agents of deterioration, as well as the local climate conditions.
- Storage methods, mounts, and techniques including appropriateness, quality, and efficiency of use.
- Evidence of recent damage or deterioration, including failure of preservation treatments, damage to objects during their use for interpretation and study, effects of visitor handling or vandalism, and deterioration due to adverse environmental factors.
- Any other general or specific issues concerning the collection's preservation, conservation, and/or treatment needs.

C. Upon completion of the survey, the conservator will meet with the park Superintendent and designated curatorial staff to review the survey results. The close-out meeting should cover the findings and recommendations the Conservator anticipates including in his/her report. At this time, the conservator will gather any data or information not already obtained that will be required for production of the survey report.

Figure 3.2. Sample Scope of Work for Requesting a Collection Condition Survey (continued)

D. The conservator will prepare a written report of the completed survey using software designated by the park. The report shall include the following elements:

- Brief description of the schedule, sequence, procedures, and methodology used in conducting the survey in the park; identification of person(s) conducting the survey; identification of park staff who were involved in the survey and how they were involved; a brief summary of the entrance and exit interviews
- Condition information on individual objects and/or groups of objects in a park-compatible electronic format.

This information must either be entered into or be transferrable to the ICMS Conservation Module [required and optional fields are described in the ICMS *User Manual*, and see also figure 8:3 for equivalent conservation terminology.] The contractor will provide data for these fields on disk using a template provided by the park. If the Conservator does not enter then data directly into the ICMS conservation module the park will transfer this information into ICMS.

E. When preventive maintenance treatment or simple treatments can be done by the park; park staff will be identified, the treatment will be briefly described and materials will be recommended. All recommended materials shall be commonly used by conservators and selected for reversibility, stability, and ease of use. Materials shall be described generically, though brand names also may be given for reference purposes.

F. Provide instructions for the park curatorial staff to follow when carrying out work that the conservator recommends they perform. In most instances, instructions will be common practices.

G. Provide a time estimate required for a professional conservator to carry out each recommended treatment. If possible, provide a cost estimate for the treatment if done by a conservator specializing in that discipline. The park can use this information to program funds to accomplish the work. When appropriate, note economies of cost or other benefits that might be realized by simultaneously treating similar objects, or objects with similar treatment needs.

IV DELIVERABLES AND PAYMENT SCHEDULE

A. Provide five copies of the draft survey report on single sided 8 1/2" x 11" paper. Each line must numbered on the left side of the page. The following must be included; a title page listing the park name, the conservator's name, project completion date and numbered table of contents. An electronic file of the document must be provided to the park. Individual object information must be provided in electronic format as described in the *ICMS User Manual*.

B. The final CSS report must be on 8 1/2" x 11" neutral pH, high alpha cellulose, white paper such as Permalife Bond Paper or equivalent, single-sided and paginated, and printed using carbon-based, black laser printer ink. The following must be included; a title page listing the park name, the conservator's name, project completion date, and paginated table of contents. An electronic copy and two hard copies must be provided to the park. The electronic file (CD or DVD or other compatible format) must be labeled with the same title as the report plus the file name. Any revised individual object information must also be provided in electronic format as described in the *ICMS User Manual*.

C. Photographic documentation

The conservator must provide the following:

- Digital files with full color images of each object in an uncompressed TIFF format with Dublin Core metadata provided for each image. JPEG files or any form of lossy compression files will not be accepted.
- Hard copy color prints all images photographed.
- A signed release form granting copyrights of all photographs to the park. (See NPS *Museum Handbook*, Part III, Figure 3.4, Assignment of Copyright by Contractor.). The Conservator may keep a copy of each image for private or educational use. Images kept by the Conservator may not be used in for-profit publications, for , for commercial distribution, or for exhibitions by the surveyor or any other individual or institution without written permission from the Superintendent or Park Curator. The credit line shall include the following information: "Courtesy of the National Park Service," Park Name, Object Name, Object Date, Catalog Number.

Figure 3.2. Sample Scope of Work for Requesting a Collection Condition Survey (continued)

- A separate sheet of photographic captions will be prepared and electronic file will be included in the disk (CD or DVD) with the report. When applicable, the captions will link directly to an object's accession or catalog number. The number shall be written in carbon black ink or pencil on the non-emulsion side of the image on the border or non-image area in neat, easily readable print.

D. Payment shall be made in two phases.

- Phase I involves the site visit and preparation of the DRAFT Collection Condition Survey. The first draft shall be due 30 days following the site visit. Upon receipt of the draft document and an invoice for 50% of the total sum shall be delivered to the contractor. The park will provide government review comments within 30 days.
- Phase II includes delivery of the final document, which is due 30 days following receipt of the review comments. Phase II payment of the remaining 50% of the total sum will be delivered upon receipt and acceptance of the final documents and receipt of an invoice.

The final Collection Condition Survey shall be sent to:

[Name - Address - Telephone number – Email address]

Figure 3.2. Sample Scope of Work for Requesting a Collection Condition Survey (continued)

Project Description

The park has a collection of approximately 300 desiccated wood and fiber objects recovered from dry caves throughout the Southwest. These materials include basketry, sandals, textiles, cordage, and a number of small wooden artifacts. In 2011, a conservator carried out a Collection Condition Survey (CCS) on this collection. Objects were prioritized for treatment and a basic treatment methodology was recommended.

All objects will be treated in accordance with the recommendations outlined in the CCS. A professional conservator with experience in wood and fiber will perform the work. The conservator will photo-document the objects in high resolution digital format and provide reports of the treatments performed on this group of objects. All activities will follow the Code of Ethics and Standards of Practice of the American Institute for Conservation of Historic and Artistic Works. The conservator will provide information that for inclusion in ICMS..

Needs: Stabilization of loose fragments, basic cleaning, removal of deposits from burial and construction of specialized mounts. Conservation treatment will also identify fiber and wood types, stabilization and cleaning protocols and mount construction methodology. These objects are primary sources for archeological research and conservation treatment is necessary so that the materials can safely be made available to researchers for study. Analysis carried out during treatment will add to the documentation available about these objects.

Recommendations will guide management decisions on future access and use, including exhibition. Photographs resulting from the project will be included in ICMS database and made available online through the NPS Museum Collections search module to increase public access to NPS collections.

Figure 3.3. Sample Project Management Information System (PMIS) Statement for Requesting Conservation Treatment Based on CCS

CHAPTER 4: MUSEUM COLLECTIONS ENVIRONMENT

CHAPTER 4: MUSEUM COLLECTIONS ENVIRONMENT

A. Overview

1. *What information is included in this chapter?*

This chapter provides information on how to protect museum collections from deterioration caused by interaction with the surrounding environment. From the moment an object is created, it begins to deteriorate. The factors that can cause or accelerate deterioration are called "agents of deterioration." See Chapter 3, Section A, 1 for a more complete discussion. Environmental agents of deterioration discussed in this chapter are:

- temperature
- relative humidity (RH)
- light
- air pollution

Basic information about these agents of deterioration is provided here to enable you to recognize how they affect collections, how to monitor them, analyze their potential impact, and how to control your collections environment. Guidance is provided on how to identify, eliminate, block, and/or minimize the negative effects of these agents of deterioration. Information on collection environment, building basics, and on non-mechanical methods to control your collections environment is provided. The chapter provides recommendations for temperature and relative humidity as well as lighting standards.

For more information, see the following sections:

E.4, What is the recommended temperature set point and fluctuation range for general collections?

F.6, What is the recommended RH set point and fluctuation range for general collections?

I.4, What are light standards?

Every park with collections must establish an environmental monitoring and control strategy for collections in storage and on exhibit. See Director's Order 24, 4.3.12 Collection Condition which states, "Monitor and record information about the environment in spaces housing collections and manage the environment to maximize preservation.''

To promote long term collections preservation, make sure that all staff that interact with the collection recognize the importance of maintaining a suitable environment. See Chapter 7, Museum Collection Storage and Appendix T, Curatorial Care of Biological Collections for additional information.

Note: Guidance in this chapter applies to all collections housed or exhibited in purpose-built, adapted structures, and furnished historic structures. Information that applies only to furnished historic structures is specifically noted.

2. Why is it important to monitor, analyze, and control the collections environment?

Monitoring, recording and analyzing climate data allows you to evaluate the risks posed to collections, adjust controls to better maintain a suitable and stable environment, and take steps to minimize damage from temperature (and variations in temperature), relative humidity (and variations in relative humidity), and light and air pollution. This, together with good collections management practices outlined in this chapter and *Handbook*, will enhance object integrity and preservation and reduce the need for invasive and costly conservation. It is also important to recognize the need to reduce energy consumption without compromising the integrity of the collections.

3. What agents of deterioration affect the museum environment?

The agents of deterioration discussed here are environmental forces that act on objects causing chemical, physical, and biological damage. ***The damage is cumulative and causes irreversible losses to collections.*** These agents of deterioration are:

Incorrect temperature that can be:

too high causing gradual disintegration, discoloration, expansion of certain materials and increased pest activity. For more information, see Section B.2, What types of materials are in the collection and how do they respond to environmental changes?

too low causing desiccation and embrittlement which results in fracturing of paints, adhesives, and other polymers.

fluctuating potentially causing delamination and fractures in materials due to the dissimilar expansive nature of the laminates.

See Section E.2 How does temperature affect objects?

Incorrect relative humidity can be:

too damp (over 65%) causing mold growth and/or swelling and deformation of hygroscopic (typically organic) materials, corrosion of metals, increased pest activity.

too dry causing desiccation of hygroscopic materials resulting in shrinkage and cracking in certain materials such as ivory, teeth or wood, and dehydration of some minerals.
above or below a critical value causing hydration/dehydration of some

minerals.

fluctuating causing cycles of shrinkage and swelling organic materials. If the material is constrained, this could potentially result in deformation or/and fractures, causing layered hygroscopic materials to delaminate and/or buckle, and loosening of joints of organic components.

See Section F.5, What deterioration is caused by incorrect relative humidity?

Light (radiation), both naturally occuring and artificial, is composed of wavelengths, including:

ultraviolet radiation (UV) that causes weakening, chalking darkening, yellowing and/or disintegration of the outer layer of organic materials and some dyed or colored inorganic materials.

visible light that fades (bleaches) or darkens the outer layer of paints, inks, dyes, wood, textiles, photos, plastics, and other organic and inorganic materials.

infrared radiation (IR) that heats the surfaces of objects causing disintegration and discoloration in materials (with the same impact as that from high temperature) and desiccation of hygroscopic materials.

See Section I for detailed information on light.

Contaminants or particulate and gaseous air pollutants that disintegrate, discolor, or corrode all types of objects, especially reactive (such as metals) and porous materials. Contaminants include:

gases, pollutants such as hydrogen sulfide, nitrogen dioxide, sulfur dioxide, formic and acetic acids, peroxides and ozone.

liquids such as plasticizers that ooze from adhesives and some plastics, and grease from human hands.

solids such as dust that can abrade surfaces and provide nutrients for pests, salt that corrodes metals.

See Section K for detailed information on pollution.

4. What are the steps to protect collections from environmental agents of deterioration?

Take the steps below to develop a strategy to protect your collections in storage or on exhibit.

- **Know the collection**

– Become familiar with objects in your collection, the materials they are made of, and how they were made and used.

- Identify sensitve objects with special environmental requirements or that have previous damage and how the damage was caused.

- Monitor object condition. Develop a "critical eye" to evaluate object condition and identify reasons for condition changes.

- Be aware that objects will have acclimatized to the local environment.

- Seek visual cues to the agents of deterioration such as condensation on cold surfaces, water stains on ceilings or walls, and fading of organic materials such as textiles or botanical specimens.

- **Know the structure and the building envelope housing the collection**

  Understand the building in which collections are kept: its location and orientation to the sun, its surroundings, the local climate, the building envelope (materials used, insulation, openings such as windows and doors, attic, basement, roof), the interior (floor plans, furniture, mechanical systems if present, etc.). For more information, see Section C, Building Basics for Collections.

- **Know your local climate and its impact on the building envelope and on the collections environment**

  Monitor exterior climate conditions and seasonal fluctuations and how they affect the building envelope and in turn, the interior spaces housing the collections. Track and evaluate climate data for long term trends. See Section C.4, How do structures respond to the local climate?

- **Maintain a stable climate and minimize fluctuations**

  Determine the temperature and RH set point and a maximum and minimum fluctuation range that accommodates the needs of most of the objects in your collection and that takes the building housing the collection and local climate into account.

  For more information on how to determine these optimum set points, see Section E. 4, What is the recommended temperature range for general collections?, F.6, What is the recommended RH set point and fluctuation range for general collections? and Section H, Methods of Controlling Temperature and Relative Humidity and consult with your regional curator and a conservator.

- **Containerize the collection**

- Organize the collection by material type and group sensitive or vulnerable materials to provide special environmental conditions efficiently.

– House objects in well constructed and sealed steel cabinets to buffer against climate fluctuations and minimize exposure to light. See Chapter 7, Museum Collection Storage.

– Enclose open shelving or large objects with muslin or polyethylene sheets to buffer or "containerize" collections.

– House sensitive or vulnerable materials separately to provide special environmental conditions efficiently. Create microclimates for instable materials.

For more information, see Section H. 2, How do sealed cabinets help stabilize the collections environment? and Chapter 7, A.2, What is a multi-layered collection storage system and how does it protect my collection?

- **Avoid the agents of deterioration in areas housing collections**

– Locate your collection storage away from the flood plain of a river, stream, and lake or seashore.

– Build or modify the storage facility so that is properly insulated, has no windows (i.e., no natural light) in collections areas, and that can readily maintain the selected temperature and RH set points.

– Build or modify exhibit spaces to block UV and exposure to daylight (radiation).

– Do not house collections in basements or attics.

- **Block agents of deterioration when you cannot avoid them**

– Be pro-active in blocking agents of deterioration by identifying problem areas and taking appropriate action.

You should:

– Cover windows in re-purposed buildings with solid material to block daylight (natural light) and minimize temperature and RH fluctuations.

– Install UV filtering materials on windows and fluorescent lights in furnished historic structures and visitor centers housing collections.

– Fill cracks and gaps in the building envelope, including around doors and windows, to better insulate the interior from the outside environment and block pest entry.

- **Test the methods used to block the agents of deterioration by monitoring**.

– Monitor RH and temperature to find out if your climate control system is working properly and if your mediation methods are effective.

– Monitor the light levels such as UV in exhibit areas.

– Monitor objects for changes that correlate to agents of deterioration and keep written documention.

For more information, see Section H, Methods of Controlling Temperature and Humidity.

- **Evaluate and respond to the environmental information gathered**

Monitoring is a waste of time if you do not evaluate and use the information to determine which mediation methods are working and which need to be modified. Adjust your environmental management practice accordingly in consultation with the park facilities manager and a conservator.

For more information on blocking and controlling agents of deterioration, see Section H. Methods of Controlling Temperature and Relative Humidity.

- **Establish a preventive conservation strategy**

Make informed decisions by ongoing monitoring and evaluation of the collections environment.

– Create an environment that mitigates agents of deterioration using effective and practical preventive measures.

– Carry out preventive conservation systematically to minimize damage from the agents of deterioration once objects enter the collection and to keep conservation treatment at a minimum.

– Continuously monitor, evaluate, and respond to environmental information and adjust your environmental practices when necessary.

– Develop a treatment plan to address specific problem objects in your collection. Objects may enter your museum damaged and deteriorated from use and exposure. Because of their history, even in the best museum environment, some objects will need treatment.

For more information, see Section H, Methods of Controlling Temperature and Relative Humidity and Section J, Monitoring and Controlling Light.

B. Collections Environment Basics

1. What variables should be taken into account when determining the optimal collections environment?

NPS collections are located throughout the U.S. in a wide range of climate zones. They include different material types that are housed in variety of structures. Consider the variables noted below when establishing an optimal environment for your collection.

- **Types of material in the collection**. Certain materials are more vulnerable or unstable than others. They may have different temperature and RH requirements and are or may be more sensitive to environmental fluctuations. House these objects separately. Handle objects composed of more than one material on a case-by-case basis. See Section E for information on temperature and F.8 for RH recommendations for sensitive materials.

- **Type of structure housing the collection.** Various structures, such as purpose built, adapted, and historic structures are capable of sustaining different temperature and RH ranges. The nature of building type and materials, as well as openings such as windows determine how effective a buffer the structure or building envelope provides the collections from the exterior climate, including light penetration.

- **Local climate.** Local climate and seasonal fluctuations impact the building envelope, and in turn, the interior building climate. Work with the facilities manager to ensure that the building envelope mediates against temperature and RH extremes and fluctuations, and light penetration. For historic structures, consult a historic architect to ensure that this can be done without damage to the historic fabric.

- **Interior collections environment.** Temperature, RH, dew point (see Section F.1 for a definition of dew point), light and contaminants are critical components of the collections environment within the area housing the collection. They influence the physical, chemical, and biological processes that cause deterioration of organic and inorganic materials.

2. What types of materials are in the collection and how do they respond to environmental

Materials respond differently to environmental changes. Cultural and natural history object vulnerabilities are determined by their physical and chemical composition and can be divided into three categories: organic, inorganic, and composite. Become familiar with the *changes?*

properties of materials in all categories in order to understand their vulnerabilities and environmental requirements.

Organic objects: Objects that are derived from once living plants or animals include wood, paper, textiles, leather, skin, horn, bone, teeth, ivory, grasses and bark, lacquers and waxes, plastics, some pigments, shell, certain fossils that are not fully lithified (combination of organic and inorganic materials), and biological specimens. All organic materials share certain characteristics and vulnerabilities. They:

- contain the element carbon
- are made of complicated molecular structures that are susceptible to deterioration from extremes and changes in RH and temperature
- may be hygroscopic, that is, they absorb water from and emit water to the surrounding air in an ongoing attempt to reach an equilibrium
- are sensitive to light
- are a source of food for mold, insects, rodents and other museum pests

Inorganic objects: Objects that have a mineral origin include metals, ceramics, glass, stone, minerals, fully lithified fossils (when permineralized), and some pigments. Inorganic objects share certain characteristics and vulnerabilities. They:

- may have undergone extreme pressure and/or heat
- are not usually combustible at normal temperature
- can react with the environment to result in a change their chemical structure (such as corrosion or dissolution of constituents)
- may be porous (unglazed ceramics and stone) and will absorb contaminants (such as water, salts, pollution, and acids)
- are generally not sensitive to light, except for certain types of glass and pigments

Composite objects: Mixed media objects are made up of two or more materials. They may include both organic and inorganic materials and may have the characteristics of both and so may react with the environment in different ways and rates. Materials may react in opposition to each other, creating physical stress and causing chemical interactions that lead to deterioration. Examples include books (paper, ink, leather, thread, and glue), paintings (wooden frame and stretcher, canvas, organic and inorganic pigments), musical instruments (wood, rawhide, paint) and jewelry (metals, stones, minerals, feathers, etc.).

Note: Inappropriate temperature and RH levels (too high and too low) as well as large and prolonged deviations beyond the acceptable fluctuation range can cause damage and deterioration to objects. It takes time for objects made from hygroscopic materials to adjust to changes in RH, depending on the type and thickness of the material used, construction and finishes. This time can range between a few hours (sheet of paper) to several weeks (wooden sculpture). Therefore, short term "spikes" can often be tolerated. In situations in which the RH changes quickly to either extreme (too high or too low) and this change remains in place for a time period long enough for the material to fully respond, damage may result. Constrained materials are at greater risk of damage then unconstrained materials.

These fluctuations accelerate and/or cause chemical, physical and biological processes that lead to object deterioration. This includes cracking, corrosion, fading of pigments and dyes, and mold growth. Exposure to light and pollutants exacerbates this deterioration.

Similarly, thin or constrained organic objects with a large surface area are particularly vulnerable to rapid and extreme fluctuations in temperature and RH. These include film-based materials, ivory, teeth, pyritic specimens, shell, as well as objects with thin skinned and wood veneers. House these materials separately in enclosed containers or in separate climate zones within the structure.

3. What is the appropriate environment for collection preservation?

A moderate climate that avoids extreme temperature and RH fluctuations and that excludes daylight and/or filters out ultraviolet and infrared radiation and air pollution provides the appropriate environment for collection preservation.

Design or adapt the structure or space housing the collections to maintain an optimum collections environment.

In storage areas exclude daylight (natural light), and UV and IR and use artificial lighting that does not emit UV or IR.

In furnished historic structures, galleries and visitor centers, exclude or block daylight and exclude, block or filter visible light in furnished historic structures and visitor centers. Keep artificial light levels low and free of UV and IR. See Section J, Monitoring and Controlling Light for more information.

Housing objects in well-sealed exhibit cases and steel storage cabinets enables you to provide an environment that buffers against climate extremes and minimizes exposure to light. See Figure 4.1, RH Readings Taken Outdoors, Within a Storage Space, and Inside a Cabinet within the Storage Space Over One Month.

House objects separately that require different RH and/or temperature levels that could be harmful or too difficult to maintain for the general collection. Note: Do not open cabinets during high humidity events to prevent trapping moisture within the cabinet.

For information on recommended:

Temperature: Section E.4, What is the recommended temperature set point and allowable fluctuation for general collections? and Section E.5 What is the recommended temperature for sensitive materials?

Relative humidity: Section F.6. What is the recommended RH set point and allowable range for general collections? and Section F.8. What is the recommended RH range for sensitive materials?

Light: I.4. What are radiation standards?

Particulate and gaseous air pollution, Sections K and I.

4. What is the equilibration relationship?

Objects continuously react/respond to their surrounding environment, absorbing and releasing heat and moisture (for hygroscopic materials) to reach equilibrium. Different materials "equilibrate" to the surrounding environment at varying speeds and rates, that is, they respond differently to changes in temperature and RH.

The equilibration relationship causes objects to react to changes in the environment, potentially damaging them, especially in situations where the change is extreme and prolonged and the material is constrained. Reactions to temperature and RH changes include swelling, contracting and cracking. Deterioration can go unnoticed for a long time (cracking paint layers) or can occur suddenly under extreme conditions (cracking of wood).

5. How do well- sealed cabinets protect collections?

Well designed and constructed sealed steel cabinets and exhibit cases buffer objects from climate extremes and fluctuations. Each successive layer within a multi-layered storage or exhibit space works to stabilize or reduce the range of fluctuations. These layers can also minimize energy loads that make for increased energy efficiency and sustainability. See Figure 4.1 and Chapter 7: Museum Collections Storage, Section A, What is a multi-layered collection storage system and how does it protect my collection? for detailed information.

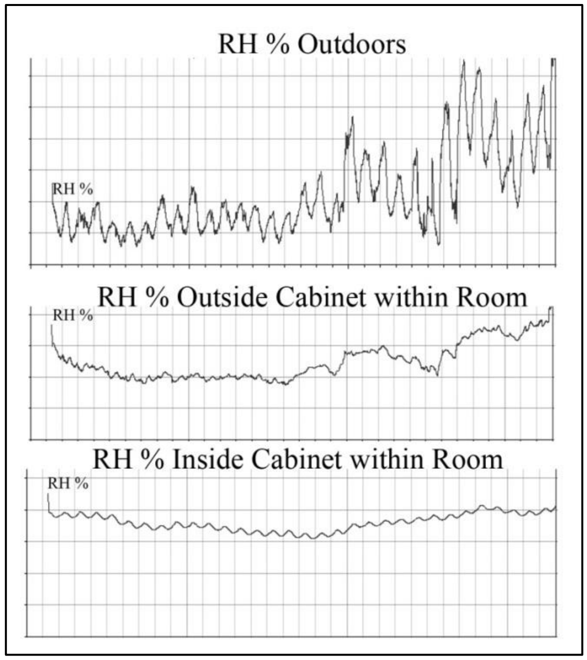

Figure 4.1 RH Readings Taken Outdoors, Within a Storage Space, and Inside a Steel Cabinet within the Storage Space without an HVAC over One Month

See Chapter 7 and Appendix T, for additional information on providing optimal storage conditions for collections.

C. Building Basics for Collections

1. What types of structures house collections?

The range of structures that house NPS collections fall into the general categories listed below:

- **Purpose built:** Structures specifically designed to house or display collections. They are well insulated and sealed against the exterior environment. Typically the storage or exhibit area(s) are separated from the exterior walls with corridors, offices, sales or similar spaces. Purpose built structures are designed to maintain a narrow temperature and relative humidity range, namely, a selected set point with the permissible fluctuation range. They exclude daylight and UV and IR radiation. These structures can support mechanical air handling systems that heat, cool, humidify, and dehumidify the air. See Section E.4, What is the optimal temperature set point and allowable fluctuation range for general collections? and F.6, What is the optimal RH set point and the allowable fluctuation range?

- **Adapted:** Structures originally built for purposes other than housing museum collections that are adapted (modified) to meet collections storage environmental, preservation, and protection needs. They range from recently constructed to older buildings.

They can be adapted for collections without concern for historic preservation as they are not classified as historic structures. These buildings can be adapted to maintain a selected set point with a relatively narrow temperature and RH fluctuation range. They can be readily adapted to block daylight, UV and IR without damage to the building fabric.

- **Historic structures:** Structures that are on or are eligible for the National Register of Historic Places and that exhibit and/or house collections. Because historic structures were designed for earlier building and/or human comfort standards, they should not be expected to maintain nor may they tolerate the same indoor environmental range as purpose built or adapted structures. Their envelope materials and assemblies may be incompatible with the desired indoor conditions for collections. They may have heating and cooling systems such as vents or fans that are incompatible with the installation of a HVAC system. Traditional methods such as opening and closing windows to regulate temperature spaces are not appropriate for spaces that house collections.

For all building types, avoid placing collections in spaces directly enclosed with exterior walls of existing masonry construction. Masonry absorbs rain water and releases that moisture (inwardly and outwardly) during the next sunny (or warm) day which adds to the humidity load of the interior space.

See *Museum Handbook* Part III, Chapter 8: Using Museum Collections in Historic Furnished Structures and the *COG* 4/7: "Museum Collection Storage Space: Is an Insulated Modular Structure Right for Your Collections?" for additional information.

2. How does the building type and envelope affect the collections environment?

The building envelope separates the collection from exterior temperature and RH fluctuations, light and pollutants. The roof, walls, floors, cellars, and other parts of the structure in contact with the exterior environment act as a buffer between the elements and the collection. Doors, windows, and chimneys can permit penetration that affects RH and temperature. They also permit light, and pollutant entry. Cracks, gaps, and the porosity of materials can hinder the effectiveness of the envelope. Similarly, dirt floors in cellars, unfinished basements and uninsulated attics negatively impact the internal environment. The type of building, its design and construction, and materials from which it is built from, such as wood, metal, concrete or masonry directly impact the interior environment.

All structures housing collections should provide a protective environment. Consult with your park facilities manager, and regional curator to determine what environment your structure is capable of maintaining.

In purpose built structures, exclude exterior windows in areas that house collections on exhibit or in storage, and treat doors, attics and basements to limit moisture and outside air penetration. In historic furnished structures, block chimneys, fill cracks and gaps, install UV filtering material over windows. Add shutters, blinds, and/or curtains to all windows. If appropriate, add double glaze windows, U-value (with thermal resistance and insulating properties) windows, or interior storm windows, or other appropriate material with UV filtering capability.

Design purpose built and adapted buildings to provide a highly protective building envelope. Historic structures may need to be adapted in order to protect the collection on exhibit from temperature and RH fluctuations and light penetration, including ultraviolet radiation. Consult with a historic architect to make sure that any modifications do not jeopardize the historic structure itself.

For collections that are stored in historic structures, in addition to adapting the structure as noted above, house the collections in sealed cabinets or within an insulated modular structure within the historic structure to moderate the negative impact of environmental fluctuations. If this is not possible, store the collections in another, more appropriate location.

3. What features impact the environmental performance of a historic structure?

Most historic structures were not designed to rely on modern mechanical systems such as heating, ventilation, and air conditioning (HVAC) systems for controlling climate. They include many features that non-mechanically stabilize their interior environments, such as high mass exterior walls and shutters on windows. The design, materials, type of construction, size, shape, site orientation, surrounding landscape, and climate all play a role in how buildings perform. Historic building construction methods and materials often maximized natural sources of heat, light and ventilation to respond to local climatic conditions.

The key to controlling the environment in a historic structure is to identify and understand the building's existing environmental controls and how they function. It is essential to understand and use the historic building's inherent sustainable qualities as originally intended to ensure that they function effectively together with any new treatments, to help create the desired environment. See *Preservation Brief 3*, "Improving Energy Efficiency in Historic Buildings" and *Preservation Brief 24*, "Heating, Ventilating, and Cooling Historic Buildings – Problems and Recommended Approaches" for additional information.

It is important to balance the needs of the collections with those of the historic structure itself. Human comfort factors should also be taken into account. If these present an issue, take appropriate action to protect the collection, or consider relocating the collections.

4. How do structures respond to the local

Temperature extremes and changes will affect the building envelope and in turn, interior spaces. Temperature and RH disparity between *climate?*

the exterior and interior can result in condensation on windows, around window and door frames, and within walls as cooler interior air meets the warmer outside air (or vice versa). Condensation can lead to mold, rotting of wood, flaking paint, spalling of exterior walls, and leaks. See F.2 for information on dew point.

Monitor temperature and RH outside and inside the structure for a minimum of one year to learn how the building envelope responds to the local climate and seasonal variations. Thereafter, do continuous monitoring in order to effectively ensure and maintain a stable collections environment. Evaluate the data to understand how the structure responds to seasonal changes. Based on the climate data and information on the condition of the collection, determine what and how much additional protection the collections need.

Be aware that most spaces are warmer near their ceilings resulting in lower RH at the upper levels and higher RH at lower levels. When necessary, consider relocating sensors or taking measures to mitigate thermal stratification. However, be aware that fans will cause a disruption of the motion detector security system.

Many historic structures were designed for human comfort in a specific local environment. They may have structural elements (such as ventilation shafts) to help accomplish this. These architectural features may be able to be adapted to help regulate the interior environment of a structure based on exterior conditions.

5. *When should I have a Historic Structure Report done?*

To understand how the historic structure functions and impacts collections, arrange for a Historic Structure Report *before* moving collections into the structure, or arrange for an update of the report. Monitor and evaluate the interior climate for at least one year to obtain baseline information and to see how the different seasons and local climate affect the structure.

Use this information to determine how the structure performs and to address climate issues within the structure and the area housing the collections. Continue ongoing monitoring. See *Preservation Brief 43* "The Preparation and Use of Historic Structure Reports" for more information.

6. *Are mechanical systems appropriate for historic structures?*

Consult with a historic architect and mechanical engineer with knowledge and experience with historic structures to determine whether a mechanical system is appropriate for the historic structure. **Note:** Introducing humidity and temperature controls into buildings that were not designed for HVAC systems can create serious problems for the structure. Where possible, use non-mechanical methods to maintain a stable climate in historic structures.

First do a thorough assessment of the structure, considering all potential and unintended consequences of possible HVAC installation and consider other alternatives in consultation with a historic architect.

Be aware that humidistatically controlled systems that introduce humidity into the air can be effective in improving the environment in historic structures. However, the added humidity may be destructive to the building fabric. See Section H 6. "What are humidstatically controlled heating and ventilation systems?"

If mechanical systems are installed in historic structures they have to be continuously monitored to prevent any malfunction that can damage collections and the structure itself. See *Preservation Brief* 24, "Heating, Ventilating, and Cooling Historic Buildings: Problems and Recommended Approaches" for more information.

7. How do I improve and stabilize the collections environment in different types of structures?

First assess the structure's interior environment. Then obtain and analyze baseline temperature, RH, light and air pollution data for at least a year and through different seasons in order to understand how the space and structure performs. Consider what elements of the building envelope block or mitigate the environmental agents of deterioration and which may introduce them to the collections environment. For example, thick masonry walls will buffer against fluctuations in temperature, but an unblocked window allows in sunlight as well as heat or cold penetration, and cause temperature swings and may lead to condensation.

When a structure is to be adapted to house collections, consult with a building engineer, historic architect, and park facilities staff on how it can be adapted to provide a stable environment for collections. This includes non-mechanical means of controls, such as managing the building envelope, using an insulated modular structure within the historic structure, to mechanical controls, such as installing a HVAC system.

When making adjustments to the environment within a historic structure, ***always*** begin with measures that require the least change to the building. This may include using storm windows with UV filtering capability, shutters, blinds, and curtains.

Only *consider adding insulation materials and an HVAC system as a last resort, and* only *if it is determined that the materials and the HVAC system will not cause harm to the historic fabric of the building.*

See *The Secretary of the Interior's Standards for Rehabilitation & Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings* for more information. Refer to Sections I, K and M on how to moderate fluctuations in temperature and RH, and how to block UV and minimize IR, visible light and air pollution.

Despite improvements to the structure, certain objects in the collection still may not be able to withstand the ambient environment. House these objects in containers or enclosures designed to fit their specific environmental needs or move to a facility capable of maintaining the required controls.

8. Does building occupancy and related activities affect the collections environment?

People, daily activities, electronic and office equipment, lighting and furnishings affect the collections environment. People emit heat and moisture that affect the temperature and RH levels within a space. They also introduce particulate air pollutants, such as dust, into a space. The larger the number of people and/or activities, the more dramatic the impact on the climate and the increased potential for damaging environmental fluctuations.

Mediate these fluctuations by ensuring adequate ventilation and climate control. Limit the number of people in an area at one time and set a limit on the number of visitors per day. Increase the distance between the visitors and the objects on open display to reduce the dust levels. Work with park interpretation and facilities management to manage tours of furnished historic structures. Have researchers work outside of the collections area and bring study collections to them. Use LED (light-emitting diode) lights that do not emit UV and emit minimal heat. Power down lighting and electronics when not in use.

Construction and renovation work pose a great threat to the structure and collections. Monitor the work area and equipment. Light, pollutants, chemicals, vibrations, and the presence of extra people will affect the environment and building structure. Make sure all equipment is turned off when not in use to prevent heat build-up and fire. Seal off the work area from the rest of the collection. Move or monitor objects especially sensitive to vibration, temperature, or moisture fluctuations while the work takes place.

9. Who should be involved in improving the collections environment within a structure?

Before embarking on a project to improve the collections environment, consult and collaborate with your regional curator, conservator, park facilities manager, structural engineer and an architect experienced in working with museum collections. For historic structures work with an architectural conservator and a historic architect.

Make sure that the contract includes a schedule for museum staff or the construction manager to inspect the construction site on a regular basis to ensure that all necessary precautions are taken.

D. Types of Deterioration

1. What is deterioration?

Deterioration is any chemical or physical change in the condition of an object. Physical and chemical deterioration often occur simultaneously. Deterioration is an inevitable, natural process by which an object reaches a state of chemical and physical equilibrium with its immediate environment.

Exposure to agents of deterioration, including light, incorrect levels of temperature and RH and pollution accelerate the rate of deterioration.

Become familiar with the inherent weaknesses and likely types of deterioration of the materials and objects in your collection so that you can readily monitor them for changes in condition. When you observe signs of damage, identify the type of damage (i.e. chemical, physical, and mechanical), and determine the cause for the changes and take appropriate action.

2. What is chemical deterioration?

Chemical deterioration is any change in an object that involves an alteration of its chemical composition. It is a change at the atomic and molecular level. Chemical change usually occurs because of reaction with another chemical substance (e.g., water, pollution, pest waste) or radiation (i.e., light and heat). Examples of chemical change include:

- oxidation of metal (rusting)
- dissolution of stone
- staining of paper documents by adjacent acidic materials
- foxing on paper prints and drawings
- fading of dyes and pigments
- darkening of resins
- darkening and embrittlement of pulp papers
- embrittlement of textile fibers
- bleaching of many organic materials
- cross-linking (development of additional chemical bonds)
- acid hydrolysis of cellulose nitrate film

3. What is physical deterioration?

Physical deterioration is a change in the physical structure of an object that does not involve a change in the chemical composition. It is often caused by improper levels of, or rapid and extreme fluctuations of temperature and RH or the interaction with some mechanical force. Examples include:

- melting or softening of plastics, waxes, and resins caused by high temperature
- cracking or buckling of wood caused by fluctuations in relative humidity
- warping of organic materials caused by high or low relative humidity
- shattering, cracking, or chipping caused by impact

- crushing or distortion caused by a harder material pressing against flexible material
- abrasion caused by a harder material rubbing against a softer material
- structural failure such as metal fatigure,tears in paper, rips in textiles
- stress caused between different materials on a composite object

Physical and chemical deterioration are interrelated and often occur simultaneously. For example, chemical changes in textiles caused by interaction with light also weaken the fabric so that physical damage such as rips and tears are likely to occur.

4. What is biological deterioration?

Biological deterioration results from several factors including excessive moisture, temperature, or food supply for museum pests. A malfunctioning HVAC system or exposure to moisture from exterior walls and/or windows can create an environment surrounding an object conducive to biological deterioration, in particular, mold.

With the right conditions, mold will grow quickly and damage can be irreversible. These conditions are very likely to support a variety of museum pests. Organic objects such as textiles, paper, wood, leather, horn and hair are particularly susceptible.

Examples of biological damage include:

- staining and weakening of wood, paper, textiles, leathers, and skins and other organic materials through mold growth
- loss of sizing in paper materials, making them more hygroscopic
- etching of inorganics by fungal acids
- rotting of wood by growing fungus when the RH is high
- staining or losses from the activity of rodents, birds, or insect pests

See *COG* 3/4: "Mold: Prevention of Growth in Museum Collections" for more information.

5. What is inherent vice?

Inherent vice is the propensity of certain materials to deteriorate because of their internal characteristics, incompatibility of materials, poor quality, unstable materials, or processing. This mechanism of deterioration is often called *inherent vice* or *inherent fault*.

In nature, organic materials often possess characteristics that protect them from natural degradation when the organism is alive but which quickly break down with the death of the organism. Their structure and composition may include features such as protective layers, insect and mold resistant chemicals, and photochemical protection.

Processing during object manufacture can remove these natural safeguards. Additives may be applied to produce a desired result without concern for long-term preservation (such as the addition of metal oxides in the manufacture of weighted silk or the use of formalin on fish and reptiles to fix the specimen). This processing causes inherently less stable materials or combinations of mutually incompatible substances that result in damaging interaction. Some inorganic materials may also be inherently unstable, for example pyrites that contain microcrystalline iron sulfides.

There are three kinds of inherent vice:

- **Short-lived materials**. Short-lived materials are the result of manufacturing processes or those materials that were not intended for long term use. Examples of impermanent materials with inherent vice include:

– cellulose nitrate and cellulose acetate film

– wood pulp paper

– certain plastics

– magnetic or digital media

- **Structural nature**. Inherent vice can also be related to the structure of an object. Poor design, construction or application of materials may cause structural failure. Examples of such damage include:

– marble table top causing bucking of supporting legs

– unraveling basketry coils

– cabinet door edges shearing away at the closure edge

- **History**. The way an object was made, processed, used, or housed before entering the collection may lead to inherent vice. Here damage and deterioration is caused by the original function and manufacture of the object, its maintenance or environment. Examples include:

– accumulation of dissimilar paint layers, such as oil and latex

– saturation in food storage containers

– deposits of soluble salts in archeological ceramics during burial

– non stainless steel wire in bird and mammal study skins or taxidermy mounts which may rust

Become familiar with the history of objects in your collection, including the processing of materials, manufacturing details, and previous use. Examine similar objects and learn to recognize inherent vice in your collections.

6. How do I identify active deterioration and its causes?

Active deterioration shows a continuing deleterious change or growth on an object over time. Active corrosion or condensation can be an early indicator of a humid environment and can help you determine what issues need to be corrected. Seek visual clues to determine what could be affecting the object and causing damage, such as improper environmental levels, RH or temperature fluctuation, light exposure, or chemical deterioration of surrounding objects or storage materials.

These include:

Cause	**Visual Clue/Damage**
Incorrect temperature and RH	Condensation forming on cold surfaces
High RH	Corrosion of metals; mold growth on paper, books, or walls, condensation forming on cold surfaces, presence of insects such as silverfish that thrive only in humid environments
Low RH, high temperature	Cracking or distortion of organic objects, phase changes in some minerals
Leaks, high RH	Water stains on ceilings or walls
Exposure to light	Color shift and/or embrittlement in organic materials, basketry, biological specimens, feathers, furs, fossils with organic coatings and consolidants, leather, painted surfaces, paper, parchment, works on paper, textiles, some minerals, wall paper, wood and plastics

Figure 4.2. Active Deterioration Cause and Visual Clue/Damage Chart

E. Temperature

1. *What is temperature?*

Temperature is a measure of the motion of molecules in a material. Molecules are the basic building blocks of everything. When the temperature increases, molecules in an object move faster and spread out; most materials then expand. When the temperature decreases, molecules slow down and come closer together; materials then contract.

Temperature and temperature variations can directly affect the preservation of collections. Temperature is also a primary factor in determining RH levels. When all other variables are held fixed, an increase in temperature generally results in a decrease of relative humidity.

2. *How does temperature affect objects?*

Temperature affects objects in a variety of ways. As temperature changes, objects will reach thermal equilibrium and adjust to the temperature of their surroundings. Increased temperatures generally cause expansion and decreased temperatures usually cause contraction. The amount of surface area exposed and the density of the material impact the time the object will take to reach equilibrium. Inappropriate temperature can accelerate chemical, physical, and biological processes that cause deterioration.

At higher temperatures:

- *Chemical reactions increase*. This is especially problematic for materials such as acidic paper, plastics, digital media and photographic materials. For example, high temperature leads to the increased deterioration of cellulose nitrate film. If this deterioration is not detected, it can lead to a fire. Most chemical reactions double in rate with each increase of 18°F (10°C). High temperatures can also cause evaporation of moisture from objects and that can in turn, result in deformation or cracking.

- *Biological activity increases at warmer temperatures*. Insects eat more and breed faster, and mold grows faster within certain temperature ranges.

- *Materials can soften*. Wax may sag or collect dust more easily on soft surfaces, adhesives can fail, lacquers and magnetic tape may become sticky.

At lower temperatures:

Very cold temperatures can make certain materials more brittle and prone to cracking, flaking, and other damage. Materials such as varnishes, lacquers, wood, oil, alkyd, and acrylic paints are especially at risk and need to be handled with extreme care. See *COG* 3/6: “An Insect Pest Control Procedure: The Freezing Process” for information on which materials not to freeze.

In general, the rate of any chemical reaction increases with rise in temperature, so in many instances, judiciously lowering temperature can improve preservation.

3. *What deterioration is caused by fluctuations in temperature?*

Temperature fluctuations can cause materials to expand and contract rapidly, setting up destructive stresses on the object. Fluctuations that occur faster than an object's ability to adjust to the change are most likely to cause damage such as cracking or exfoliating. Soluble salts in archeological and paleontological material may undergo cycles of efflorescence and deliquescence, resulting in surface delamination or other physical damage. Rapid variations can cause more problems than the specific level.

Avoid abrupt and extreme changes in temperature. It is often rapid fluctuations that cause more problems to an object than the specific level. This is particularly true for composite objects. If objects are housed outside such as a gun carriage, repeated freezing and thawing can cause damage. Temperature is also a primary factor in determining relative humidity. When temperature varies, RH may vary as a consequence.

4. *What is the recommended temperature for general collections?*

NPS collections are located in a wide range of climates throughout the U.S. Therefore you should determine the temperature set point based on an evaluation of your collection needs, the type of structure in which the collections are housed, the local climate and seasonal variations.

In exhibit, storage and research spaces, where comfort of people is a factor, the recommended temperature range for most NPS collections lies between 59 – 77°F[i] (15 – 25°C). Keep the temperature as level as possible.

Figure 4.3. Recommended Temperature Set Point for General Collections

In areas where comfort of people is not a concern, temperature can be kept at much lower levels, but above freezing. Studies indicate that reducing the temperature can extend the life of many materials. Certain materials require even lower temperatures, including cold storage. See Section E.5 for information on temperature standards for photographic materials and Appendix T, Section V, Biological Low-Temperature Collections. **Note: The cooler the better.** However, irrespective of where your collections are located, maintain a controlled temperature and avoid abrupt changes in temperature for long term collection preservation.

Over the year you may want to allow the set point to vary or drift with the seasons. Drift means that your set point varies in different seasons; usually higher temperature in the summer and lower in the winter. Allowing drift will often reduce energy costs over the long-term as mechanical systems work less to maintain the appropriate environment. **These variations should be gradual, taking place over weeks and months.** See F.7 for information on seasonal drift.

> ***Wherever your collections are located, keep the temperature within the permissible range and avoid abrupt fluctuations to promote long term collections preservation.***

House sensitive or chemically unstable materials separately within the general storage area or in a separate facility at the appropriate temperature. Chemically unstable materials with inherent vice such as acidic paper, modern electronic and digital records, certain photographic materials, and certain plastics require cold storage to slow the chemical processes responsible for their deterioration. Note that items in cold storage must be properly packaged so that when removed from storage, they can equilibrate to ambient conditions without condensation on the surface of the objects.

5. *What are the temperature standards for photographic materials?*

Museum standards for photographic media recommend or require cold temperatures to preserve film and color media. The Code of Federal Regulations, *Facility Standards for Records Storage* (36 CFR 1228.232 (b.) Subpart K, Sept 2005) that applies to federal archives and museums **requires** cold storage for film and color photographic materials at 35°F or below and 35% RH. The criteria set by the International Standards Organization (ISO) 18911, *Safety Film Storage* **recommends** cold storage at 35F or below at 30 - 40% RH (or cool storage at lower RH) for the extended storage of the above-mentioned materials. Under Directive 1571 - Appendix A the U.S. National Archives and Records Administration lists cold storage as a standard.

See COG 14/10 *Cold Storage for Photograph Collections –An Overview* and Appendix T: Section V, Biological Low-Temperature Collections for additional information.

F. Relative Humidity

1. *What is relative humidity (RH)?*

Relative humidity (RH) is a ratio (expressed in percent) between the mass of water vapor in a fixed volume of air (the absolute humidity) and the maximum mass of water vapor that a fixed volume of air could hold (without condensation) at the same temperature.   RH varies with changes in temperature and moisture content of the air. The relative humidity goes up as the air approaches saturation (100%) for a particular temperature. The general relationship between temperature and humidity is that for a given volume of air, as the temperature rises, the humidity decreases and *vice versa*.

If temperature is lowered without some means of reducing the moisture content in the air, then the RH will rise. Conversely, if the temperature is raised without some means to add moisture to the air, the RH will decrease. For example, if you have a mold problem it is not enough to just lower the temperature; the RH must be controlled as well.

Relative humidity is important because of the role water plays in various chemical and physical forms of deterioration. There are many sources for moisture and/or water; exterior (outdoor) humidity levels, rain, nearby bodies of water, wet ground, broken gutters, leaking pipes, damp basements, moisture in the walls, human respiration and perspiration, wet mopping, flooding, and cycles of condensation and evaporation.

All organic materials and some inorganic materials absorb and give off water depending on the RH of the surrounding air. Effects of RH on objects include:

- faster corrosion of metal objects at higher RH
- pests and mold growth are more common at higher RH
- shrinking and cracking in organic materials can occur at low RH

The following definitions clarify how these factors affect the environment in your museum.

Absolute humidity (AH) is the quantity of moisture present in a given volume of air. It is not temperature dependent. It can be expressed as grams of water per cubic meter of air (g/m3). A cubic meter of air in a storage case might hold 10 g of water. The AH would be 10 g/m3.

Dew point (or saturation temperature) is the temperature at which the water vapor begins to condense out of the air. It is a direct measure of the mass fraction of water vapor in the air. If the temperature drops below the dew point the water will condense forming dew. In a building, the water vapor may condense on colder surfaces in a room, for example, walls or window panes.

Relative humidity relates the moisture content of the air you are measuring (AH) to the amount of water vapor the air could hold at saturation at a certain temperature. Relative humidity is expressed as a percentage at a certain temperature. This can be expressed as the equation:

$$\boxed{\text{RH} = \frac{\text{Absolute Humidity of Sampled Air x 100}}{\text{Absolute Humidity of Saturated Air at Same Temperature}}}$$

In many buildings it is common to turn the temperature down in the evenings when people are not present as a sustainability measure. If you do this you may cause unacceptable daily swings in the RH. Turning down the heat to increase the RH may be beneficial to the collections if the RH is too low. However, turning down the heat in relatively damp conditions may increase the RH to the level where mold grows.

2. Why is dew point an important element of managing the museum environment?

Dew point is an important consideration in managing and maintaining a stable environment as it relates to RH. At a constant dew point, when temperature increases, RH decreases; when temperature decreases, RH increases. Raising or lowering temperature without accounting for dew point can lead to incorrect RH levels and create a risk of condensation. Humidifying the air raises the dew point and dehumidifying the air will lower it.[ii] Making such changes should always take structural constraints into account. If a structure is heated and humidified in the winter or air conditioned in the summer, the dew point created by the mechanical system can cause condensation to form in the walls. This is especially problematic in historic structures.

3. What is the relationship between temperature and relative humidity?

Relative humidity is related to temperature. In a closed volume of air (such as a cabinet, exhibit case or storage area) where the amount of moisture is constant, a rise in temperature results in a decrease in RH and a drop in temperature results in an increase in RH. For example, turning up the heat when you come into work in the morning will decrease the RH; turning it down at night will increase the RH.

In a closed system, relative humidity is* inversely *related to temperature (i.e., when the temperature goes up, the RH goes down; when temperature goes down, the RH goes up.)

Changing any one of these variables will impact the others, resulting in a change in the environment. The environment will seek equilibrium (a natural balance) when there is a change in temperature, RH, or dew point. Understanding this relationship allows you to manage your collections environment more effectively.

4. How do materials react to changes in relative humidity?

Most **organic materials** are hygroscopic. Hygroscopic materials absorb and release moisture to the air. The RH of the surrounding air determines the amount of water in organic materials. When RH increases they absorb more water; when it decreases they release moisture to reach equilibrium with the surrounding environment. Moisture equilibrium is relatively slow and can take days or weeks to complete. The amount of moisture in a material at a certain RH is called the *Equilibrium Moisture Content* (EMC). Over time, these reactions with water can cause deterioration. Refer to Appendix N: Curatorial Care of Wooden Objects for more information.

Most **inorganic materials** are not hygroscopic. They do not equilibrate with changes in RH as they do not naturally contain moisture. However, too much moisture in the air will cause mold growth, corrosion, and other damage to metals. Certain minerals such as salts will absorb moisture from the air, as will other inorganic materials.

5. What deterioration is caused by incorrect relative humidity?

Deterioration can occur when RH is too high, too low or fluctuating.

- **Too high:** When relative humidity is high, chemical reactions may increase, just as when temperature is elevated. Many chemical reactions require water; if there is a lot available, then chemical deterioration can proceed more quickly, such as metal corrosion, oxidation of iron sulfides, and hydration of minerals. High RH levels cause swelling and warping of wood and ivory. High RH can make adhesives or sizing softer or sticky. Paper may cockle, or buckle; stretched canvas paintings may become too slack. High humidity also supports biological activity. Mold growth is more likely as RH rises above 65%. Insect activity may increase. RH levels above 20% promote highly destructive oxidation in specimens containing microcrystalline iron sulfides

- **Too low:** very low RH levels cause physical damage including shrinkage, warping, and cracking of wood, ivory, teeth, bone and shell; shrinkage, stiffening, cracking, and flaking of photographic emulsions and leather; desiccation of paper, adhesives, and basketry fibers.

- **Fluctuating:** changes in the surrounding RH can affect the water content of objects, which can result in dimensional changes in hygroscopic materials. They swell or contract, constantly adjusting to the environment until the rate or magnitude of change is too great and deterioration occurs. Deterioration may occur in imperceptible increments, and therefore go unnoticed for a long time (such as cracked paint layers). The damage may also occur suddenly (for example, cracking of wood). Materials particularly at high risk due to fluctuations are laminates, constrained and/or composite materials such as photographs, magnetic media, veneered furniture, paintings, and other similar objects. Greater surface areas also put materials at a higher risk.

Become familiar with objects in your collection and how they may react to RH changes.

6. What is the recommended RH set point and fluctuation range for general collections?

NPS collections are made of a wide variety of materials that are located in many different climate zones, and that are housed in a range of structures throughout the U.S. Therefore, you should determine the set point for your collections by evaluating the nature of the materials in the collection, the space in which they are housed, and your local climate. Do this in consultation with your regional curator, a conservator or other expert in museum environments.

***The relative humidity set point for most NPS collections lies between 45 – 55 %. Ideally, fluctuations should not exceed ± 5% from the set point*.**

Figure 4.4. Recommended RH Set Point and Fluctuation Range for General Collections.

If you are in climate zone with distinct seasons, you may allow for a seasonal drift in your RH set point, yielding a total annual range of 40% minimum to 60% maximum. The fluctuations should not exceed ± 5% for each seasonal set point. Monitor environmental conditions and review the data monthly. See E.7 for information on seasonal drift. However, if you are located in an extreme climate, such as the arid Southwest, 35% RH [iii]could be the set point as objects will have equilibrated at much lower RH levels.

For example, if you are in Ohio you may determine that the set point is 50% with an allowable range of ±5%. The humidity could go as high as 55% or as low as 45% within a month.

Do not allow the RH to go as high as 65% as mold might develop. Below 35%, certain material (teeth, bone, and shell) may become brittle, crack, and spall. See Figure 4.5 for the recommended RH levels for sensitive materials.

Wherever your collections are located, keep RH within the permissible range and avoid abrupt fluctuations to promote long term collections preservation.

Consult your regional curator or a conservator to determine your set point. Monitor environmental conditions and evaluate the data regularly. Also monitor the condition of the objects. If climate induced damage is observed, implement improvements. The greater and more prolonged the RH fluctuation outside the allowable range, the greater the risk to collections. There are many ways to limit fluctuations, not all dependent on having an expensive mechanical system. For example, good climate control is achievable by housing collections in well-constructed and sealed storage and exhibit cases within a well maintained building envelope. These will buffer the interior contents from RH fluctuations. Good enclosures also help protect collections during shut-downs or failures of mechanical systems as well as protecting against other agents of deterioration. See Figure 4.1.

For collections housed in historic structures, work with facilities management to achieve and maintain an optimal set point and a permissable range. House sensitive materials with different requirements separately from the general collections. See Figure 4.5 for the recommended RH levels for sensitive materials.

If you are planning to build a purpose-built storage facility or exhibit gallery to house sensitive collections, for more specific design parameters, refer to the American Society of Heating, Refrigeration and Air-Conditioning Engineers [ASHRAE] *Handbook*-HVAC Applications, Chapter 23, Museums, Galleries, Archives and Libraries (www.ashrae.orga) and the PAS198:2012 Specifications for managing environmental conditions for cultural collections published by the British Standards Institution.

7. What is seasonal drift?

Over the year you may want to allow the set point to vary or drift with the seasons**.** Drift means that your set point varies in different seasons; usually higher RH in the summer and lower RH in the winter. Allowing drift will often reduce energy costs over the long-term as mechanical systems work less to maintain the appropriate environment. These variations should be gradual, taking place over weeks and months and should not exceed the recommended fluctuation limits. They should not be brief and variable. For collections housed in a historic structure, allowing for seasonal drift is likely to contribute to the preservation of the structure itself.

8. What is the recommended RH range for sensitive materials?

House sensitive materials separately from the general collections, such as in another storage space or cabinet. For sensitive materials, see the Figure 4.5 below.

Material Type	**Relative Humidity**
Unstable or corroding metal Stable metal	<15% <35%
Teeth, bone and shell	30 – 55% (lower than 30% can result in mechanical damage)
Naturally mummified animal remains	15 – 20%
Stable pyrite and pyritic specimens Unstable pyritic specimens	<45% <20%
Freeze dried specimens	<40%
Plastics	30 – 45% (See *COG* 8/4 for additional recommendations)
Most photographic materials	30 – 40% (if housing photographic materials within a general area. See E.5 for photographic storage standards.)

Figure 4.5. Optimum RH Ranges for Sensitive Materials

Materials recovered from archeological sites may need to be housed within special RH ranges. The condition of these objects depends on their equilibration to the conditions in the surrounding soil. Once excavated, these materials have to adjust to a new and different environment. See Appendix I: Curatorial Care of Archeological Objects for more information. For objects on exhibit, see *MH-III,* Chapter 7, Section I, Preserving and Protecting Objects in the Exhibit Process.

G. Monitoring and Analyzing Temperature and Relative Humidity

1. Why should I monitor and evaluate temperature and relative humidity?

Ongoing monitoring and evaluation of temperature and RH enables you to understand the environment in your storage and exhibit spaces over time. It allows you to:

- establish a baseline of temperature and RH to see if the spaces housing collections are providing an optimal environment
- identify temperature and RH variations in areas housing collections
- monitor equipment to be sure it is working properly, including making sure that data loggers are properly calibrated
- establish how the internal climate performs in relation to the local climate through different seasons over time
- determine and then take the appropriate action to lower the risk of damage to collections when recommended temperature and RH levels are exceeded
- develop and implement a climate control strategy to improve the overall environment, including implementing non-mechanical and "low tech" solutions where possible determine whether your strategy is working

2. What kind of monitoring equipment should I use?

Most dataloggers provide information on temperature and/or RH in real time as they occur. They are small and can easily be placed in storage areas, cabinets, exhibit cases, furnished historic structures, shipping crates, and other area where collections are located.

Other equipment used to measure and/or record temperature and RH, includes hygrothermographs, hygrometers, psychrometers and humidity indicator strips. However, dataloggers make for convenient and efficient recording and analysis of temperature and RH. See *COG 3/3*: "Comparing Temperature and Relative Humidity Dataloggers for Museum Monitoring (Revised)" for more information.

3. Where should I place dataloggers to monitor the environment?

Use dataloggers to set up a monitoring program to better understand your collections environment. Place dataloggers in different locations, such as the basement, and first and second floors of a furnished historic structure. This will allow you to gather data to evaluate conditions in the spaces housing collections. Also place dataloggers inside selected storage cabinets and exhibit cases to monitor how well these enclosures maintain a stable environment. Place the datalogger away from the windows, vents, air intake units and other sources of heat, cold and light to prevent incorrect readings. Keep in mind the thermal gradient within a room and place dataloggers at different heights. Also place dataloggers in areas or containers that provide microclimates for sensitive materials. Make sure dataloggers are calibrated.

Install dataloggers into spaces before introducing collections to better understand the environment. Monitor for at least a year before moving collections into the space, and then do ongoing monitoring. If possible, install a datalogger outside to monitor temperature and RH outside the structure or obtain readings from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center web site for climate data.

4. What data should I collect to manage the collections environment?

Collect information from daily, weekly, monthly and annual readings and keep a parallel record of observations, noting seasonal variations, abnormal occurrences, such as exterior climatic conditions, a leaky roof, re-calibration of equipment, or an unusual visitation pattern. Use this information to evaluate your local climate, identify short-term and long-term impacts on the collections environment and compare data across seasons and visualization of long-term trends.

Retain the information collected, such as datalogger graphs in order to assess building and HVAC performance over time. Review and evaluate data regularly. When evaluating data, consider the following variables and how they affect the collections environment:

- quality, condition and components (such as a vapor barrier, insulating value of windows) of the building envelope housing the collection
- staff activity
- public visitation
- local climate
- events such as leaks that affect RH and temperature
- HVAC equipment performance or failure
- condition and accuracy of the monitoring equipment

Then determine:

- if temperature and RH levels are stable and within the recommended set point and permissible range
- which spaces have the most stable levels, and why and how those conditions can be replicated to obtain stable levels in other spaces housing collections

Monitoring and evaluating data allows you to:

- make informed decisions on how to control temperature and RH
- identify and respond to problems in your collections environment
- group and house collections based on most suitable available environmental conditions
- evaluate whether changes you have made are improving the environment
- assess future priorities
- build an argument about the need to get environmental upgrades or a new building

H. Methods of Controlling Temperature and Relative Humidity

1. What steps should I take to control and maintain a stable climate?

Follow the steps outlined below to control and manage temperature and RH in order to provide a stable environment for your collections.

- **Gather information**

An effective climate control strategy is based on reliable information gathered on an ongoing basis about your collections, spaces housing collections, the building envelope, interior environment, and the local climate. Collect data for a minimum of one year before establishing an optimal set point. Do ongoing monitoring and evaluation, and take appropriate actions to maintain optimal conditions.

- **Determine acceptable temperature and RH set points**

Determine your temperature and RH set points after evaluating the:

– nature and condition of the materials in the collection

– nature and condition of the structure housing the collection

– local climate and seasonal variations

– events that influence the interior climate such as leaks, HVAC malfunction, rain, wet mopping, or unusual or excessive visitation patterns

– ability of non-mechanical and mechanical systems and/or equipment to maintain the temperature and RH set points and allowable fluctuations

– ability of staff to maintain equipment

Be aware that the narrower the range (both temperature and RH), the greater the building environmental equipment, maintenance and operation cost.

- **Use a team approach to control and manage your museum climate**

Assemble a qualified team to carefully plan and implement a climate control strategy. Work with your regional curator, facilities management, a conservator and mechanical engineer with museum climate expertise. As needed, consult a historic architect on all aspects of the strategy, and its implementation and commissioning. The strategy should keep energy costs in mind.

- **Implement non-mechanical measures to control climate when and wherever feasible**

Non-mechanical methods described in this chapter will greatly contribute to stabilizing your collections climate. These controls do not require installing fixed mechanical systems and can aid in reducing energy costs. Take the structure and local climate into consideration when developing a non-mechanical and sustainable control plan. Monitor regularly to insure that these controls are effective and adjust accordingly.

- **Maintain the building envelope**

A well sealed and maintained building envelope excludes and/or minimizes the impact of climate events, and temperature and RH extremes. In consultation with maintenance, examine the structure and spaces housing collections to identify possible sources of moisture and air seepage, and work to correct these problems.

Sources of high RH levels include:

- leaking roof, ceiling, or windows
- gaps in walls, floors, or foundation vapor barrier
- dirt cellars
- seepage or cracks in and around windows and doors
- leaking plumbing
- damaged gutters and downspouts

- wet walls and foundations from poor drainage

- open water sources such as sinks or toilets

- vegetation that grows on or next to exterior walls

- **Moderate and/or control the interior environment by implementing non-mechanical or "low tech" solutions for objects on exhibit and in storage**

– Separate collections storage areas from work spaces and areas where people are likely to gather.

– Limit the number of visitors in spaces housing unenclosed objects such as in furnished historic structures. Large groups of people can raise the RH from moisture introduced by breathing and perspiring.

– Locate electronic equipment outside the collections area to prevent additional heat buildup.

– Exclude or block windows in storage areas to minimize temperature and RH fluctuations.

– Install double glazed windows, U-value windows (with thermal resistance and insulating properties) and interior storm windows (with UV blocking capability) to buffer against temperature and RH extremes and fluctuations while blocking UV. For historic structures, consult with a historic architect and the regional curator when considering this step.

– Exclude or block natural light in storage areas

– Block and/or filter natural light in exhibit galleries and furnished historic structures.

– Install blinds, curtains, drapes, and/or exterior shutters as appropriate to minimize heat buildup from sunlight. Use these coverings to block UV in historic structures.

– Use LED lighting where possible to avoid heat build up and exposure to UV.

- **Containerize objects**

– House objects in well sealed and constructed cabinets, cases, including exhibit cases, boxes, folders and enclosures to buffer temperature and RH flucturations, and limit light damage and help protect collections from pests.

– Develop separate storage zones to accommodate the different environmental needs of collections. Housing objects that require cooler or dryer conditions separately will enhance efficiency by maintaining a specific target climate range.

– Create microenvironments to house sensitive objects (such as some metals, textiles, paper, pyritic minerals, and fossil specimens) that require a specialized RH level.

- **Moderate areas adjacent to the building envelope**

Trees immediately adjacent can help moderate the interior environment by providing shade in the summer and permit the passage of sunlight in the winter. However, be aware that vegetation that is too close to a structure may habor museum pests and also elevate local moisture levels.

- **Do ongoing monitoring and evaluation**.

Continue on-going monitoring and data evaluation to determine how well your strategy is working after implementation, to identify trends and problems, and to take appropriate actions to maintain optimal conditions.

2. How do sealed cabinets help stabilize the collections environment?

Housing objects in well designed and constructed sealed steel cabinets and cases will buffer against temperature and RH extremes and fluctuations. They provide an effective, low cost and sustainable way to create a stable environment. In a temperate climate, a well-sealed cabinet interior can provide a stable RH between 45% and 55%. See Figure 4.1. Continue on-going monitoring to ensure that the target climate within cabinets is being maintained.

Certain climate sensitive materials such as metal require temperature and RH levels that the structure or space cannot readily maintain. House these objects in separate spaces or cabinets, or a specialized microclimate. This approach allows you to house sensitive materials at specific temperature and/or RH ranges that cannot be easily maintained within general collections areas and in historic structures. Examples include:

- freezer storage for cellulose nitrate film and other photographic materials
- sealed dry storage containers for metals and other materials that require low RH
- humidity-buffered and temperature controlled cases that house fragile organic and inorganic materials

temperature-controlled vaults for manuscript collections

- prefabricated insulated modular structure for storing collections in a historic or adapted structure

For more information, see *MH-I*, Chapter 7, Museum Collections Storage and Appendix T: Section D. 8, What storage systems will best protect my park's biological collections?

3. What is humidity buffering?

Many materials in a museum environment absorb water and give off water. These materials can slow RH changes and *buffer* the environment around the object to minimize damage. Certain organic materials (cotton, paper) are effective at buffering. Use these materials to help limit changes in an environment. By wrapping an object in a layer of unbleached muslin or paper and/or including buffering material such as silica gel packets within a well-sealed cabinet or exhibit case, you can provide a local climate for sensitive objects. Refer to *COG* 1/8: "Using Silica Gel in Microenvironments" for guidance on using silica gel. Discuss various options with a conservator.

4. What is an active or mechanical control system?

An active or mechanical control system uses specialized equipment to alter the temperature and moisture content of the air. It includes systems for heating, cooling, humidifying and dehumidifying the air. A well designed fixed mechanical system can maintain optimal temperature and RH levels, circulate air, and filter particulates and gases from the air.[iv]

Installing a well-designed heating, ventilation and air conditioning (HVAC) system to achieve and maintain appropriate RH and temperature levels, and filter particulates and gases from the air as described in this chapter can be challenging. In some cases, especially with historic structures, this approach may be detrimental to the structure itself.

Before embarking on a program to install, upgrade, or design a new HVAC system, assemble a team of experts and plan a system that protects both the collections and the structure housing the collection. Choose team members with expertise in collections care, historic structure preservation, and mechanical, electrical, and structural engineering. Information from your ongoing monitoring program allows your team to design a practical system that will preserve both the collection and the structure, as well as identify and address, on an ongoing basis, issues and needs of your climate control system.

Note: Use non-mechanical controls whenever possible and evaluate performance *before* adding a supplemental mechanical system.

5. Can I use portable mechanical equipment to control temperature and relative humidity?

In some cases, you may choose to use portable humidifiers, dehumidifiers, heaters, and air conditioners. They are especially helpful in historic structures that cannot readily or should not accommodate an HVAC system. In the short-term, this equipment can improve the environment in a space holding collections. It is less expensive and invasive than installing a new HVAC system. Portable equipment can be used to create different climate zones within a space.

Be aware that portable equipment requires regular operation attention to add water (such as a portable humidifier) or have the water reservoir (such as portable dehumidifiers) regularly emptied. They must be closely monitored to prevent water damage or electrical fires and should be regularly cleaned. Consult a specialist to establish what is appropriate for the structure. Work with your team of experts to identify the most appropriate solution to your climate control issues. See H.8, Who should be involved in planning for an HVAC system?

- **Humidifiers** add moisture to the air. Use a humidifier in the winter to counteract the drying effect of a central heating system. Only use an unheated evaporative humidifier. This type of humidifier does not disperse minerals in the air, and if the humidistat (a switch that turns off the equipment when a certain RH is reached) malfunctions, it will not raise the RH level above a set point, such as 65%. Be aware that these humidifiers can increase moisture that may condense on surfaces such as cabinets, doors, windows, and walls. Consider adding an evaporative section with "face and bypass" dampers onto the air handling system to more closely control the space conditions.

- **Dehumidifiers** remove moisture from the air and lower the RH. Do not use this equipment as a permanent corrective measure. Instead, find out why the air is so damp and work to remove the source of the water or moisture.

Be sure air is well circulated when using portable equipment. Fans may be needed for circulation. In consultation with a mechanical engineer, select the size and number of dehumidifiers and humidifiers based on the size of the space, the air exchange rate, differences between the inside and outside of the building, and the number of people using the room. See *Preservation Brief* 24, "Heating Ventilating, and Cooling Historic Buildings: Problems and Recommended Approaches" for more information.

6. What are humidistatically controlled heating and ventilation systems?

Humidistatic control is a way to automatically control RH in a building by taking advantage of the inverse relationship between temperature and RH. Humidistatically controlled heating is based on the principle that it is possible to maintain a stable RH by manipulating and varying the temperature.

A humidistat sensor adjusts the temperature up and down to maintain a stable RH. If the RH rises above a set point, the heat is turned on until the RH drops back down. However, using this system, temperatures can drop very low or rise very high, so this type of environmental control system is best used in areas that are infrequently accessed and that do not house any sensitive objects.

Humidistatically controlled ventilation is used in areas with high or low relative humidity. If interior RH is lower than exterior RH, dampers are opened by sensors and the air is circulated through the building. If exterior RH is too high, the dampers remain closed. N**ote:** This type of system is designed for building protection only.

Both of these techniques may be cost effective ways to improve the environment in historic structures that were not built to house museum collections. If you are considering using humidistatic controls work with an engineer or architect who has experience with this type of equipment and with a conservator as collections are present. **Note:** This type of control is not well suited for human comfort.

7. What is an HVAC system?

A heating, ventilation, and air-conditioning (HVAC) system is responsible for moving air through a structure and setting the desired temperature and RH. HVAC systems can be imagined as a continuous loop of air that moves into and through an enclosed space before returning to its starting point, where properties of the air are changed to maintain the desired climate conditions in the spaces.[v] HVAC systems manage moisture by controlling the dew point within a structure and managing the air that enters the structure. These systems can both humidify and dehumidify the air.

- **Humidification.** There are two types of humidifiers used in air handling systems:

– *Steam humidifiers* in which a heat source is used to evaporate the water and add it directly to the air

– *Evaporative humidifiers* in which the air to be humidified is used as the heat source to evaporate the water and add it directly to the air. Because the air itself is the heat source for evaporation, this type also cools the air as it adds moisture.

- **Dehumidification.** Dehumidification can be accomplished in two ways:

– *Refrigerant dehumidifiers* work on the same principle as a refrigerator by cooling and reheating the air. Cooling the air lowers the vapor pressure of the water vapor causing it to condense within the machine. When air hits a cool coil, the moisture in the air condenses and it reaches a relative humidity of 100%. The air is then reheated to bring RH down to an appropriate level.

– *Desiccant dehumidifiers* force air through a moisture-absorbing material (like lithium chloride) to absorb moisture. In a separate step hot air is blown over the desiccant to regenerate (dry) it.

8. *Who should be involved in planning for an HVAC system?*

Use a team approach when planning to install or upgrade an HVAC system. Consult with the park maintenance staff, regional curator, preservation specialist, conservator, and mechanical engineer with experienced in installing HVACs in museums. In consultation with these specialists, develop the HVAC system that includes installation, commissioning and long term maintenance of the system.

Monitor and evaluate the climate within the structure for at least a year to determine if a new or upgraded HVAC is necessary.

9. *What is HVAC system commissioning and when is it necessary?*

Commissioning an HVAC system allows you to determine whether the system is maintaining the target RH and temperature set points and if it is staying within allowable fluctuation ranges. To commission a new HVAC system you need to closely monitor and evaluate its performance for at least one year after installation. This will allow you to evaluate how the system performs through different weather conditions, seasons, and operating conditions. Commissioning ideally begins early in the design process and ends well after installation.

Be sure to include a defined commissioning period such as a year, in your purchase document and maintenance agreement, as well as a requirement to correct any system deficiencies or problems that present during the commissioning period.

System performance requires ongoing, monitoring and evaluation for the life of the system to ensure that it functions properly, maintains a stable climate with the set points and allowable fluctuations that you established, and that it responds appropriately to environmental changes.

10. *What is the advantage of using a prefabricated modular structure?*

A prefabricated modular structure is a well-sealed; often vapor tight, highly insulated structure that can be constructed within a larger space to maintain levels of temperature and RH that would otherwise be unsuitable for the surrounding structure. If a structure cannot maintain the temperature and RH levels required for preserving an entire collection, consider storing the collection in a prefabricated modular structure. This method is especially advantageous for historic structures.

Make sure that the structure will be able to withstand the added weight of a prefabricated modular structure. See *COG* 4/7: "Museum Collection Storage Space: Is an Insulated Modular Structure Right for your Collection?" for more information. Monitor, evaluate and commission the system as you would an HVAC system. If the non-mechanical controls are insufficient, implement a mechanical system to create the appropriate climate. See *COG* 4/8: "Selecting Environmental Control Systems for Insulated Modular Structures" for more information.

11. *What is the time-weighted preservation index (TWPI)?*

The time-weighted preservation index is a mathematical model developed to estimate how long some organic materials will last at certain temperature and RH levels

The TWPI was developed specifically for paper-based collections and is more commonly used for archives and libraries. It may not be appropriate for mixed collections found in many NPS parks. Its use in various types of collections is being researched. Consult with a paper conservator to determine if it is appropriate to use for storage of your paper and photo collections that are housed separately from the general collections. The TWPI allows you to make educated decisions choosing a set point for RH and temperature for certain types of collections, such as paper materials. For more information, see the Image Permanence Institute's preservation metrics web page.

I. Light

Light is an agent of deterioration that causes irreparable damage to museum objects. It causes fading, darkening, yellowing, embrittlement, stiffening, and many other chemical and physical changes. This section gives an overview of the nature of light. It provides lighting standards for museum objects and information on how to prevent damage caused by natural or artificial light to your collections. It includes sections on how to monitor and control lights, as well as equipment and techniques on how to document and interpret monitoring data.

Damage to all museum objects that results from exposure to light, even at low levels, is cumulative and irreversible. Many materials, including organic materials are particularly sensitive to light damage, such as paper, inks, feathers, furs, leather and skins, photographs, textiles, works on papers and wooden objects. Objects on exhibit in furnished historic structures and visitor centers are at great risk of light damage. Typically, these structures have many windows and objects on display in historic structures are usually not contained within a protective enclosure. Follow recommendations outlined in this chapter to avoid and mitigate damage that results from exposure to light.

Consult with a lighting specialist and conservator when developing a lighting plan for collections housed in exhibit galleries and furnished historic structures.

1. *What is light?*

Light is a form of energy that stimulates our sense of vision. This energy has both electrical and magnetic properties, and is known as electromagnetic radiation. To help visualize this energy, imagine a stone dropped in a pond. The energy from that stone causes the water to flow out in waves. Light acts the same way. We can measure the "wavelength" (the length from the top of each wave to the next) to measure the energy of the light. The unit of measurement is the nanometer (1 nanometer [nm] equals 1 thousand millionth of a meter).

The spectrum of electromagnetic radiation can be divided into parts based on the wavelength:

- **Ultraviolet (UV)** on one end has very short wavelengths (300 - 400 nm) and high energy. UV is not visible to the human eye.
- **Visible light** portion of the spectrum lies between UV and IR, with longer wavelengths between 400 – 760 nm. Humans can see light in this band of the spectrum.
- **Infrared (IR)** wavelengths on the other end of the spectrum starts at about760 nm. We perceive IR as heat. It is not visible to the human eye.

While UV radiation is the most damaging to museum objects, visible and IR radiation also cause damage to museum objects. Light damage is irreversible and cumulative.

Different light sources contain varying amounts of UV, visible light and IR. Daylight or natural light contains all three. Many types of museum lighting (daylight, fluorescent lamps, fiber optics, and quartz tungsten-halogen lamps) emit varying degrees of UV radiation. Development in lighting technology has made it possible to light objects without exposure to UV, such as light-emitting diodes (LEDs). See Section J.8, What are the advantages and disadvantages of using light-emitting diodes (LEDs)?

The energy in light reacts with the molecules in objects causing physical and chemical changes. Because humans only need the visible portion of the spectrum to see, we can limit the amount of energy that contacts objects by excluding UV and IR and minimizing visible light that reaches objects from light sources. Equipment, materials, and techniques are widely available to block, eliminate or reduce these agents of deterioration and that are described in this section.

Eliminate all UV in spaces housing museum objects on exhibit, in storage, and in work areas.

2. *How is light measured?*

The strength or intensity of visible light is referred to as the *illumination level* or *illuminance*. Illuminance is measured in *lux* or *foot-candle*. *Lux* is the amount of light flowing out from a source (candle) that reaches and falls on one square meter. *Foot-candle*, the English or Imperial measurement, is one lumen per square foot. One foot-candle equals about 10 lux. Museums use lux or foot-candles as units of measure.

Illuminance is measured in museums because we are concerned with the *light energy that falls on objects*, not how much light energy comes from the source. When measuring light levels (see Section G), hold the meter at the surface of the object to catch the light that is reaching that surface.

UV is measured in units of microwatts (of UV) per lumen (of light), abbreviated to µwatts/lumen. While museums use lux or foot-candles as units of measure, it can also be measured in milliwatts per square meter. This ratio indicates the power of UV relative to the quantity or intensity of visible light. To avoid damage, eliminate all UV radiation with emissions below 10 µwatts/lumen (10 mW/l). This can be achieved by blocking natural radiation completely and by using UV filtration and absorption materials. See Section J, Monitoring and Controlling Light for more information.

3. *What deterioration does light cause?*

When light shines on an object, physical and/or chemical changes begin to occur on the exposed surface. Energy from light breaks molecular bonds or rearranges atoms in an object, chemically altering it. As the object's molecules absorb the light energy, the change that occurs is known as photochemical deterioration.

Ultraviolet radiation, the shorter the wavelength (*Ultraviolet [UV]* within the spectrum), the more energy in the light, and the more damaging to objects. This damage can be rapid and severe, or slow and slight. Even small amounts of light will cause irreversible and cumulative damage**.** Some examples of irreversible light damage include:

- Discoloration, including yellowing and fading
- weakening and embrittlement

Infrared light raises object temperature, increasing the speed and frequency of chemical reactions, and should also be eliminated. If lighting is too close to, or focused on an object, IR can raise the temperature. It may also lower the water content of porous materials. There is heat buildup from:

- sunlight
- incandescent spotlights
- quartz halogen lights
- fluorescent ballasts
- lights in closed cases

Design exhibits so there is no heat buildup from IR generated by lights or lighting equipment. See Section J for ways to monitor light and protect collections from light damage.

4. *What are the light standards?*

Protect collections from damage caused by natural and artificial light by eliminating UV and IR, reducing the amount of light (minimizing visible light and keeping artificial light levels low.) The radiation standards for visible light levels, maximum annual exposure for visible light levels and UV levels for different materials are provided below.

Exhibit lighting requirements differ from storage lighting requirements. Objects on exhibit are exposed to light over time and visitors need to be able to see objects on exhibit.

Balance preservation concerns with those of providing visibility. However, preservation concerns must take precedence over access considerations to ensure that the object is available for future generations.

Consult with a conservator as you develop or update lighting for museum, visitor center and furnished historic interiors.

Visible Light Levels	**Materials**
50 lux (5 foot-candles) or less (For extremely fragile light sensitive objects, reduce exposure time by covering exhibit case and allow the public to 'peek')	*Extremely light-sensitive materials;* organic materials including, biological specimens, blue prints, basketry, books, drawings, dyed organic materials including plant materials (extremely fugitive pigments and dyes), feathers, fur, leather, manuscripts, paper, parchment, photographs (including albumen and tinted photographs), plastics, prints, tapestries, textiles, tortoiseshell, watercolors on any medium, wall paper, works of art on paper
100 lux (10 foot-candles) or less	*Light sensitive materials*; lacquer ware, tempera paintings, undyed organic materials (basketry, bone, horn, ivory, plant materials, teeth)
150 lux (15 foot-candles) or less	*Moderately sensitive materials*; paintings (oil, acrylics) furniture, objects with painted surfaces, polychrome panels, finished wood surfaces
300 lux (30 foot-candles)	*Non sensitive materials;* metals, stone, ceramics, some glass

Figure 4.6: Standards for Visible Light Levels (Source[vi])

5. *Does length of exposure to light matter?*

Even small amounts of light will cause damage to most materials. The rate of damage is proportional to the illumination level multiplied by the time of exposure. Therefore, it is essential for you to determine how much exposure an object on exhibit should be subjected to, and over what period of time. Use the Figures 4.6 through 4.8 to calculate how long an object should be on exhibit.

Limit damage from light by reducing the amount of light and the exposure time.

When considering light damage to an object, note that the rate of deterioration is directly proportional to the illumination level multiplied by the time of exposure. Think of it as an equation:

Deterioration = Level of Illumination x Exposure (Exhibit) Time

Expressing light damage as an equation demonstrates that to reduce deterioration, *both* the level of illumination and the duration of exposure must be reduced. When determining-how to limit damage to objects exposed to light, keep in mind the “reciprocity law that states:”

Low light levels for extended periods cause the same amount of damage as high light levels for brief periods.

A dyed textile or taxidermy mount on exhibit for six months will fade about half as much as it would if left on exhibit for one year under the same conditions. Some types of photochemically induced deterioration will continue even after an object is removed from light. See Section J for guidance on controlling visible, UV and IR light levels.

Calculate the exposure time using the following equation:

Duration of exposure x Intensity = Total Exposure

For example; 200 hours x 60 lux = 12,000 lux hours
60 hours x 200 lux = 12,000 lux hours

Maximum Annual Exposure for Visible Light Levels	**Materials**
55,000 lux hours (15 lux x 10 hours x 365 days)	*Extremely sensitive materials* such as blue prints, books, drawings, dyed organic materials
180, 000 lux hours (50 lux x 10 hours x 365 days)	*Sensitive materials* including organic materials (biological specimens, feathers, fur, leather, manuscripts, paper, parchment, photographs, prints, tapestries, textiles, tortoiseshell, works on

	paper, watercolors on any medium, wall paper), plastics
365,000 lux hours (100 lux x 10 hours x 365 days)	*Moderately sensitive* materials including lacquer ware, undyed organic materials (bone, horn, ivory, uncolored plant materials)
550,000 lux hours (150 lux x 10 hours x 365 days)	*Somewhat sensitive* materials including paintings (oil, egg tempera, acrylics) furniture, painted surfaces, finished wood surfaces
730,000 lux hours (300 lux x 10 hours x 365 days)	Metals, stone, ceramics and some glass

Figure 4.7. Standards for Maximum Annual Exposure for Visible Light Levels (Source[vii])

6. *How long should objects be on exhibit and at what light levels?*

Follow the exposure duration limit recommendations provided in Figure 4.8 when placing objects on exhibit. Include a rotation schedule so that objects do not exceed the recommended exposure guidelines.

Materials	**Exposure Duration Limit**	**Light Level**
Extremely light sensitive materials (1) albumen & tinted photographs, blueprints, extremely fugitive pigments & dyes, highly degraded paper & silk, pre-19th century Japanese prints with color	3 months over 5 years	5 footcandles (50 lux)
Extremely light sensitive materials (2) books, organic materials such as biological specimens, dyed basketry or other plant material, feathers, fur, leather, manuscripts, parchment, , paper (documents, works on paper, wall paper), paintings with organic pigments and dyes, plastics, tortoiseshell, historic photographs including carte de visite, tapestries, textiles in poor condition or with organic dyes, watercolors on any medium	6 months over 5 years	5 footcandles (50 lux)
Light sensitive materials organic materials including bone, horn, ivory, uncolored basketry or plant materials, teeth, paintings with mineral pigments, leather (dyed), pastels, textiles in good condition or with aniline dyes, lacquerware, tempera paintings	12 months over 5 years	10 footcandles (100 lux)
Moderately sensitive materials enamels, furniture and finished wood surfaces, leather (undyed), objects with painted surfaces, paintings (oil, acrylics)	24 months over 5 years	15 footcandles (150 lux)
Non sensitive materials; ceramics glass, metals, stone, metal and stone jewelry	unlimited	unlimited

Figure 4.8. Exposure Duration Limit Recommendations (Source [viii])

Consider the variables noted below before permitting objects to be exhibited or used in research, and take into account the following:

- light sensitivity of the object
- time of exposure
- light level
- type of use
- color and contrast of object

The human eye can adapt to a wide variety of lighting levels, so a low light level should not pose visibility problems. However, the eye requires time to adjust when moving from a bright area to a more dimly lighted space. This is particularly apparent when moving from daylight or brightly lit interiors into a darker exhibit area. When developing exhibit spaces, gradually decrease lighting from the entrance so visitors' eyes have time to adjust. Keep light levels below levels noted in Figure 4.6 through 4.8.

For example, if a researcher needs to examine fine detail in the weave of a textile, but will only be working on the object for a few hours, and the object is not fragile and rarely exposed to light, you can allow for a *slightly* higher level light to be used.

Light sensitive objects require very low light levels, short exposure times and no UV.

See Figures 4.6 - 4.8.for lighting standards and guidelines.

Note: Staying below these exposures levels does not prevent light damage. There is no minimum level where damage will not occur. However, managing light levels enables you to minimize risk somewhat while balancing collection preservation with accessibility.

J. Monitoring and Controlling Light

Ongoing monitoring, documentation and evaluation of light levels in all areas that house collections over time will allow you to take appropriate control actions. Monitoring and documenting light levels allows you to:

- identify areas of high light levels that need to be corrected
- determine what light levels are at different times of the day, during different seasons, and during various events

- take measurements when changing or installing new lighting fixtures to be sure the changes are within recommended levels

- be sure that light levels are at required levels and that UV blocking materials are still effective, that there is no IR and that visible light is appropriately controlled

1. *What equipment is used to monitor light levels?*

Monitor light levels using specialized equipment. Use a visible light meter to measure visible light and a UV meter to measure ultraviolet light. Use a thermometer to measure heat buildup from IR. Different meters are available for measuring visible and UV light from various vendors. Some dataloggers also include sensors for monitoring light.

- **Visible Light Meter***:* Use a visible light meter to measure visible light, namely, the visible portion of the electromagnetic spectrum. When purchasing a new meter, be sure to purchase one that measures in the standard unit, lux. The meter should be sensitive enough to measure light levels as low as 15 lux with a reasonable degree of accuracy (10% or better).

- **Ultraviolet Meter***:* Use a UV meter to measuring UV levels. These meters give UV readings in microwatts per lumen.

If a UV meter is not available, assume that unfiltered sunlight, fluorescent and quartz-halogen lamps emit unacceptable and destructive UV radiation.

Use a standard set of procedures when monitoring light levels with both meters. Aim the sensor toward the light source to catch the light hitting the object you are monitoring. Be sure no shadows from your hand or body are in the way. Make sure the sensor is parallel to the surface of the object and aimed toward the light source. If the object is larger than about one foot square, take several readings. Before using any equipment, read the manufacturer's instructions for operation and maintenance.

- **ISO's Blue Wool standard cards** can be used to measure light damage. They are specially dyed textiles made so that the most sensitive sample fades in half the time needed to fade the next most sensitive sample. There are eight samples to a set. You can use them in two ways:

  – Place one set of standards at the place you want to measure. Place another set in total darkness.

  – Secure aluminum foil over one half of a set of standards and put out in the places you want to measure.

  By comparing the two sets of standards, or two halves of one set, you can determine that light damage is likely at the levels/rates of deterioration measured. The standards will not help you estimate how much exposure to light a material will withstand in a particular situation. Blue Wool standards can be effectively used to bolster your case that light damage is occurring and that changes are needed to protect museum objects. They are available from conservation suppliers.

The *Light Damage Calculator* developed by the Canadian Conservation Institute allows you to estimate the fading of colors on selected materials that have been exposed to light.

2. What steps do I take to develop a lighting improvement plan?

Develop a lighting improvement plan for collections in storage and on exhibit. The plan includes the gathering of information and how to determine if a lighting problem exists, what the cause is, and what actions are needed to correct the problem, and determining if those actions were effective. Follow the steps below to develop a lighting improvement plan. Guidance on how to implement the plan is described in this section.

- **Gather information**

Document the following *lighting information*:

– types of existing lighting fixtures, ballasts, and filters

– movement of sunlight into the room(s) throughout the day

– seasonal variations in light

– events such as filming or photography

– location of light monitoring sites

– light exclusion and filtering materials and where they are installed

– gather baseline and ongoing lighting information

Document the following *collections information*:

– identify objects that are most susceptible to light damage and their level of sensitivity, such as paper, photographs, feathers and other organic materials

– optimal exposure time for material types

– how light may affect the objects once you have identified the types of light and variations in lighting

– floor plan for each exhibit or storage space that indicates the location of each monitoring site

– establish monitoring sites near susceptible objects and use these same sites for each monitoring session

– abandon monitoring old sites and establish new ones as conditions change

- **Evaluate monitoring data**

– do ongoing monitoring to make sure the plan is effective

– record data on the Light and Heat Measurement Record illustrated in Figure 4.9.

- **Take corrective actions and document**

– determine if corrective actions are effective

– Take appropriate action as needed

Use a range of methods and equipment to minimize the risk of light damage to your collections. Monitor and document light levels before and after taking any action to be sure that your changes have been effective.

3. How do I protect collections from light damage?

Use a range of methods and equipment to minimize the risk of light damage to your collections. Monitor and document light levels before and after taking any action to be sure that your changes have been effective.

- **Eliminate all ultraviolet radiation (UV)**

– Exclude exterior windows in new purpose-built structures that house collections

– Block windows in adapted spaces or structures that house collections.

– Install UV filtering material over all windows in furnished historic structures, visitor centers and exhibit galleries in consultation with a conservator and historic architect.

– Install glazed, double glazed, interior storm windows or U-value windows with UV filtering capability where appropriate.

– Use UV filtered or coated light sources.

– Use UV filtering glass or acrylic when framing documents and works of art.

– Take ongoing readings, including at different times of the day and various seasons, to ensure that UV blocking materials are still effective.

For information on UV filtering materials, see question 4 below.

- **Eliminate infrared radiation and/or heat buildup**

– Eliminate sunlight by eliminating or blocking windows in storage areas.

– Use window coverings and/or filters in historic furnished interiors, galleries and visitor centers.

– Do not use incandescent spotlights.

– Keep lights and ballasts outside exhibit cases.

– Use filters for artificial lighting to minimize IR build up.

– Keep light sources away from objects. If lighting is too close to or focused on an object, IR can raise the temperature. It may also lower the water content of porous materials.

– Use effective air circulation systems (such as fans and air conditioners) to help control heat buildup.

- **Mitigate and control daylight and artificial light**

– Lower light intensity and duration in exhibit and storage areas.

– Install light filtering materials on all windows and light sources. These include UV blinds or sheets of UV blocking glass. Do not use reflective films or tints in historic structures as they convey an inappropriate appearance

– Install window coverings such as blinds, shades, curtains, shutters, and exterior awnings.

– Locate objects on exhibit away from daylight sources such as windows.

– Light sensitive objects with fiber optics or LEDs. Do not use daylight to illuminate collections on exhibit.

– In areas where objects are displayed:

○ implement a schedule in consultation with interpretation and maintenance staff to keep blinds, shutters, and curtains drawn or lowered to prevent and/or minimize visible light from reaching objects on display.

  - Work with intepretive staff to ensure that windows are covered, particularly during period of intense sunlight/UV radiation, such as between 11am - 3 pm.
  - Keep curtains and blinds closed while visitors are not present.
  - As necessary, interpret a furnished historic room as an evening setting and provide intepretive information about traditional use of these coverings.

– Use:

  - opaque dust covers (such as cotton muslin or Gortex®) to cover light-sensitive objects
  - rugs to protect floor coverings.
  - dust covers when visitors are not present for extended periods. These are useful in storage areas and exhibit areas that are not open to the public for part of the year.

- **Minimize and control light intensity**

– Lower light levels and keep as low as possible. Follow lighting level standards in Section 4.4, Standards for visible light levels.

– Step electric voltage down, including bulb wattage, in consultation with facilities management.

– Replace lighting fixtures to block UV and IR build up by installing LEDs where possible.

– Use fewer fixtures where possible

- **Reduce exposure time to light sources**

– Limit exposure time in accordance with times noted in Figure 4.7. Standards for maximum annual exposure for visible light levels.

– Install motion detectors in work and exhibit areas that activate lighting only when people are present.

– Implement a regular exhibition rotation schedule for light sensitive objects on exhibit, no longer than 3 to 6 months under controlled lighting conditions. See question 8, What is the benefit of rotating objects on exhibit? for more information.

– Use reproductions of highly sensitive materials on exhibit.

House objects in closed cases and cabinets, enclosures, boxes, and folders to minimize light exposure in storage and work areas.

4. What kinds of UV filters can I use?

Several types of UV filtering materials can be used in storage and exhibit areas, and in furnished historic structures. Work with facilities management and consult with a historic architect to select the most appropriate materials for a furnished historic structure.

There is a wide range of UV filters that can be used on structures, exhibit cases and on framed works of art. They include:

– UV filtering glass or acrylic in windows and for framed works of art

– UV filtering double or secondary glazed windows

– UV filtering panels suspended or mounted over or in front of unfiltered glass that permit light penetration

– UV filtering interior storm windows

– UV filtering blinds, window shades or drapes for windows. Do not use film on historic windows as it may damage the historic glass. It also has a finite usage life and needs to be replaced on a regular schedule.

– UV filtered fluorescent tubes and filter sleeves for fluorescent tubes

Note: The plastic material that carries the UV filtering coating often breaks down faster than the filtering chemical. Replace filters periodically, and whenever they begin to turn yellow or crack. Monitor UV radiation at least every five years to be sure the filtering material is still effective.

Deploy an effective lighting system to protect your collection on exhibit. Work with a conservator to implement the best available lighting for your furnished historic structure.

See *Preservation Tech Notes*, Museum Collections Number 2, Reducing Visible and Ultraviolet Light Damage to Interior Wood Finishes, *COG* 3/10: "Choosing UV Filtering Window Films," *MH-III*, Chapter 7, Section H, Exhibit Conservation and Section I, Preserving and Protecting Objects in the Exhibit Process and J, Exhibit Case Design, Using Museum Collections in Exhibits, and the NPS Harpers Ferry Center, Exhibit Conservation web site.

Note: Balance access with preservation needs but make sure that preservation takes precedence to ensure that NPS collections are available for future generations.

5. What should I know about photography, flash photography, and photocopying and collections preservation?

Lighting used for photography, videography, and photocopy machines can cause excessive light exposure and heat buildup. To minimize damage, implement the guidelines noted below.

General photography and videography(filming)

- Avoid overheating objects with studio lights, especially light sensitive materials.
- Create a separate area or space for photography.
- Request heat absorbing light filters and be sure the area is well-ventilated with fans or air conditioners when photography is allowed in museum areas.
- Turn lights off whenever photography or filming is not taking place. If lighted rehearsals are necessary, use dummy objects until the final filming or photography will take place.

Flash photography and photocopying

Conservation research indicates that excessive flash photography and photocopying of light sensitive materials causes damage. Popular or iconic museum objects are likely to be heavily photographed or photocopied and therefore subject to fading and other damage. Certain materials such as handwritten documents, daguerreotypes and blueprints are particularly light sensitive.

You should:

- prohibit flash photography for light sensitive materials on exhibit
- limit photocopying of light sensitive materials

However, in order to provide access to these materials, make a master or reproduction images and/or photocopies readily available. See question 5 below.

For other non-light sensitive materials, flash photography can be permitted, as the exposure period is very short. Many museums permit photography but do not allow flash photography to avoid disturbing visitors. See *MH-III*, Chapter 6, Section D, Filming and Photography in Spaces Housing Museum Collections.

6. How do I limit damage from research use?

When collections, including objects, archival materials, and natural history specimens are used by researchers, they are exposed to light. Set up separate work spaces and research rooms so that your entire collection is not exposed to light when people are working with individual objects. Incorporate the following practices into research room use to limit the damage that occurs from this use.

- Develop procedures so that collection items are exposed to light only while the researcher is using them.

– House documents in containers, including boxes and folders.

– Remove objects from cabinets only when the researcher is ready to work.

- Limit the time the object is exposed to light and set a maximum lux level based on the object's sensitivty

- Limit the number of times an individual document can be photocopied. Create a copy of frequently requested archival materials and distribute as necessary.

- Take high quality photographs of frequently requested objects and make available in various formats, including online, as necessary.

- Limit the use of additional light sources, such a flash photography as noted question 4 above.

See *MH-III*, Appendix D: Planning a Research Space, and *COG* 19/7: "Archives: Reference Photocopying," and 4/14: "Planning a Research Space," for more information on limiting light damage from collection use.

7. What data should I collect to complete Light and Heat Measurement Record?

Complete the Light and Heat Measurement Record shown in Figure 4.9. Use building floor plans in conjunction with this record. Analyze the data from the Light and Heat Measurement Record and seek answers to questions below to determine how to minimize the damage from light. Consult the regional curator and/or a conservator when doing this evaluation.

- Which areas have acceptable levels of light for the objects?

- How long have objects been on exhibit in these areas?

- Do the objects on exhibit how signs of damage? Remember, not all damage can be detected by visual inspection.

- Which areas have light levels that are too high? Take corrective actions and determine whether these changes have helped. For example, if UV filtering blinds are installed over glass window panes, monitor for UV before and after installation

- Has the UV been eliminated? Has it reduced visible light?

- What are the light levels in storage?

- How often are collections in storage used? Where and how are they used? What levels and duration of light exposure do they normally receive?

- Can light levels be reduced in research rooms to improve preservation and still provide adequate access?

- How often are archival collections copied? Is there 'duplication master' so that originals do not have to be continuously copied?

- Are you maintaining and evaluating a record of the data you collect? This information will help you make a case for needed changes in lighting or removal of threatened objects. Keep a permanent file of all light monitoring data.

- How can I work with interpretation staff to minimize light damage to collections on exhibit in furnished historic structures, visitor centers and museums?

NATIONAL PARK SERVICE **LIGHT AND HEAT MEASUREMENT RECORD**					
Structure: *Family Home*					
Date	**Time**	**Location** (of object being measured)	**UV Reading (uw/ lumen)**	**LUX Reading**	**Room Temp eratu re**
4/26/2014	11:00 am	Wooden buffet in dining room opposite the bay window Comment: Cloudy day, sheers drawn over UV blind, drapes open	10	75	68
5/24/2014	11:30 am	Wooden buffet in dining room opposite the bay window Comment: Bright and hot, sheers drawn over UV blind, drapes closed	10	75	72
6/26/2014	11:15 am	Wooden buffet in dining room opposite the bay window Comment: Bright and hot, sheers drawn over UV blind, drapes closed	10	78	73

Figure 4.9. Sample Light and Heat Measurement Record

8. What is the benefit of rotating objects on exhibit?

Rotating objects on exhibit allows you to limit light exposure and thereby limit light damage. Create a rotation plan for light sensitive objects on exhibit in the museum, visitor center or furnished historic structure.

Consider the duration and intensity of exposure and the fragility of the material when developing the schedule. Certain materials, such as paper and textiles are extremely light sensitive and should be exhibited at 5 footcandles for short periods of time and rotated regularly. For example, display a rare historic handwritten letter in a UV free exhibit case for no longer than 3 months to avoid irreversible damage. A more robust document should be rotated off exhibit after 6 months, that is, it should not be on exhibit longer than 6 months. Display sensitive objects under low lighting levels.

If you are unable to lower light levels or need to have materials on exhibit beyond recommended times, arrange to exhibit facsimiles and reproductions in place of the museum object. Make fascimiles of extremely sensitive materials such as handwritten diaries or daguerretypes so as not to damage the original object. Use this as a opportunity to educate the public about object preservation by including this information in an exhibit caption or as part of the interpretive tour narrative.

See Figures 4.6 through 4.8 for recommended times and levels, and *MH-III*, Chapter 7, Section I, 4, How do I balance exhibit lighting with preservation requirements?

LEDs (light-emitting diodes) produce light through the movement of electrons through semiconductor material. LEDs are widely used in museums as they are energy efficient and sustainable, do not emit UV, and emit little or no infrared.

9. What are the advantages and disadvantages of using Light-Emitting Diodes (LEDs)?

Because they have a long life span compared to many other light sources, maintenance costs are lowered. LEDs provide immediate, full light when used with motion sensors, making them a viable option for less-used spaces. LED bulbs are point sources; they emit light in a specific direction, and provide effective lighting. Many lighting fixtures can be retrofitted with LED bulbs, while permitting retention of historic fixtures.

Advantages of using LEDs are noted below. LEDs:

- do not emit UV and very little IR.
- are energy efficient (they remain cool)
- use low voltage
- have a long life

- are durable
- do not contain mercury or other toxic chemicals
- are flexible and easy to install
- readily capable of focusing light on a specific location

Disadvantages of using LEDs include:

- LEDs can be problematic in true color rendering and rendered color may change over time.
- Before burning out, the light, which is initially white, begins to color shift, affecting the appearance of the space and objects on exhibit. Bulbs do not all color shift at the same time or to the same hue, potentially causing a rainbow of color over objects and artwork.
- Installation costs are high, including the high cost of bulbs and in replacing fixtures that cannot be retrofitted.
- LED bulbs often do not work with existing dimmer technology on fixtures.
- When bulbs burn out, some may flash on and off, which can be disturbing to visitors.

Consult with a conservator to select the appropriate LEDs for your specific use. Be sure to select a company with a long and well-documented warranty plan.

K. Particulate and Gaseous Air Pollution

1. What is air pollution?

Air pollution comes from contaminants produced both outside and inside museums. Contaminants can be airborne, transferred by contact, or contained (inherent) within objects themselves. All have the potential to cause or exacerbate damage to museum objects.

Common pollutants include: dirt, which includes sharp silica crystals; grease, ash, and soot from industrial smoke; sulfur dioxide, hydrogen sulfide, and nitrogen dioxide from industrial pollution; formaldehyde, and formic and acetic acid from a wide variety of construction materials, off-gassing of some plastics; ozone from photocopy machines and printers; and many other materials that can damage museum collections.

Air pollutants are divided into two types:

- **particulate pollutants** such as dirt, dust, soot, ash, molds, heavy metal dust, asbestos, and other fibers

- **gaseous pollutants** such as sulfur dioxide, hydrogensulfide , nitrogen dioxide, formaldehyde, ozone, formic and acetic acids

Exposure to these pollutants may also have adverse health impacts on staff. Engineering controls such as local exhaust ventilation or the use of personal protective equipment may be necessary to minimize exposure. Staff should be trained on the recognition and control of exposure situations. Refer to Chapter 11, Curatorial Health and Safety for more information.

See Figure 4.10 for a list of some common forms of deterioration by air pollution.

2. What deterioration is caused by particulate air pollutants?

Particulate pollutants are solid particles suspended in the air that come both from outdoor and indoor sources. These particles are mainly dirt, dust, mold, pollen, and skin cells, though a variety of other materials are mixed in smaller amounts. The diameter of these pollutants is measured in microns (1/1,000,000 of a meter). Knowing the particulate size is important when determining the size of air filters to use in a building.

Some particles, such as silica, are abrasive. In addition, pollen, mold, and skin cells can be attractive to pests. Particulates can interact with gaseous pollutants and cause deterioration in three different ways. Particulates may be:

- a source for sulfates and nitrates (these particles readily become acidic on contact with moisture)

- a catalyst for chemical formation of acids from gases

- an attractant for moisture and gaseous pollutants

3. What deterioration is caused by gaseous air pollutants?

Gaseous pollutants are reactive chemicals that can attack museum objects. These pollutants come from both indoor and outdoor sources.

Outdoor or atmospheric pollutants are brought indoors through a structure's HVAC system or open windows. There are three main types of outdoor pollution:

- sulfur dioxide (SO_2) and hydrogen sulfide (H_2SO) produced by burning fossil fuels, sulfur bearing coal, and other organic materials

- nitrogen oxide (NO) and nitrogen dioxide (NO_2), produced by any kind of combustion, such as car exhaust as well

- ozone (O_3), produced by sunlight reacting with pollutants in the upper atmosphere

When sulfur and nitrogen compounds combine with moisture and other contaminants in the air, sulfuric acid or nitric acid is produced. This acid then causes deterioration in a wide variety of objects. Ozone reacts directly with the objects causing deterioration.

Indoor air pollution generally comes from new construction and building materials as well as new office furniture and other sources such as:

- wood, which can release acids
- plywood and particle board, which give off acids from wood and formaldehyde and acids from glues
- unsealed concrete, which releases minute alkaline particles
- some paints and varnishes, which release organic acids, peroxides, and organic solvents
- fabrics and carpeting with finishes, such as urea-formaldehyde, and wool fabrics that release sulfur compounds
- glues used to attach carpets, that can release formaldehyde
- plastics that release plasticizers and harmful degradation products such as phthalates and acids
- electric or light equipment, such as photocopy machines, printers, and some air filtering equipment, which release ozone.

Museum objects themselves may also contribute to indoor air pollution. For example, many plastics are inherently unstable and as they deteriorate they can give off acidic by-products, such as cellulose nitrate and diacetate plastic, used for film. See *COG* 8/4: "Care and Identification of Objects Made from Plastic" for more information. Other sources of pollutants from museum objects include:

- celluloid and other unstable plastics used to produce many 20th-century objects
- pyroxylin impregnated cloth used for book bindings
- residual fumigants and pesticides, such as ethylene oxide
- wool can release sulfur that will tarnish silver

Object Materials	Deterioration	Primary Air Pollutants	Environmental Factors Accelerating Damage
ceramics	damaged surface	acid gases	moisture
leather	weakening, powdered surface	sulfur oxides	mechanical wear
metals	corrosion/tarnishing	sulfur oxides and other acidic gases	water, oxygen, salts
paint	surface erosion, discoloration	sulfur oxides, hydrogen sulfide, ozone, particulates	water, sunlight, microorganisms
paper	embrittlement	sulfur oxides	moisture, mechanical wear
stone	surface erosion, discoloration	sulfur oxides and other acidic gases, particulates	water, temperature fluctuations, salt, vibration, microorganisms, carbon dioxide
textiles	weakened fibers, brittleness, soiling	sulfur oxides, nitrogen oxides, particulates	water, sunlight, mechanical wear
textile dyes and pigments	fading, color change	nitrogen oxides, ozone	sunlight
shell, eggshell	efflorescence or breakout of salts, “Byne’s Disease”	acetic and formic acid	moisture

Figure 4.10. Deterioration of Museum Objects Caused by Air Pollution

L. Monitoring and Controlling Particulate and Gaseous Air Pollution

1. How do I recognize particulate and gaseous air pollution?

As with other agents of deterioration, monitor to identify whether or not air pollution is causing damage to collections that are in enclosed or open storage, on exhibit, or in transit. Take the following steps to identify and understand air pollution levels:

- **Inspect storage and exhibit spaces** (such as floors, open shelving, tops of cabinets, cases and tablesin addition to polished surfaces such as piano tops.) for dust. Note how much dust has built-up since the last cleaning. Watch for increased insect activity using your IPM program. Increased insect activity is often related to an unacceptable accumulation of dust.

- **Observe and note active corrosion on metal objects** for pollution from chlorides in coastal areas Chlorides will react with unpainted iron or steel objects, causing rust. In highly trafficked, industrial and some mining areas, sulphides will react with silver and copper to cause tarnish, and lead will corrode on exposure to acetic acid.

- **Observe and document a building's air control system and the nature of the structure**. Concrete walls and adobe are sources of high levels of dust. Some concrete dating from 1940-1975 contains asbestos, making it a health risk as well as a source of damaging particulates. Improperly filtered air intakes can transfer high levels of pollutants into museum spaces.

- **Identify exhibit cases, storage cabinets, and shelving** made out of unacceptable materials. These include untreated wood or painted wood that can offgas formaldehyde and acetic acid.

- **Monitor how much dust and dirt is tracked into spaces by visitors and employees.**

Also consider the surrounding air quality. Some parks have on-going air monitoring research, and you can contact the Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards to obtain information on levels of ozone, sulfur dioxide, nitrogen dioxide, and particulates recorded in the park. This data will assist park staff in identifying potential pollutant problems that may exist.

Areas with high concentrations of gaseous and particulate air pollution should establish a program for monitoring signs of active deterioration on objects in museum storage and exhibit areas.

2. How do I monitor air pollution?

There are several ways to monitor air pollutants in museums. Each method has advantages and disadvantages. Different pollutants may require different methodologies. Investigate the monitor types and evaluate the information you want to recover. Consult with your regional curator and a conservator and refer to *COG* 8/5: "Monitoring Off-Gassing of Plastics" and other resources in the bibliography for more information.

Oddy tests: Oddy tests were developed by conservation scientists to evaluate materials that are used in contact with objects in storage or on exhibit. In this test, metal coupons (small samples of different metals) are placed in a closed container with the material being tested and a small amount of moisture. The container is slightly heated and after a set amount of time, the metal is examined for corrosion. The test provides an indication of how 'safe' a material is and whether or not it will cause deterioration in your collection. Problems with this test include:

- unusual reactions - as heat and moisture are raised in the container, reactions may occur that would not happen in a normal museum environment

- little reproducibility since it relies primarily on visual indicators, making results from this test widely variable

Passive sampling devices: These are devices that absorb particular pollutants. They are placed in the area you want to test for a period of time, and then removed and sent to a lab to be tested for presence and levels of pollutants. Each passive sampling device measures one type of pollutant. For example, one device will measure for formaldehyde, another for acetic acid. However, there are problems with these devices:

- They may require off-site analysis.

- The devices have varying sensitivities. Use devices that can detect gaseous pollutant in parts per billion (1:1,000,000,000 ppb) or lower levels.

A-D strips. These strips detect acetic acid. They were developed to detect and measure acetate film deterioration, or "vinegar syndrome," in film collections. They change color as the level of acidity increases. They are used to set priorities for film reformatting.

When monitoring for contaminants, take human health impacts into consideration. If there is concern about effects on museum objects, the effects on the museum staff should also be considered. Contact your safety officer or Bureau industrial hygienist for questions about personal exposure monitoring. If you believe direct measurement is needed, contact your regional curator for assistance.

3. *How do I minimize and control air pollution?*

Eliminate gaseous and particulate pollution to the lowest practical level. Do the following to reduce levels of air pollution:

- Keep areas housing collections clean and prevent dust accumulation by implementing a museum housekeeping plan that includes:

– Use high efficiency particulate air (HEPA) vacuums which trap more particulates. Regular vacuum cleaners exhaust many smaller particles into the air. See *MH-I*, Chapter 13, Housekeeping chapter and *COG* 1/6: "Choosing a Vacuum Cleaner for Use in Museum Collections."

– cleaning, and vacuming floors, tops of cabinets and exhibit cases in storage and exhibit areas

– keeping work surfaces clean

– work with custodial staff to keep all areas clean

- frequently clean tour routes to reduce dust deposition on objects
- for gaseous pollutants (SO_2, ozone, formaldehyde, organic acids, etc.) consider carbon filtration.

- Separate office and curatorial work spaces from museum collections storage spaces. Areas that are not frequently accessed usually stay cleaner than high traffic areas.

- Place door mats at appropriate doorways, in particular, from the outside, to minimize tracking dirt into storage and exhibit areas. Clean mats regularly.

- Upgrade and maintain seals and weatherstripping around doors and windows to keep pollutants and pests out. Install door sweeps on doors where weatherstripping is impractical.

- House all objects, particularly, sensitive objects in well sealed and constructed exhibit cases and storage cabinets. Maintain sound gaskets on all storage cabinets. See resources in the bibliography for more information.

- Store archival materials in museum quality boxes, map cases, and folders.

- Use dust covers to protect objects on open shelving. Dust cover material should be chemically and physically non-damaging and provide as complete a dust seal as possible, while allowing easy access. Use clear polyethylene sheeting, unbleached cotton muslin, Tyvek®, or Gore-Tex®. See *COG* 4/2: "Dust Covers for Steel Shelving," for more information.

- Separate objects that offgas pollutants (such as cellulose nitrate negatives or objects, diacetate negatives, or hardwoods such as oak, birch or beechwood) from other objects. Store silver that is wrapped in acid -free tissue and then placed in anti-tarnish cloth bags. Exhibit silver with anti-tarnish strips or on a pedestal covered with anti-tarnish cloth.

- Store, exhibit, and transport objects in appropriate cases. Avoid using exhibit materials (for example, hardwoods) that offgas organic acids. The adhesives used in plywood and veneers may be a source of pollutants. See Figure 4.11 for a list of harmful and safe materials.

- In areas with high air pollution levels consider installing pollution filtering in your HVAC system. These filters extract gaseous and particulate pollutants before they get into a museum space. Work with HVAC engineers to design a system appropriate to your facility. Do not use filtering systems that generate damaging ozone.

Use portable air filters with activated-carbon filters to remove particulates from the air. These filters will also remove some gaseous pollutants. See NPS Tools of the Trade for more information.

Storage and Exhibit Construction Materials Known to Release Harmful Substances	
Materials	***Harmful Vapors***
wood (particularly oak, birch, beech)	organic acids
wood panel products	organic acids, formaldehyde
protein-based glues, wool, silk	volatile sulfides
vulcanized rubber	volatile sulfides
some dyes	sulfur compounds
cellulose nitrate	nitrogen oxides
cellulose acetate	acetic acid
Poly(vinyl chloride)	hydrogen chloride
polyurethanes	volatile additives
some photographic processes	acetic acid
coating materials	various volatile compounds
Storage and Exhibit Construction Materials That Appear to be Safe	
metals	
glass	
inorganic pigments	
polyethylene and polypropylene (test before use)	
acrylic solutions (some acrylic emulsions are suspect) applied as liquid	
polyester fibers	
cotton and linen	
[1.] Note: while these materials are generally considered safe, manufacturing processes may add coatings and additives that can damage museum collections. Testing is appropriate for certain materials.	

Figure 4.11. Storage and Exhibit Construction Materials Known to Release Harmful Substances and Materials that Appear to be Safe

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O. Endnotes

[i] This temperature range expands the NPS *Museum Handbook,* Part I, Ch. 4, Museum Collections Environment, (1999) guidance slightly, and is in accordance with the AIC Interim Guidelines endorsed by the Association of Art Museum Directors that states: **"**For the majority of cultural materials… a temperature range of 59 - 77ºF (15 - 25ºC), is acceptable." See the IIC declaration on Environmental Guidelines that cites the AIC guidelines, 26 Sep 2014.

[ii] The explanation of dew point's importance in Section F.2 has been adapted from information in the Image Permanence Institute's *Seminar Reference Workbook for Sustainable Preservation Practices for Managing Storage Environments, Section 1, Defining an Optimal and Sustainable Preservation Environment.* Courtesy, the Image Permanence Institute.

[iii] This RH range revises the NPS *Museum Handbook,* Part I, Ch. 4, Museum Collections Environment (1999). It is somewhat broader than that cited by AIC Interim Guidelines as endorsed by the Association of Art Museum Directors in order to accommodate the many climate zones in which NPS park collections are located and the RH ranges to which they have acclimated. The AIC Interim Guidelines state, "For the majority of cultural materials, a set point in the range of 45 - 55% relative humidity with an allowable drift of +/-5%, yielding a total annual range of 40% minimum to 60% maximum…" See the *IIC* declaration on Environmental Guidelines, Sep 26, 2014.

[iv] *The ABCs of Air Conditioning: A Primer of Air Conditioning Types and Methods,* American Association of Museums. PIC- Green. http://www.pic-green.net/home-2 outlines the types of air conditioning systems, introduces cooling load calculation, and compares the functioning of system types.

[v] The explanation of an HVAC system as a continuous loop in Section H.7 is drawn from the Image Permanence Institute's *Seminar Reference Workbook for Sustainable Preservation Practices for Managing Storage Environments.* Courtesy, the Image Permanence Institute.

[vi] Figure 4.6. Standard for Visible Light Levels. Sources: The NPS *Museum Handbook,* Part I, Chapter 4, Museum Collections Environment, (1999) guidance on standards for visible light levels was updated with information obtained from several sources, including the Winterthur Preventive Conservation Team, The George Washington University Museum Studies Program, Canadian Conservation Institute, and the Arthur M. Sackler Gallery and Freer Gallery of Art, Smithsonian Institution.

[vii] Figure 4.7. Standards for Maximum Annual Exposure for Visible Light Levels. Sources: NPS *Museum Handbook,* Part I, Chapter 4, Museum Collections Environment, 1999 was updated with information from the *Light Duration Guidelines for Exhibited Works of Art*, developed by The Arthur M. Sackler Gallery and Freer Gallery of Art, Smithsonian Institution, Courtesy The Arthur M. Sackler Gallery and Freer Gallery of Art, Smithsonian Institution.

[viii] Figure 4.8. Exposure Duration Limit Recommendations. Sources: Information from NPS *Museum Handbook* and NPS *Conserve O Grams* incorporated into, and expands information in the *Light Duration Guidelines for Exhibit Works of Art* developed by the Arthur M. Sackler Gallery and Freer Gallery of Art, Smithsonian Institution. Courtesy The Arthur M. Sackler Gallery and Freer Gallery of Art, Smithsonian Institution.

Index

Chapter 5: Biological Infestations

CHAPTER 5: BIOLOGICAL INFESTATIONS

A. Overview

1. What information will I find in this chapter?

This chapter contains information on:

- how to respond to infestations
- how to set up an Integrated Pest Management (IPM) plan for museum collections that is an ecosystem approach to the control of museum pests, and how to evaluate its effectiveness
- how to monitor and inspect for museum pests
- what control actions will exclude museum pests
- how to identify pests that can damage museum collections

The chapter provides information on a range of IPM techniques and tools that prevent and solve pest problems. This includes inspection, monitoring, cultural and mechanical controls, as well as chemical controls if warranted.

The chapter includes a Recommended Freezer Temperatures and Duration of Freezing Cycles chart (Figure 5.1), Sample Museum IPM Plan (Figure 5.2), Sample Object Pest Incident Report (blank) (Figure 5.3), Sample Object Pest Incident Report (completed) (Figure 5.4), Sample Freezer Treatment Record (blank) (Figure 5.5), Sample Freezer Treatment Record (completed) (Figure 5.6), Sample Pest Trap and Evidence Monitoring Log (blank) (Figure 5.7), Sample Pest Trap and Evidence Monitoring Log (completed) (Figure 5.8), Sample Pest Monitoring Database Report (blank) (Figure 5.9), Sample Pest Monitoring Database Report (completed) (Figure 5.10), Sample Floor Plan with Trap Locations (Figure 5.11), Sample Pest Identification Request Letter (blank) (Figure 5.12), and sample action plans for common museum pests (Figures 5.13 - 5.22).

Note: Consult with a historic architect to determine the appropriate procedures and materials to use in historic structures.

2. What is a museum pest?

National Park Service (NPS) Management Policies (2006) section 4.4.5.1 defines a pest as "an organism that interferes with the management objective of the site." For museums, a pest is defined as any organism that jeopardizes museum resources. For example, if mice or evidence of their activity is found in the collections storage area, they are considered pests. However, if they occur in a meadow, they are part of the habitat and are not considered a museum pest. Other kinds of pests may enter structures containing collections but are not considered museum pests if they do not eat or otherwise damage collections materials. These 'perimeter invaders' can indicate other problems, such as insufficient housekeeping or exclusion. See Section G, Identification of Museum Pests, for detailed information on museum pests and how to recognize them and their evidence and traces, such as webbing, rodent smudge marks, and chewing or gnawing.

3. What conditions support museum pest infestations?

Museum pest infestations are supported by a variety of poor conditions:

- Specific environmental conditions, including high temperature and relative humidity (RH), which can attract and support moisture pests such as silverfish and mold. Heated buildings attract rodents in the fall as they seek a warm habitat.
- The nature, composition, design and condition of the structure determines how effective a buffer it provides the collections from the exterior environment and the entry of museum pests.
- Poor sanitation and housekeeping in all spaces and structures housing collections provide food, water, and harborage to pests.
- Absence of effective museum policies, practices and standard operating procedures, such as those that restrict food, drink and live plants from areas and structures housing collections.
- Improper storage furniture, such as poorly sealed cabinets and storage furniture that is not raised four to six inches off the floor.

B. Responding to Infestations

1. What should I do if I find live pests or evidence of pests in or around museum collections?

Follow these steps if you encounter a live infestation or observe evidence of pests or their activity in or around museum collections.

- **Document what, where and when you see signs of pest activity immediately**. Don't panic. If you rush to kill the pests you may cause more harm to the object (and to yourself) than if you observe it and document its habitat. Before disturbing the evidence, make careful observations of the site, symptoms, and extent of damage to determine if there is an active infestation. Be thoughtful about each step you take. Do thorough written and photographic documentation before safely removing pests and evidence of pests. Consult with your park IPM manager for additional guidance.
- **Isolate infested and potentially infested objects immediately**. Wearing disposable gloves, place infested object in a well-sealed plastic bag. **Do not** carry unbagged infested objects through the collection as eggs, larvae, adult insects, or mold spores can be accidently dropped and the infestation spread. If an object with suspected mold is damp, isolate it in a lidded cardboard box instead of a sealed plastic bag. Move the infested object to an isolation room outside of the collections area. Determine how long to isolate the infested object. See Section E.16 for information on determining isolation periods.

  See Sections F.4 and F.5 and *COG* 2/8: "Hantavirus Disease Health and Safety Update", for information on handling mice and rat infestations, *COG* 3/4:"Mold: Prevention of Growth in Museum Collections" for information on handling objects infested with mold, and Chapter 11, Curatorial Health and Safety.

- **Determine the extent of the infestation.** Start at the location where the first infested object was found and inspect the collections/areas in ever widening circles. Immediately isolate additional infested objects as they are found and document the findings.

- **Identify the pests and evidence of pests**. Bag the pest for identification by an expert as necessary. Determine what the pest is through its feeding habits and traces, life stages such as larvae or pupae, shed skins, frass (insect waste, which may be a soft powdery material, granular pellets or stains, depending on the specific pest), fecal remains, urine, grease marks and other indicators. Consult an entomologist or biologist if needed. Identify the suspect pest to be sure that it is a museum pest that will cause damage to museum objects. See Section G for information on identification of pests. Review the pest's biology and inspect all objects the pest is attracted to as a food source or habitat in the area of the infestation. See *COG* 3/11: "Identifying Museum Insect Pest Damage," for additional information.

- **Clean the area surrounding the removed infested object:**
  - Gather and remove all pest remains or traces from the collections area.
  - Retain the pest and all traces as reference material for confirmation from an expert. Store in vials or secure containers and label. This information will serve future staff as a reference. **Do not retain rodents or any traces of rodent infestations.** Properly dispose of traces of rodents following procedures in *COG* 2/8.
  - Clean the cabinet or shelf with a high-efficiency particulate air (HEPA) vacuum and then a disinfectant, following normal cleaning procedures. HEPA filtration is essential to avoid re-distribution of eggs and frass into the air.
  - Use a HEPA vacuum to clean the floor.
  - **Do not follow these procedures if there is a mouse or rat infestation as they may present a human health risk.** See Section F.5 and *COG* 2/8 for more information on how to clean the area following a rodent infestation.

2. What should I do after isolating the infested object?

Follow the steps below and select the appropriate method or tool to address the infestation in the object:

- **Answer the following questions to determine how to proceed**:
  - Can the pest and pest traces be simply removed?
  - Are eggs, larvae, immature, pupae, or other life stages present?
  - What is the least damaging approach to treating the infested object?

- **Determine what actions to take,** including cleaning, isolation or other actions. Determine the life cycle of the pest in consultation with an entomologist or biologist, the park IPM manager and a conservator and monitor the object until you are sure that no more pests are present.

- **Gather and document the following information before consulting with a conservator**:
  - Description of infestation.
  - Type of pest (if unknown obtain expert identification).
  - List of objects and material types involved (ex: wagon with wood, metal, fabric, and rubber).
  - Description of damage such as droppings on surface, loss of material, staining.
  - Description of objects' proximity to infestation (direct or indirect) and location of infestation.
  - Clean-up efforts since discovery of infestation.
  - Description of the area or structure housing the collection, and its environmental conditions such as temperature and RH, and environmental controls such as an HVAC system or portable dehumidifier.
  - List of available supplies such as HEPA vacuum, plastic bags, sheeting, and freezer.
  - Date, time of year and weather conditions when the infestation occurred.

- **Determine the cleaning method for the isolated object** in consultation with a conservator and the regional curator and then **clean the object.** Remove all traces of the pest from the object. Dead pests, larval skins, pupal cases, fecal matter, and nests can attract other pests. If an infestation is limited to a single object and has not progressed too far, careful HEPA vacuuming with HEPA filters may remove the problem.

  Before cleaning, ensure the structure of the object can withstand the stress of vacuuming. Use screening material on the HEPA tube when vacuuming museum objects. Cleaning will probably not remove all eggs as some can be microscopic. Review the pest's biology and focus efforts on areas where eggs are likely to be deposited. Dispose of collected pests and waste in a sealed container and remove them and the vacuum bag from the structure immediately so they don't become a source of new infestations.

Exception: ***Do not vacuum when addressing a mouse or rat infestation, as this increases the risk of transmission of hantavirus**. **Do not attempt to clean or handle the object until after the isolation period as specified in COG 2/8.***

- **Determine object treatment options** in consultation with a conservator and the regional curator. Determine if treatment is necessary. If so, after considering all options, **treat the object using the least damaging approach possible**. Treatment options, including freezer and anoxic treatments, are described in Section B.4. Some objects may not need any treatment.

- **Determine how long to isolate the object before returning to storage or exhibit** after treatment. The isolation period is determined by the life cycle of the specific pest and can vary from two weeks to several months, so it is critical to identify the pest. Determine the pest's life cycle and monitor the object until you are sure no more pests or any pest life stages, including eggs, larvae and pupae, are present. See Section E.16 for information on recommended isolation periods and Section E.15 for guidance on isolation procedures. Consult the park IPM manager and the regional curator or conservator, and if necessary, an entomologist.

- **Document the treatment.** Record damage to the object, the period of isolation, and any treatments used. Complete a Pest Incident Report, for any infested object. See Figure 5.3, Sample Pest Incident Report (blank). See Section D.5 for additional information on documentation.

3. What should I do after all infested objects have been removed from the collections area?

After all infested objects have been removed from the collections area and isolated; determine how the pests entered and how to prevent reentry in the future.

- **Determine the source of the infestation.** Inspect the area of the infestation to determine how the pests entered and what conditions supported them. If the problem is determined to be gaps in the building envelope, collaborate with facilities management staff to have appropriate repairs made or exclusions installed. If infested objects were brought into the collection, evaluate and modify the policies and procedures as appropriate that allowed this to happen. See Section F.3 for more information on excluding pests from areas that house museum collections.

- **Increase inspection and monitoring** of the area to confirm that you have eliminated the infestation. Increase the number of insect sticky traps or rodent snap traps to determine if pests are still present. For additional information, see Section E.

- **Review the current museum IPM plan** to ensure it is effective. Create a plan, if you do not have one in place, to detect, monitor, and prevent the problem from recurring. See Figure 5.2, Sample Museum IPM Plan, for further information.

- **Modify the museum IPM plan** as necessary.

4. What treatments can I use to stop an infestation?

Consult with the regional curator and a conservator to determine which of the following treatments are appropriate for the contaminated or infested object.

- **Freezer treatment, also called low temperature treatment:**

Freezing is the method of choice for treating most active insect infestations of objects. Use a freezer that reaches at least -4° F (-20° C) or colder. Consult the regional curator or a conservator for assistance in selecting a freezer. Determine how long to freeze the object, based on the freezer temperature, object size, material and packaging.

See recommended freezer temperatures and associated freezing cycles below.

Freezer Temperature	**Minimum Period at Target Freezer Temperature**	**Calculate Additional Time in Freezer**	**Conditions Essential to a Successful Freezer Treatment**	**Total Time in Freezer**
-4° F (-20° C)	1 week	**X hours** for the center of object to reach freezer temperature. Not to exceed 6 hours. Determine using thermocouple or indoor-outdoor thermometer. **Y hours** for dense or well insulated objects to reach freezer temperature (may take additional time)	-Object is properly bagged and sealed -Object is placed in the freezer ***after*** the target temperature has been reached -Center of object reaches target temperature under 6 hours -Object remains in freezer for sufficient time to kill pests -Freezer reaches and maintains target temperature -There is proper air circulation in freezer	**1 week + X + Y = Total Freezer Time**
-22° F (-30° C)	72 hours			**72 hours + X + Y = Total Freezer Time**
-40° F (-40° C)	48 hours			**48 hours + X + Y = Total Freezer Time**

Figure 5.1: Recommended Freezer Temperatures and Duration of Freezing Cycles

The object must **rapidly** reach the freezer temperature **within six hours**, and stay at that temperature for the amount of time needed to kill insects at all life stages, such as larvae and pupae. **The time needed is dependent on the type of material being frozen and its packaging.** For example, a large package of pressed herbaria specimens will take longer to reach the freezer temperature than a single herbarium sheet.

It is essential to follow the procedures exactly to ensure success and to avoid creating cold-hardy insects.

Procedures:

- Wrap the object in acid-free tissue paper and seal in a polyethylene bag before placing in the freezer *that has already reached the target temperature*. Place flexible or delicate objects on a handling board or in a box.

- Use a remote reading thermocouple or indoor-outdoor thermometer to determine if the object has reached the correct temperature.

- After the total time allotted, remove the object from the freezer and leave in the packaging for a minimum of 24 hours, until it has reached room temperature.

- Isolate the object for a minimum of one month following treatment.

- Regularly inspect the object to determine that no insects are present. If you discover additional insects during this period, it means the procedures have not been followed exactly. Determine why the initial freezing treatment failed. Consult a conservator, IPM coordinator and/or an entomologist to correct the problem and find an appropriate treatment method to eliminate the pests.

  See *COG* 3/6: "An Insect Pest Control Procedure: The Freezing Process."

- Document the treatment with a Freezer Treatment Record, to be kept with the object's accession record and IPM records. See Figure 5.5, Sample Freezer Treatment Record (blank), and Figure 5.6, Sample Freezer Treatment Record (completed).

For large objects, use a walk in freezer or a freezer truck. If these are not available, contact a conservator to discuss other treatment options.

Caution: Be aware that certain materials such as wax, inlaid wooden objects, and canvas paintings can be significantly damaged by freezing. Contact the regional curator and a conservator to discuss the safety of freezing.

- **Anoxic treatment***:* Replacing the air with a gas (nitrogen, argon, carbon dioxide) or using an oxygen scavenger/absorber in a closed space can kill insects and their eggs. Museums and professional pest control companies use a variety of techniques that require special equipment and experience. For more information on anoxic environments and their use in pest control see *COG* 3/9: "Anoxic

Microenvironments: A Treatment for Pest Control."

Caution: Control temperature and RH during anoxic treatments to avoid damaging objects.

- **Pesticide application:** Pesticides have generally been phased out for museum collections. However, if a pesticide is proposed for use, it requires park and regional IPM approval through the Pesticide Use Proposal System (PUPS) before application. Consult with the park and regional IPM coordinators, regional curator and a conservator to be sure that the pesticide will not harm objects. See Section F.6, *COG* 2/16: "Chronology of Pesticides Used on National Park Service Collections", and *MH-I*, Chapter 11, Section D, Hazardous Chemical and Materials Used in Collections Care, for more information.

  Caution: Pesticides can damage and contaminate museum objects and can affect the DNA of specimens.

- **Conventional chemical fumigation:** All chemical fumigants are classified by the Environmental Protection Agency (EPA) as restricted use pesticides. Any pesticide (general or restricted use) proposed for use on NPS lands or properties requires park and regional IPM approval through PUPS before application. Chemical pesticide fumigation is now rarely used in museums. Only subject museum objects to chemical pesticide fumigation if all other treatments cannot be used. Consult with the regional curator, regional IPM Coordinator, and a conservator before considering fumigation of museum objects.

  Caution: Fumigants are chemical pesticides which may damage and/or contaminate museum objects.

  On rare occasions, it may be appropriate to fumigate a *museum space* to ensure pests are removed. Most chemical fumigation requires a licensed pesticide applicator, specialized equipment and proper skills. Vikane (sulfuryl fluoride) is one product used for fumigating structures; however, it has no residual effects and does not prevent future infestations. (A recent study indicates that it affects protein DNA.) Many other fumigants that were used in museum spaces in the past are now prohibited.

- **Heat Treatment***:* Heat treatment is not widely used for museum collections as it has the potential to damage objects. Heat fumigation can be-used to kill all stages of pests in structures. However, contents should be removed as heat can damage objects.

C. Integrated Pest Management (IPM)

1. What is IPM?

NPS *Management Policies* (2006) Section 4.4.5.2 defines IPM as "a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage by cost-effective means while posing the least possible risk to people, resources, and the environment."

IPM uses various techniques to prevent and solve pest problems using knowledge of a pest's habits, ecology and the environment in which it thrives and survives. These include preventive maintenance, adherence to an established housekeeping plan, rigorous exclusion, sanitation, and a pest trapping program.

IPM is site specific, adaptable to any museum setting, and protects the museum and its collections from museum pests with minimal pesticide use.

2. Why should I use IPM?

IPM provides an effective and sustainable strategy with which to make informed and responsible decisions about protecting collections from museum pests. It focuses on preventing infestations rather than treating them. It uses monitoring and pest identification to determine the most appropriate, effective, low-risk treatment methods. Although pesticides can in some cases be the most appropriate treatment, IPM discourages reliance on chemical treatments and provides safer alternatives.

3. What are the statutes and mandates for developing and implementing an IPM program?

NPS policy establishes IPM as the preferred method for managing pests in park units, directed by presidential memorandum, laws, and DOI and NPS directives and policies as noted below.

Title 7 USC 136r-1 Federal Insecticide Fungicide and Rodenticide Act SEC. 303 Integrated Pest Management states "Federal agencies shall use Integrated Pest Management techniques in carrying out pest management activities and shall promote Integrated Pest Management through procurement and regulatory policies, and other activities."

President Carter's August 2, 1979 Integrated Pest Management Memorandum from the President requires all federal agencies to use IPM technology for pest control and to reduce use of toxic pesticides.

Department of the Interior Departmental Manual (DM) and directives mandate the use of IPM strategies and plans, including 517 DM 1 Pesticides: Integrated Pest Management Policy and 411 DM 1 Chapter 15, Section 3 Integrated Pest Management.

Director's Order (DO) #24 4.3.9, Integrated Pest Management requires that staff "approve, keep current, and implement an Integrated Pest Management Plan that addresses the museum collections."

NPS *Management Policies* (2006) Section 4.4.5.2 Integrated Pest Management Program states "The Service conducts an integrated pest management (IPM) program to reduce risks to the public, park resources, and the environment from pests and pest-related management strategies" and that "The Service and each park unit will use an IPM approach to address pest issues."

NPS-77, *Natural Resources Management Guidelines* (1991) states that IPM is used to determine when and how infestations are treated, with an emphasis on decreasing pesticide use. It "integrates compatible techniques to maintain pest damage below an unacceptable injury level while providing protection from threats to public health and safety." Additional guidelines relating to the IPM program appear in other chapters of NPS-77.

Proposed pest management activities must be conducted in accordance with Director's Order #77-7: Integrated Pest Management.

4. What are the essential elements of an IPM program?

An effective IPM program includes the components listed below. Each component of the IPM program is on-going and the whole process is cyclical in nature. To carry out an effective IPM program you should:

- Gather information about your collections and object materials, the types of pests attracted to these materials, the interior and exterior environmental conditions, and the condition of the building envelope.
- Identify pests that can cause damage to your collections and identify vulnerable collections such as organic materials.
- Review NPS policy to understand how IPM works and your responsibilities when using chemical treatments.
- Establish priorities to focus on tasks systematically. For example, monitor all areas housing collections but concentrate monitoring in areas that house materials that are highly susceptible to museums pests, such as botany specimens and wool clothing.
- Establish action thresholds. Determine how many museum pests in a collection are too many.
- Monitor objects and environmental conditions, and monitor for pests.
- Implement an ecosystem approach to managing and controlling museum pests. Modify pest habitats, use good housekeeping, install exclusions and use non-chemical treatments such as freezer and anoxic treatments.
- Document monitoring and treatments.
- Build consensus by working with other staff in the park. IPM requires coordinated strategies to be effective.
- Evaluate results to be sure your strategies are working. Modify the IPM plan as necessary.

For additional information, see the "11 Step Process to Developing and Implementing an Integrated Pest Management Strategy" developed by the NPS Biological Resource Management Division's (BRMD) Integrated Pest Management Program. See Section D for information on how to develop a museum IPM plan and Figure 5.2 for a Sample Museum IPM Plan.

5. What types of damage can pesticides do to museum objects?

Pesticides are those chemicals with an EPA registration number used to control pests of any kind. Request pesticides through PUPS after consulting with the park IPM coordinator.

Exposure to certain pesticides can cause the following damage to collections:

- Metal corrosion, including iron, brass, and other light color metals.
- Deterioration of proteins, such as fur, feathers, leather, wool, horsehair.
- Deterioration of paper.
- Shrinking, stiffening, or softening of plastics.
- Color change in dyes and pigments.
- Staining from surface and vapor contact.
- Contamination of objects and specimens that may affect analysis and research, such as DNA sampling.

In the past, museums routinely used pesticides in collections. Many of these materials have left residues on museum objects that may be hazardous to staff and researchers. Pesticides can negatively affect collections for research, for example, pesticides can affect specimen DNA. Search collection documentation for records of previous pesticide use. Be aware, however, that users often did not record pesticide use. Be sure to take precautions when handling the objects. Refer to the *Conserve O Grams* listed below for information on the health and safety risks associated with some pesticide residues found on museum objects.

Pesticides, fungicides and pest repellents listed below were formerly widely used in museum collections. However, some pesticides contain the following active ingredients that are now banned by EPA. None listed below are recommended for use:

- Arsenic (see *COG* 2/3: "Arsenic Health and Safety Update")
- Mercuric chloride
- Thymol
- Dichlorodiphenyltrichloroethane (DDT)
- Ethylene oxide (see *COG* 2/2: "Ethylene Oxide Health and Safety Update")
- Dichlorvos (Vapona, DDVP) (see *COG* 2/4: "Dichlorvos (Vapona) Update")
- Naphthalene (moth balls)
- Paradichlorobenzene (PDB) (moth balls)

6. What is preventive pest management?

Preventive pest management refers to actions that are taken to prevent museum pest infestations and conditions conducive to pests. **Inspecting** and **monitoring** for pests and **effective museum housekeeping** are crucial to preventing infestations, environmental monitoring, as well as evaluation of IPM practices and thorough documentation.

Appropriate facility design and construction practices also prevent museum pest infestations. See the San Francisco Department of the Environment's Pest Prevention by Design: Authoritative Guidelines for Designing Pests

Out of Structures for more information. See Section F, Control Actions for additional information on preventing pest infestations.

D. Developing a Museum IPM Plan

1. What is the purpose of a museum IPM plan?

The purpose of a museum IPM plan is to provide pest management guidelines to help preserve the park's collections, and to protect the health and safety of staff and visitors. The museum IPM plan:

- Provides a framework with which to make responsible decisions for excluding, monitoring, identifying, and treating pests.
- Identifies the most appropriate and cost effective management solution for the specific pest situation.
- Is used in structures that house collections.
- Is an integral part of the park IPM plan. The curator should work with the park IPM coordinator and the facilities manager to incorporate the museum IPM plan into the park IPM plan.

Note: IPM and museum housekeeping are closely connected and should be done in concert.

2. What are the responsibilities of staff involved in developing and implementing the museum IPM plan?

The development and implementation of an effective museum IPM plan involves the individuals noted below.

- **Superintendent** has ultimate responsibility for the park IPM plan and provides sufficient staffing, training, and funding to effectively carry out a pro-active museum IPM plan.
- **Curatorial staff** is responsible for the care of the collections, monitoring for pests in all spaces containing collections, and implementing the museum IPM plan.
- **Park IPM coordinator** establishes pest management priorities for the park, approves or denies proposed pesticide use, assists the museum curator with prevention, detection, and management of pest problems, periodically reviews museum pest monitoring reports, educates staff to detect evidence of pest infestations, and as necessary, consults with the park natural resources and safety staff.
- **Regional IPM coordinator** is responsible for alerting park IPM coordinators of new pest issues and technology, approves or denies proposed pesticide applications on a case-by case basis and serves as the liaison between the park and the service-wide IPM coordinator in providing IPM training and information to develop management strategies.
- **Maintenance staff** is trained in recognizing evidence of pests and contacts the Park IPM Coordinator and curatorial staff if evidence of museum pests is detected. Schedules routine maintenance of, and upgrades to structures housing collections, in consultation with park

curatorial staff.

- **Park safety officer** is consulted on public health issues and any proposed pesticide use. The park safety officer is aware of what pesticides are being proposed for use in the museum and who is using them and ensures that they are used safely.

All staff working in and around museum collections are responsible for implementing IPM practices. This includes:

- eating *only* in designated food areas; there is no eating in collections or work areas such as at desks
- not allowing live flowers or plants in all areas housing collections
- daily pick up of trash in designated food areas to avoid attracting pests

For roles and responsibilities regarding pesticide use see the annual *Policies and Procedures for Submitting 2013 Use Logs and 2014 Proposals for Pesticides, Biological Control Agents, and Genetically Modified Organisms* memo.

3. What is included in a museum IPM plan?

Include the following sections when creating a museum IPM plan:

- **Signature page***:* includes signatures of management to approve and key park managers to concur that staff take timely and appropriate actions to conduct the museum IPM program.
- **Introduction and objectives**: describes the IPM plan and its objectives.
- **Statutes and mandates:** lists the legal requirements and NPS IPM policies mandated for all parks.
- **Background and site description**: briefly discusses past pest management methods and describes each area/structure containing museum collections in the park.
- **Staffing responsibilities***:* lists individuals by job title and what they are responsible for in relation to IPM.
- **Preventive pest management:** discusses measures to prevent pests and eliminate conditions conducive to pests, through inspection and monitoring (including routine inspection of area(s)/structure(s)/ housing collections, routine inspection of individual objects in storage and on exhibit, routine inspection and isolation of incoming objects, and pest trapping program), documentation, environmental monitoring and museum housekeeping.
- **Pest identification and action thresholds:** provides information on how to identify pests and defines the action thresholds or the point at which no additional pests can be tolerated.

- **Control actions:** describes various mechanical and cultural controls, including exclusion, elimination of food, moisture and harborage, and habitat modification.

- **Actions if pests are found:** lists the steps to follow when responding to an active infestation and the types of treatments available to stop an infestation, including isolation, cleaning, exclusion, sanitation, freezer treatment, anoxic treatment, and pesticide application.

- **Evaluating the IPM plan:** discusses ongoing monitoring and evaluation and how to determine if the plan is successful, such as comparison of data over time to see if pest levels have decreased, and states the plan should be modified if pest control actions have not been successful.

- **Action plans:** create an action plan for each relevant pest in the appendix. See Section D.4 for more information.

For information on how to develop an IPM plan, see Figure 5.2, Sample Museum IPM Plan. Adapt this sample Museum IPM Plan by adding specific information about your park, collections, history of pest problems, and past and current pest management methods.

4. What is an action plan?

An **action plan** describes a pest, what to do when you find one, and how to eliminate conditions conducive to pests to prevent a pest situation. Action plans give detailed information about specific types of pests and are included as appendices to the museum IPM plan. Create one for each type of pest that is likely to occur at your site. Include the following information in each action plan:

- **Pest description/biology:** description, biology, and habits of each species of the pest (if there are multiple).

- **Damage:** typical damage caused by the pest, including types of material they are attracted to and what signs of damage to look for.

- **Monitoring and inspection:** the most effective type of monitoring for the pest, including specific directions for inspections and what kinds of traps to use.

- **Action thresholds:** The action threshold or the point at which action must be taken. For example, the action threshold for dermestid beetles is finding one insect or any traces of the insect that indicate an active infestation.

- **Control actions**: including non-chemical and chemical controls that can be used to eliminate remove, and prevent the pest. Divide these actions into “prevention” and “management” categories.

- **Pest activity on-site***:* known history of the pest at the site, including the date and location of past infestations; control actions used and if they were effective.

Customize the action plan to fit the needs of your collection and site. Add information to the action plan as you acquire it. See Figure 5.13 for a blank sample action plan, and Figures 5.14-5. 22 for sample action plans for dermestid beetles, clothes moths, powderpost beetles, stored product pests, silverfish, springtails, psocids, molds, and mice and rats.

5. What documentation should be included in the IPM plan?

Ongoing documentation is a vital part of IPM. Documentation includes recording the date and location of the catches, the number, locations and type of the traps, the types and quantity of pests, the evidence of pest infestations, and the external climate conditions. Use Figure 5.3, Pest Incident Report (blank), and Figure 5.7, Pest Trap and Evidence Monitoring Log (blank), to document the monitoring. Store monitoring data in a pest monitoring database or paper log and retain for ongoing reference. See Figure 5.10, Sample Pest Monitoring Database Report (completed) and Figure 5.8, Sample Pest Trap and Evidence Monitoring Log (completed).

Document all object infestations and area infestations. See Section B.2 for information that should be gathered and documented for each infestation. Complete a Sample Pest Incident Report (blank), Figure 5.3 for every infested object. Record all evidence of pests found in inspections that may indicate an infestation, such as webbing or frass, in a Sample Pest Trap and Evidence Monitoring Log, Figure 5.7. Take photographs where appropriate.

Map results of inspection and monitoring as well as infestations using a copy of the floor plan labeled with the monitoring results. Indicate where pests have been found on the floor plan to the case/shelving unit level to help determine problem areas and how to target IPM efforts effectively. See Section E.7 for more information using floor plans for pest trapping and Figure 5.11, Sample Floor Plan with Trap Locations, for a sample floor plan.

Other documentation includes environmental monitoring data and object treatment records. Use environmental monitoring forms in Chapter 4, Museum Collections Environment, to document environmental monitoring. Object treatment records include cleaning, freezer treatments, and anoxic treatments. Record the treatment for each object in the Interior Collections Management System (ICMS) Preservation supplemental record.

File the object treatment information in the appropriate accession file or catalog folder, as outlined in the *MH-II*, Chapters 2, Accessioning and 3, Cataloging. Retain all IPM information such as the Trap Monitoring Logs, floor plans with trap locations, floor plans with infestation locations, PUPS forms, environmental monitoring reports, copies of object treatment records, control actions and photographs in an IPM binder. Include the brand and chemical names of insecticides and fumigants, as appropriate.

6. How do I know if the IPM plan is effective?

Ongoing monitoring provides data to determine the plan's effectiveness. Regularly evaluate the documentation to determine if the plan is effective through the comparison of year-to-year and month-to-month inspection, monitoring, and trapping records. Determine whether your pest control program procedures are successful by evaluating results of inspection and monitoring; that is, the absence of museum pests in traps, incoming objects, as well as objects in storage and on exhibit.

Review the environmental monitoring data to see if the control actions have successfully changed the environment. If high RH was a problem, continually take RH readings to see if your actions, such as using a portable dehumidifier, have solved the problem.

Evaluate your implemented control actions on an ongoing basis to determine if they have been effective. For example, review your exclusion activities and determine if the structure is adequately sealed by determining if pests are still entering the structure. If so, reevaluate and improve your exclusion methods to ensure that no pests will enter the structure. Determine if you have met the objectives stated in the IPM plan.

If your IPM plan is effective, you should have satisfactory answers to the following questions:

- Is the structure/building envelope properly sealed?
- Are containers housing collections properly sealed, such as with effective cabinet gaskets, to exclude pests?
- Are there fewer pests in the traps?
- Are there no longer signs of pests in areas and containers housing collections?
- Is the infestation gone?
- Do you effectively work with park staff to accomplish the plan?

If your IPM plan is working well, your time will be spent on prevention and maintenance and not on dealing with live pests and infestations.

E. Inspection and Monitoring

1. What is monitoring and what is inspection?

Although the terms inspection and monitoring are often used interchangeably, they refer to two different activities.

Monitoring is systematically and continuously keeping track of all pest activity in collections areas, through routinely inspecting spaces and objects, establishing a pest trapping program to detect pest activity and thoroughly documenting all infestations.

Inspection is closely examining spaces and objects for any evidence of an infestation and is a critical part of pest monitoring programs.

2. Why should I monitor for pests and the environment?

Monitoring

Monitoring for pests and monitoring the environment is essential to your museum IPM program and provides the following information:

Pest monitoring tells you . . .	**Environmental monitoring tells you . . .**
Baseline information on the pests in the collection	Baseline information on the museum environment
How pests got into the museum	If exterior weather conditions are driving pests indoors
Where pests are in the museum	If conditions in the areas housing the collections will support or attract pest activity, such as high RH
How many pests are in the museum	If temperature and RH are stable and appropriate
If control actions are working, such as improving exclusion	If control actions are changing the environment, such as adding a humidifier

By monitoring for pests and the museum environment, you can develop strategies to eliminate future access and survival of pests in the collection and evaluate the effectiveness of your IPM plan. Environmental conditions are also extremely important in understanding pest life cycles and habitat requirements. For information on environmental monitoring, refer to Chapter 4, Museum Collections Environment.

3. How do I monitor for pests?

When developing a monitoring strategy, identify materials in the collections and what pests are attracted to those materials as food sources. Determine what areas in the space and structure are most vulnerable to pests and where they are likely to survive. Recognize what environmental conditions support pests. For example, will there be mostly protein eaters because the collection includes many woolen textiles? Are collections housed in a poorly sealed and damp historic structure?

Consider what kind of pests will be attracted to your collections and will be supported in the environment in your building. Know the composition of the collections and be familiar with the life cycles of common pests. This information will allow you to anticipate what pests may present a risk. For example, wool rugs and feathered headdresses that are made of protein can serve as food for dermestid beetles. Understanding the dermestid beetle life cycle will tell you that larvae feed on protein and adults do not feed on objects but seek daylight as they feed on live plants. Place traps on window ledges to detect activity and conduct a thorough inspection of all items made of protein. Work with the park and regional IPM coordinator to develop a strategy to identify likely museum pests and develop a monitoring strategy to determine whether these pests are present.

Monitoring relies on a variety of techniques.

- **Routine inspection of structure(s)/area(s) housing collections.** Routinely inspect the spaces housing collections to look for signs of pests, at least once every six months. Check windowsills and door jambs especially carefully.

- **Routine inspection of objects in storage and on exhibit.** Inspect objects for the signs of pest damage listed below in Section E.12. Do spot checks at least every six months; check more vulnerable objects such as biological specimens and ethnographic objects every three months. House objects in storage on white surfaces so frass and other evidence of pests are readily visible. Storage cabinets should be raised four to six inches off the floor to aid in cleaning. Check cabinets housing collections closely. Lift and examine objects closely and establish baseline inspection data. Map the locations of discovered infestations. Complete a Sample Pest Incident Report (blank), Figure 5.3, for every infested object. See Figure 5.4, Sample Pest Incident Report (completed), for an example.

- **Pest trapping program.** Identify pests moving into and throughout the areas housing collections and the building. Use traps to "zero in" on problem areas where pests may be entering and where collections have been infested previously.

- **Documentation.** Document the inspection and trapping program to provide a baseline and record of problems that can be evaluated over time. Include photographs where possible. See Section D.5 for more information on documentation.

Complete monitoring tasks on a regular schedule as noted below.

Daily	- Inspect rodent snap traps - Monitor and empty light traps
Weekly	Inspect insect sticky traps
Monthly	Replace insect sticky traps
Every 3 months	Check vulnerable objects like biological specimens and ethnographic objects, particularly in spring and fall
Every 6 months	- Inspection of structure/areas housing collections - Spot check objects in storage and on exhibit

These tasks can be incorporated into the park museum housekeeping plan.

4. What is included in a pest trapping program?

A pest trapping program includes strategic trap placement, consistent monitoring, ongoing documentation and evaluation of the results to determine the effectiveness of the program. Pest trapping includes:

- **Insect sticky traps**, used for monitoring and trapping insects. See Section E.7 for more information.

- **Rodent snap traps**, baited with peanut butter or cotton tied to the trap's trigger, used to monitor for mice and rats. See Section F.4 for information.

5. What kinds of traps should I use to monitor for pests?

There are four types of pest traps. Use them in combination. Decide which kind of trap is most appropriate for a particular place and for the problem.

- **Insect sticky traps** collect insects on an adhesive base. They are used to monitor for pests. Also known as blunder traps, they are available in a box or tent shape, with the tent shape recommended for general use.

Replace them regularly, at least monthly, when they become populated and dirty, or when the adhesive loses its tackiness, whichever comes first. See *COG* 3/7:"Monitoring Insect Pests with Sticky Traps", and NPS *Tools of the Trade* for additional information.

- **Rodent snap traps** trap and kill rodents, such as mice and rats. They can be baited with peanut butter to attract rodents. **Note:** peanut butter can attract insects. Use cotton or string tied to the trigger bar of the trap to attract mice and rats in search of nesting materials. Live traps and electronic mouse traps are not recommended for use. See Section F.4 for more information.

- **Pheromone traps** are insect sticky traps that include a pheromone attractant specific to one species of insect. Therefore, you must identify the insect before purchasing pheromone traps. They are available for webbing clothes moths, case-making clothes moths, drug store beetles, cigarette beetles, warehouse beetles, varied carpet beetles, black carpet beetles, and the German cockroach. Others are being developed. Pheromone traps have a relatively short life span; the lures must be replaced regularly. See *COG* 3/7 for additional information.

  Caution: **Use pheromone traps *only* if you suspect the target pest is present. Do not use for routine, ongoing monitoring**. Always follow instructions on pheromone trap packaging to prevent attracting additional pests into collections areas. Use these traps *only* in well-sealed rooms. Keep them at least 15 feet from any door that opens to the outside.

  If used incorrectly, there are potential risks to using pheromone traps. Do not use pheromone traps in areas such as loading docks or cafeterias adjacent to collections storage areas. Never place pheromone traps in direct contact with objects, storage containers or display mounts. See museumpests.net for more information.

- **Light traps** are useful for detecting and controlling certain flying insects that are attracted to light. Light traps emit ultraviolet light (black light) that attracts flying insects, particularly flies, beetles, and moths that are trapped on a sticky board or in a bag. Be aware that windows also act as passive light traps, so closely monitor windowsills.

  Caution: **Use light traps *only* if you suspect you have an infestation. Do not use for routine, ongoing monitoring.** Place light traps carefully to prevent attracting more pests. Monitor and empty light traps daily to ensure that any trapped insects do not attract more pests.

  If used incorrectly, there are potential risks to using light traps. Do not place light traps in rooms with windows or gaps under doors, as they are likely to attract pests into the room. Do not use light traps outdoors. Do not use these traps where the UV light will fall on light-sensitive collection objects.

6. Should I use pheromone traps and light traps?

Do not use pheromone traps and light traps routinely as there is a risk that they may attract pests into collections areas. Only use these traps on a case by case basis in consultation with a conservator and the regional curator. These types of traps are only appropriate in certain circumstances, such as to monitor for flying insects.

7. How do I establish an insect sticky trap program?

The insect sticky trap program consists of the steps noted below.

- **Step 1. Draw a floor plan of the area to be monitored**. Indicate the locations of all doors, windows, water and heat sources, drains, and HVAC vents. Include furnishings such as museum exhibit and storage cabinets and cases. Note the types of materials housed in all enclosures and the spaces housing collections. For an example, see Figure 5.11, Sample Floor Plan with Trap Locations.

- **Step 2. Number and date the tops of the traps** for quick identification.

- **Step 3. Place insect sticky traps throughout the area to be monitored**. Where possible place the trap against the wall, as pests tend to move along this surface. Critical areas where pests are likely to be found include:

  - Along the perimeter walls
  - In corners
  - Near doors
  - Near windows and other light sources
  - Under furniture
  - Near water sources
  - Near drains and other damp places
  - Near heat sources
  - Inside and outside exhibit and storage cabinets

- **Step 4**. **Indicate the location of the traps on the floor plan**.

- **Step 5**. **Inspect the traps on a regular schedule** and record the:

  - Trap number
  - Location of the trap
  - Date inspected
  - Species of pests found in the trap
  - Number of individuals per species found in the trap
  - Life stage of the species, unusual conditions, replacement date for the trap, climate control system, weather conditions and any other useful information.

- **Step 6. Complete the trap monitoring log** (Figure 5.7). See Figure 5.8, Sample Pest Trap and Evidence Monitoring Log (completed), for a completed sample. Enter information into a simple computer spreadsheet or database program. See Figure 5.10, Sample Pest Monitoring Database Report (completed), for a sample pest monitoring database printout.

- **Step 7. Inspect insect traps weekly** during the initial phase of the monitoring period, usually the first three to six months, to identify current problems and solve them quickly. Long-term monitoring will identify problems that can develop later on, as well as seasonal variations throughout the year.

- **Step 8. Refine the trap placement**, as trapping becomes routine. Based on the evidence found, move traps or inspect as needed. Careful placement of traps allows for precise identification of problem areas.

- **Step 9. Replace sticky traps** at least monthly, when they become populated and dirty, or when the adhesive loses its tackiness, whichever comes first. If rodents are inadvertently caught in an insect sticky trap, contact the IPM staff member, who will safely dispose of the trap and rodent.

Note: Establish a regular cycle of inspecting and emptying traps as dead pests are a food source that may attract other pests.

8. How frequently should I inspect objects and structures for pests?

For objects: Spot check objects on exhibit and in storage once every six months. Inspect pest-sensitive objects every three months, particularly in spring and fall, during breeding season.

For structures: Routinely inspect the structure/area housing collections at least once every six months.

Doing several full inspection cycles during times when pests are known to be active (based on monitoring and structure/room inspection) will allow you to determine where pests are frequently located and to target intensive inspection to these areas of known vulnerability. Use trapping results to determine when and where pests are active and breeding in your local climate, and then target inspections to those times.

9. How do I inspect objects for pests?

Inspect objects closely with good lighting and magnifying lenses. Place objects on flat surface lined with a white surface (blotter paper, paper board, tissue) where any fallen insects or traces such as droppings, frass, webbing, and casings can be readily noticed. Examine the underside of furniture and pallets for webbing and insect eggs, and inspect wooden objects for exit holes of wood-boring insects.

Use a long wave UV black light in the dark to detect certain molds that fluoresce under black light on objects. This is difficult to do reliably and requires appropriate training and protective eyewear. Be aware the UV radiation can trigger sporulation in some fungal species.

10. How do I inspect structures for pests?

Thoroughly inspect the areas housing the collection and the entire structure as a variety of museum pests with different biology and living requirements can potentially be supported. Inspect the structure's exterior for access points.

Closely observe spaces for evidence of pests, structural deficiencies, cultural practices that could support pests, all potential food sources (fabrics, organic objects, etc.) and possible harborage sites. Inspect rodent snap traps daily. Routinely check for signs of infestations during housekeeping tasks and ensure that maintenance and interpretive staff look for signs of pests in exhibit areas. Inspect and isolate all new and returning collections objects.

11. Where should I inspect for pests?

Pests flourish when water, food, and harborage are available. All pests need moisture to survive. Focus inspections on finding sources of dampness that may attract microorganisms and fungus-feeding pests. Watch for spilled water or condensation around water coolers and fountains, de-humidifiers and humidifiers, drains, sinks, and water pipes. Check mechanical rooms, floors, and ceilings for water leaks. Inspect building exteriors for other sources of moisture, such as roof leaks.

Inspect for pests in the following common harborage sites:

- Inside and under drawers, cabinets, and furniture
- Attics and store rooms where rodents or other pests may have made food caches
- Above drop ceilings, and inside elevator shafts and light fixtures
- Fireplaces and chimneys
- Inside electrical equipment and motors (including computers)
- Entry points into the structure and into areas housing collections, such as window sills and door jambs
- Near water sources such as drains and sinks
- Doorways and hallways with outside access
- In stored cardboard or wooden pallets housing collections
- Behind baseboards and wall trim and in inaccessible wall voids which could hold dead animal carcasses. Maintenance staff should do this in consultation with a historic architect.

12. What evidence of pest damage should I look for during inspections?

Different pests cause different types of damage. Search the collections areas and objects for:

- Discovery of flying adult or crawling larval insects
- Moth or beetle pupae
- Pupal tubes or cases
- Insects captured in traps or in ceiling light fixtures
- Chewing or gnawing marks
- Feeding or exit holes
- “Grazed” surfaces
- Presence of feeding debris or fecal pellets/droppings/frass (insect waste, which is usually a soft powdery material) around or below objects
- Shed/cast skins
- Webbing
- Nest/burrows
- Food caches
- Flyspecks
- Hair falling from fur or pelts
- Missing pile from rugs
- Rodent smudge/grease marks
- Odors or sounds
- Infested or damaged food or food packaging
- Bait consumption

See *COG* 3/11 for additional information.

13. What tools and equipment do I need for inspections?

Use the following tools and equipment for inspections:

- Flashlight

- Magnifying glass
- Nitrile gloves
- Tape measure
- Camera
- Screwdrivers
- Step ladder
- Mirror to view up chimneys
- Sticky labels or marker for numbering traps
- Long wave UV black light (requires protective eyewear)
- Dust mask (NIOSH-approved disposable filtering face piece respirator with two straps. The park safety officer may require that you wear a respirator for inspections involving mold, bird or bat droppings, or heavy dust. If a respirator is needed, the user must be in a respiratory protection program. For inspections involving rodent infestations, see *COG* 2/8).
- Talc (sprinkle on the floor to detect rodent tracks in rooms not open to the public to indicate mice activity. For use in a historic structure, sprinkle talc onto Mylar®. As talc may be a respiratory hazard, consult with the safety officer before use).

Create a separate tool kit for inspections involving rodents. See *COG* 2/8 for more information.

14. When do I isolate and inspect objects?

Inspect and isolate objects when they may bring pests into collections areas or may be infested.

- **For *all* new objects, and new and returning loans***:* Newly accessioned objects and new and returning loans have the potential to introduce museum pests to your collections. To prevent this, carefully **inspect, isolate and monitor all incoming objects** for possible pest infestations or microorganisms before introducing these objects into collection storage or exhibit areas. See Section E.15 for procedures.

  Note: Be aware that incoming objects, especially incoming objects from archeological sites, may potentially be health hazards. Consult with the regional curator and park resource management staff and see Chapter 11, Curatorial Health and Safety, for more information.

- **For potentially infested objects***:* If you suspect that objects may be infested, isolate them immediately and monitor for signs of infestation. An object may potentially be infested if you find evidence of pest activity on or near the object, or have found pests that eat the object's material in nearby pest traps. Determine the isolation period, following procedures from Section E.15 below. Observe isolated objects for signs of pest activity and take appropriate action.

- **For infested objects***:* If you find evidence of an infestation during inspection, immediately isolate the objects. Determine what treatments are needed to remove the infestation.

15. What procedures should I use to isolate objects?

Follow these procedures to isolate objects.

- **Isolate objects in a designated isolation room**, away from collections areas. Locate the isolation room adjacent to the shipping and receiving area. Do not locate it within the collections area. The isolation room must be well sealed and have good lighting. If this is not possible, isolate objects in a well-sealed cabinet outside of the collections area. See Section F for additional information on the importation of pests.

- **Place the incoming object, potentially infested object, or infested object on a white surface, seal in a polyethylene bag and place in the isolation room.** If placing objects in an isolation cabinet, line the cabinet with the white material. Wrap large items in polyethylene sheeting and seal.

- **House objects with evidence of a mold infestation in lidded cardboard boxes** instead of sealed plastic bags, so the mold will not worsen. Ensure that the mold problem is addressed. See Figure 5.21, Sample Action Plan: Mold, for more information.

- **Observe the objects closely for signs of pest activity. Note:** Bagging is not considered a treatment by itself. Also, some kinds of insects will chew through the plastic.

- **Handle non-collection materials such as packing materials and exhibit construction materials in the same way but house these separately from collection areas**. Immediately discard any packing materials that cannot be verified as pest-free, such as cardboard, in an exterior garbage container.

- **Clean objects** and remove all pest traces by vacuuming off all webbing, insects, possible insect or spider eggs, and mold with a HEPA filter vacuum.

- **Determine, in addition to isolation, what action to take:**

  – Freezer treatment
  – Anoxic treatment
  – No further action besides isolation

  Consult the regional curator and/or a conservator to determine the most appropriate treatment method for any type of infestation.

- **Complete a Pest Incident Report** for all infested objects. See Figure 5.4, Sample Pest Incident Report (completed).

16. How long do I need to isolate the object?

Isolation periods vary based on why you are isolating the object and what pests are involved.

- **For all new objects, and new and returning loans***:* Isolate objects for a minimum of one month. Living pests can usually be detected within this period. However, be aware that insect eggs can be dormant for years depending on the species. Mold can also be dormant. Metal, glass, ceramic or stone objects should be thoroughly inspected and cleaned but do not need to be isolated. Inspect objects for signs of an infestation throughout the isolation period.

- **For potentially infested objects:** If you suspect an object may be infested, determine the best way to treat the object, such as a freezer or anoxic treatment, in consultation with a conservator and the regional curator. Note that bagging is not considered a treatment by itself. After the treatment, isolate the object for a minimum of one month and continually inspect throughout the isolation period. If you discover pests, determine the appropriate isolation period based on the pest species.

- **For infested objects***:* If an object is infested, determine the best way to treat the object, such as a freezer or anoxic treatment, in consultation with a conservator and the regional curator. After treatment, determine the isolation period, which ranges from a minimum of one month to several months, depending on the identification of the pest and its life cycle. Consult the regional curator, conservator, entomologist or IPM manager to determine the appropriate isolation period.

- **For objects potentially infested with woodboring beetles***:* Woodboring beetles are problematic to eradicate. They can lay dormant for long periods of time so they are difficult to eradicate. You may have an active woodboring beetle infestation if you see exit holes or piles of frass below wood objects.

  Isolate the objects for a minimum of 12 weeks at room temperature. Regularly inspect the objects for signs of an active infestation during the isolation period by monitoring for frass falling out of exit holes from larval action. Be careful not to move the objects and dislodge frass from the holes. Old exit holes are dark in color from the wood oxidizing while newer exit holes are usually lighter.

  It is preferable to isolate the object in the isolation room for a period of one year, if you have the space. If this is not possible and if no frass has appeared after 12 weeks, you can remove the object from the isolation room. Then double bag or wrap it in two layers of plastic on white paper. Inspect regularly for frass and holes in the plastic for a minimum of one year. Holes indicate that the object is still infested as adult beetles have chewed their way out of the plastic.

17. How do I determine that I have a pest infestation and what are action and injury thresholds?

Action thresholds are used to determine whether you have a pest infestation. The **action threshold** is the point at which pest levels, evidence of pests, and any observed damage to objects indicate that collections will be damaged if action is not taken. For example, if you see a mouse, mouse droppings, or gnawed objects, the action threshold has been exceeded. The **injury threshold** is the point at which the collections have been damaged by pests. The injury threshold cannot be exceeded, as damage to collections objects cannot be tolerated. The action threshold is specific to the pest and is determined by where the pest is found within the structure.

Establish zones to help you determine if the action threshold for a particular zone has been met. For example, zone one is collections storage, zone two is a workroom, and zone three is the entry hall into the building. If a museum pest or perimeter invader is discovered in zones one and two [both areas house collections], follow the steps outlined in Section B. If a museum pest or perimeter invader is discovered in zone three, a non-collections area, determine the source of the infestation and increase inspection. You will not need to isolate objects.

The presence of museum pests in any part of the structure indicates other problems that may threaten museum collections, such as poor sanitation or exclusion.

While a museum pest is a far greater concern than a perimeter invader (which does not feed on collections), the action threshold is still met if a perimeter invader is found in an area housing collections. The presence of perimeter invaders indicates a problem, such as poor sanitation or insufficient exclusion. Actions still must be taken to prevent more pests from entering the collections area.

Expect to trap more insects in historic structures than in new dedicated or purpose built storage facilities and visitor centers. Determine the various thresholds before starting a monitoring program and include these in the IPM plan. Include action thresholds in each action plan. For more information about action plans, see Section D.4. See Figures 5.13-5.22 for sample action plans.

The action threshold for any area housing collections is the sighting of ONE larva or adult pest or any traces of the insect or organism.

F. Control Actions

1. What control actions will exclude pests from areas housing collections?

Cultural, mechanical, and chemical controls are used to prevent pests from getting into, and thriving in the collection. Use one or more of the following actions or tools in a well thought out plan to exclude and control museum pests in areas housing collections.

- **Cultural controls** are policies and procedures that prevent infestations.
- **Mechanical controls** are techniques that limit pest habitats and exclude pests from structures and spaces housing collections, including rodent snap trapping.
- **Chemical controls** include pesticides which kill pests, pheromones which repel or attract pests, and insect growth regulators which prevent development. Proposals to use these tools to prevent or treat infestations must be reviewed and approved on a case-by-case basis prior to purchase and use.

2. What are cultural controls?

Cultural controls modify human behavior and include:

- Developing and implementing a good housekeeping plan. See Chapter 13, Museum Housekeeping, for more information.
- Inspecting and isolating *all* incoming collections, including new accessions, new and returning loans, purchases, and field collections, as well as exhibit and storage material *before* placing them in collections storage or exhibit areas.

- Isolating infested and potentially infested objects for inspection and possible treatment.

- Housing objects in well-sealed closed storage and exhibit cases in museums and exhibit spaces.

- Raising storage cabinets four to six inches off the ground to facilitate cleaning.

- Inspecting free- standing objects that are not housed in cases more frequently.

- Prohibiting food, drink and smoking in areas housing collections. Designate an area where staff can eat away from collections, such as a break room. Keep all food sealed in containers with lids.

- Prohibiting decorative live and dried plants within areas housing collections, including furnished historic structures. Use artificial plants and flowers as needed.

- Eliminating plants and mulch adjacent to the structure. Work with a historic architect, park facilities management and cultural landscape staff.

- Properly disposing of trash in sealed containers and removing from building daily, including trash from staff offices and break rooms.

- Maintaining a stable temperature and RH. Keep RH below 65% to discourage moisture pests and be aware that high temperatures can support museum pests. See Chapter 4, Museum Collections Environment for more information.

- Focusing inspections to find sources of dampness and potential entry points in the structure.

- Ensuring that persons entering the collections areas do not track in pests.

3. What are mechanical controls?

Mechanical controls include:

- **Exclusion** by creating a tight building envelope by sealing the structure through a range of exclusion techniques and systematically and regularly inspecting the structure's exterior and interior spaces for potential entry points.

  Work with a historic architect, and park facilities management and cultural landscape staff to find an appropriate alternative if the treatments described below are not appropriate for the type of structure, including historic structures.

  – Sealing, caulking or otherwise blocking:
    - Holes in the exterior of the structure 1/4" or larger to exclude mice and rats, as rodents can fit through very small (1/4" for mice and 1/2" rats) openings.

- Windows or sealing using gaskets and/or weather stripping.
- Gaps and holes, particularly spaces around windows and doors. Larger holes may require a filler such as wire mesh or spray foam insulation prior to caulking.
- Pipe, electrical conduit and HVAC duct wall and roof penetration holes.

– Installing 20 mesh screening on:
  - Window exteriors
  - Air vents
  - Hot air registers
  - Floor drains

– Installing self-closing devices, sweeps and gaskets on all exterior and interior doors in areas housing collections and ensuring that all doors form an airtight seal

– Installing bird and rodent-proof chimney guards over fireplace chimneys

– Repairing cracks and openings in stone and cement foundations with concrete or mortar

– Creating an 18 – 30" wide vegetation free zone, also called a sanitary barrier or 'hot zone,' around the perimeter of structures, preferably full of four inch deep gravel where possible. See Chapter 7, Museum Collections Storage, for more information. Be aware that this treatment may not be appropriate for historic structures.

  - Eliminate mulch and plants next to the building as it provides habitat for insects and rodent, and holds moisture.
  - Eliminate vegetation against the building foundation or walls as this allows pest access and encourages pest activity and inhibits drainage and access.

- **Sanitation** by practicing good sanitation techniques:

  – Emptying all trash containers and removing trash from structure daily

  – Thoroughly clean trash receptacles to remove food residue

  – Keeping areas around dumpsters clean

  – Regularly vacuuming to minimize dust and other particulates, at least monthly. Use a vacuum cleaner with a HEPA filter instead of a broom to clean floors and structures, including floors, windowsills, walls and cabinet tops. Remove all traces of insects from the structure, such as frass, eggs, discarded skins, and discovered dead insects.

- **Eliminating harborage** sources from the interior and exterior of the structures containing collections:

  - Removing bird and insect nests promptly from building exterior. **Note:** see Migratory Bird Treaty Act of 1918 (16 USC 703-711) to ensure that removing bird nests is legal. See *MH-I,* Appendix A for more information.

  - Removing rubble and/or firewood from around the exterior of the structure.

  - Ensuring that dumpsters and other large exterior trash receptacles are kept at a distance from the building and are not directly adjacent to the loading dock.

  - Cleaning gutters regularly.

  - Removing plants such as ivy growing on the structure.

  - Trimming trees and shrubs so that they do not come into contact with the structure.

  - Eliminating clutter from areas containing collections, especially cardboard and wooden or plastic pallets.

  - Storing boxes and other items off of the floor.

- **Eliminating moisture** sources for pests:

  - Eliminating water draining towards structure.

  - Promptly repairing roof, window, building, plumbing or sewer leaks.

  - Insulating cold water pipes to prevent formation of condensation.

  - Monitoring air conditioning units, humidifiers and dehumidifiers for excess moisture.

- **Eliminating food** sources for pests:

  - Properly disposing of trash in sealed containers and removing from structure daily, including trash from staff offices and break rooms.

  - Regularly inspecting wall voids and interior of suspended ceilings for lint, dirt, animal carcasses or other sources of food for pests.

  - Promptly removing dead insects and animals and animal waste from structure.

– Isolating moldy objects and vacuuming with HEPA filter.

- **Modifying habitat** to ensure that pests will not be attracted to structures:

  – Using sodium vapor lighting, which is less attractive to insects, for exterior fixtures. Mount lights away from and not on the structure to avoid attracting pests.

  – Mounting outside lights 30 feet away from the structure facing away from the structure.

  – Locating receiving/unloading area away from collections.

4. How do I establish a rodent snap trapping program?

Snap trapping, in conjunction with exclusion, is the most effective strategy for eliminating rodents from structures. Snap traps eliminate rodents and monitor for rodent entry, allowing evaluation of exclusion efforts. These traps also avoid problems of mice and rats dying in inaccessible locations where they will produce a foul odor and attract other pests. Do not use live traps or glue boards as they increase the risk of exposure to rodent urine, feces and associated pathogens. They are also inhumane. Electronic traps are not recommended because they are not always effective and can cause rodents to excrete urine that can potentially spread viruses.

Effective rodent trapping depends on saturating an area with a large number of well-maintained snap traps, using baits that attract rodents, and placing traps where animals will encounter them. Placement is important. Rodents prefer to travel close to walls and objects where the side of their body is close to a surface, rather than going across the middle of a room. Rodents usually continue to use the same pathways. Urine left by rodents on these pathways will show up under a UV light so these pathways can be identified.

- Create a floor plan with the trap locations, following the procedures listed in Section E.7. Number and date each trap. Make sure the number and date will not be obscured by the catch/carcass.

- Set and bait the appropriate quantity of rodent snap traps in each space. Use about eight traps per room; larger rooms need more traps. Place two snap traps on each side of the room's entry points. Adjust traps to snap closed with the least disturbance by filing off manufacturing burs from the trigger mechanisms and careful setting. Bait the traps with peanut butter or cotton. However, be aware that peanut butter can attract insects. Note that snap traps are also effective without bait.

- Locate traps every six to ten linear feet along walls and runways used by rodents. Put traps behind or under (but not touching) objects, under furniture, against walls, or in other locations where rodents find concealment. Place two traps at each trap station parallel with the wall, or place a single trap with its trigger end against the wall. See *COG* 2/8 for an illustration. Place a Mylar® rectangle beneath each trap, cut one inch wider than the trap, to prevent the spread or absorption of any liquids from the trapped mouse or rat, especially when trapping on a porous historic wooden floor.

- Inspect rodent snap traps daily.

- To dispose of a trapped rodent, wear gloves and spray the rodent and trap with disinfectant. Minimize handling by placing the trap and rodent in a plastic bag and discard. Treat every rat and mouse as potential hantavirus hazard. See *COG* 2/8 for additional information.

- Keep snap traps out year-round for general monitoring, baited with cotton or yarn, which is attractive as a nesting material for female rodents.

For additional information see the CDC's Clean Up! Snap Up! Trap Up! website.

5. How do I clean objects contaminated or potentially contaminated with hantavirus?

An object that may have been contaminated with hantavirus must be handled with extreme caution. The sighting of any mouse or rat or signs of mice or rats such as droppings or nests ***must*** be treated as if hantavirus is present. **Do not vacuum.** Wear proper personal protective equipment, including nitrile gloves, when cleaning up mice and rats and their traces. Respirators and associated medical clearance are needed to clean up after heavy infestations. See *COG* 2/8 for more information. Immediately double bag the object in plastic and isolate it from the rest of the collection. Keep the object isolated at room temperature. **Do not freeze the object as this extends the viability of the virus. Isolate for a minimum of three weeks. However, a longer period of six weeks is strongly suggested.** The virus is typically viable for 24 - 48 hours, but in some conditions it can survive several days longer.

If the object is wet or damp with rodent urine, virus viability and risk to people is higher. To render the virus inactive, the object must be dried. Wearing personal protective equipment, follow the steps outlined above, and in the *COG* to isolate the object and place a desiccant such as silicone dioxide within the bag. Silica should never come into direct contact with the object. *Caution*: silica is potentially harmful to some materials if they are excessively dried. Once the object is dry, continue isolation for an additional minimum period of three weeks to ensure the virus is deactivated.

Note: Do not apply bleach or other solutions directly onto a museum object. As applying bleach directly will damage a museum object, the CDC has indicated that isolation is sufficient treatment to deactivate hantavirus and that normal cleaning can follow the isolation period. Consult with the regional curator and a conservator before proceeding with any further treatments.

6. What are chemical controls?

Chemical controls include:

- Pesticides must be submitted and approved through PUPS, including fumigation, localized application of sprays, and dusts used as a crack-and-crevice treatment.

- Crack and crevice treatments involve putting low risk pesticide dusts, such as boric acid, silica aerogel or diatomaceous earth, in a bulb duster and puffing a thin layer of dust under baseboards and cabinets and in other hidden areas where insects seek concealment. It kills insects but is not harmful to mammals. For additional information, consult the park IPM coordinator, regional curator or a conservator.

While chemical controls may be the most appropriate methods for treating an infestation, **do not** use them on museum objects. They may only be used around objects, not directly on them.

Note: The exception is when treating a wood object infested with powderpost beetles. If other treatments are not possible, a trained wood conservator may use localized applications of low-risk, approved pesticides, such as borate, on the affected wood. You must have approval through PUPS before using this treatment.

G. Identification of Museum Pests

1. What are museum pests?

Museum pests are biological agents that damage museum collections. These include insects, mold, mice, rats, birds and bats. Pests damage objects through feeding, gnawing, defecating, nesting behavior, and by attracting other types of pests. Museum pests are generally grouped as follows:

- Fabric pests
- Wood pests
- Stored product pests
- Moisture pests
- Rodents
- Other vertebrates, including bats and birds
- General pests
  - museum pests
  - perimeter invaders

Identifying the pest species and its life stage is critical in determining what is happening in the areas being monitored. This chapter provides brief descriptions of certain museum pests. Other pests may be found. For assistance in identifying unknown pests, contact park and regional IPM coordinators, entomologists, the regional curator, or NPS Cooperative Park Study Units. Also seek assistance from entomologists in the Cooperative Extension Service, U.S. Forest Service, state departments of food and agriculture, or at local universities and natural history museums. See Figure 5.12 for a sample pest identification request letter.

Start a reference collection of pests to compare to when identifying new pests and photo-document damage to your collection. These insects can be stored on small squares cut from insect sticky traps and placed in small plastic boxes or vials. See *COG* 11/8: "Curation of Insect Specimens," for information on making a reference collection of insect pests.

2. Where can I see images to help identify pests?

The following online references contain images of pests that you can use to help identify pests. See Section H, Selected Bibliography, for additional references.

- Center for Invasive Species and Ecosystem Health operated by University of Georgia's bugwood.org
- *COG* 3/11, Identifying Insect Damage
- Iowa State University's Bug Guide and Image Galleries
- museumpests.net
- NPS Integrated Pest Management Information Manual
- Penn State's Entomology Fact Sheets
- University of Florida's Featured Creatures
- whatseatingyourcollection.com

3. What are fabric pests?

Fabric pests are protein eaters. The two main groups are carpet beetles (of the family Dermestidae) and clothes moths (of the family Tineidae). The larvae of these insects feed on all types of protein-based animal products found in museum collections, such as wool, silk, fur, feathers, leather, horn and carcasses of other arthropods. They are among the few creatures that can digest keratin. The adult beetles and moths do not feed on collections and are often seen at windows seeking a way outside to locate pollen or other food adults depend on.

- **Carpet beetles** are also commonly known as dermestids. Carpet beetle larvae cause damage by feeding on a wide variety of materials including fur, feathers, wool and silk cloth, wool felt, hair, study skins, and taxidermy or trophy mounts. They may not be seen because they hide from light, burrowing deep into objects. The larvae shed their skins as they grow. Look for these skins during inspections. The frass is often granular to touch. Adults are attracted to daylight and come out of hiding to seek pollen from flowers and mate. They may collect along windowsills, a good location to monitor with sticky traps. There are many species of carpet beetles, but the ones described below are commonly found in museums. These beetles can be easily mistaken for other types of beetles that do not damage museum collections. See Figure 5.14, Sample Action Plan: Dermestid Beetles, for more information.

  - **Black carpet beetles** (*Attagenus unicolor*) are the most abundant and destructive of the carpet beetles. They feed on wool, silk, fur, felt, feathers, leather, insect specimens, casein and hide glues, books and bird and mammal specimens and will feed on various plant materials, such as yeast, cereals, seeds, grains and spices. The adult is 1/8- 3/16" long, a solid dark brown or dull black color, and more elongated than the carpet beetles described below. The larvae are less than 1/4" long and carrot-shaped. They are covered with golden brown hairs and have a characteristic "tail" of long hairs at the rear end.

  - **Varied carpet beetles** (*Anthrenus verbasci*) are primarily scavengers. They are common in bird nests, on dead animals, and in insect collections. They can damage woolens, carpets, wall hangings, hides, horns, and bone objects. Small populations often go unnoticed behind furniture or along baseboards, feeding on accumulated lint, hair, food crumbs, dead insects, and other organic debris. The adult is about 1/8" long, oval to round, blackish with splotches of white, yellow, and black on its back. The larvae are 4-5 mm long, teardrop-shaped, and covered with rows of light brown hairs.

- **Common carpet beetles** (*Anthrenus scrophulariae*) attack carpets, woolens, animal products such as feathers, furs, leather, silks, mounted museum specimens, and pressed plants. The adult is about 1/8" long and black with white scales and a band of orange scales down the middle of its back. The larvae are reddish-brown and covered with brown or black hairs. Larvae are active and move rapidly.

- **Furniture carpet beetles** (*Anthrenus flavipes*) attack upholstery (particularly old horsehair-stuffed furniture) and objects made from wool, fur, feathers, silk, horns, and tortoise shell. The adult is about 1/8" long and is rounded and blackish with variable mottling of yellow and white scales on the back and yellow scales on the legs. The larvae are difficult to distinguish from the common carpet beetle.

Other kinds of dermestid beetle larvae will also feed on textiles and protein materials, including:

- **Hide beetles** (*Dermestes maculatus*) feed principally on leather, animal hide, and bird and mammal skins. The adult is 1/3 to 1/2" long and is reddish brown to black in color, with a white underside with lateral black spots. The 1/2" larvae are black with a broad dorsal band.

- **Larder beetles** (*Dermestes lardarius*) feed on hides, horn, hair, fur, feathers, bird, mammal and insect specimens, skins, human food, and commonly dead cluster flies in attics. The 1/3" long adult is brown to black in color with light or yellowish transverse bands across the wing covers, white undersides with black patches along lateral borders of abdomen, and have clubbed antennae. The 1/2" larvae are hairy with alternating light and dark brown bands.

- **Black larder beetles** (*Dermestes ater*) feed on bone, carcasses, wool, wood, cork, and insulation (materials where larvae also make pupal chambers). The adult is 1/3" long and dark brown to black. The larvae are 1/2" long and yellowish brown with a narrow dorsal stripe.

- **Odd beetles** (*Thylodrias contractus*) feed primarily on dead insects, and will also feed on plant materials, animal skin collections and freeze dried specimens, and attack textiles and fibers made from natural materials such as wool or silk. Male and female adults look different from each other and other dermestids. They are 1/8" long, narrow and yellowish-white in color. The larvae look similar to carpet beetles but will roll up in a ball when disturbed.

– **Cabinet beetles** (*Trogoderma ornatum*) feed on animal products such as wool, feathers, furs, skins, bee glue, cocoons, and dead drywood termites and on vegetable matter like grains, nuts, wheat, corn, spices, seeds, and tobacco. Adults are 1/8" long and black with red-banded wings with white hairs. The larvae are 3/8" long and reddish-brown with white undersides and two appendages on the tail.

– **Larger cabinet beetles** (*Trogoderma inclusum*) feed on stored grains, woolen clothing, dried insects, dried casein and corn meal. The adult is 1/10 - 1/5" large and light in color.

– **Warehouse beetles** (*Trogoderma variabile*) feed on seeds of all kinds, dead animals, candy, dog foods, dead insects, milk products, starches, stored cereal products, dried grain insect collections, hides, and skins. They are 1/8" long and brownish-black. The larvae are 1/4" long and range from yellow-white to dark brown depending on age.

- **Clothes moths** are small, silvery-beige moths with a wingspan of less than 1/2". They have narrow wings fringed with long hairs. Small grain- and flour-infesting moths are often confused with clothes moths; however, clothes moths have different flying habits. They avoid light and are rarely seen flying. They prefer dark corners, closets, and storage areas, and usually remain out of sight. The primary food of clothes moth larvae is soiled woolens, but they also feed on silk, felt, fur, feathers, and hairs. They often damage woolen clothes (particularly old military uniforms), feather hats, dolls and toys, bristle brushes, weavings, and wall hangings. See Figure 5.15, Sample Action Plan: Clothes Moths, for more information.

  - The **webbing clothes moth** (*Tineola bisselliella*) and the **casemaking clothes moth** (*Tinea pellionella*) are the two most common clothes moths found in museums. The larvae are 1/4 - 1/2" white caterpillars with brown heads. They feed on the surface of the infested material. The webbing clothes moth produces feeding tunnels of silk and patches of silken webbing on the fabric's surface. The casemaking clothes moth is rarely seen, since it constructs a cylindrical case of fabric that it carries around to hide and feed in. The color of the larval case will often match the material on which it's feeding. Use this clue to help locate infested materials.

  - **Carpet moths** (*Trichophaga tapetzella*) are uncommon in the U.S. but can be imported on fabrics. They feed on hair-stuffed furniture, tapestries, old carpets, furs, feathers, and taxidermy or trophy mounts. These are also general feeders on a variety of dried animal and plant proteins, dead insects and nests, and animal carcasses.

    Note: Regularly inspect objects vulnerable to clothes moths because clothes moths are difficult to detect *until after* damage has been done.

Action threshold *for fabric pests is the sighting of one larva or adult insect or any traces of the insect or damage to objects that indicate an active infestation, such as shed larval skin, pupal cases, grazing damage or holes*. For management actions, see Section F, Control Actions.

4. What are wood pests?

Objects made of wood are susceptible to attack by a number of wood-infesting pests. Wood-destroying organisms can digest cellulose (termites and some powderpost beetles) excavate it for habitat (carpenter ants). The culprits in museums are usually woodboring beetles or drywood termites. Both can severely damage valuable objects while remaining invisible to the untrained eye.

- **Woodboring beetles** or powderpost beetles, are a group of beetles in the insect families *Anobiidae* (anobiid, furniture, and deathwatch beetles), *Lyctidae* (true powderpost beetles), and *Bostrichidae* (false powderpost beetles). The term "powderpost" comes from the fact that the larvae of these beetles feed and digest cellulose and, given enough time, the appropriate temperature, and adequate moisture, will reduce the wooden object to a mass of fine powder.

  Woodboring beetles spend months or years inside the wood in the larval stage. Their development depends on moisture and temperature. Their presence is apparent when they emerge from the wood as adults, usually leaving pin hole openings, often called "shot holes," behind and piles of powdery frass (digested wood that looks somewhat like sawdust) below the object. Depending on the species, holes may be round or oval-shaped and normally range in diameter from 1/32 - 1/8". If conditions are right, females of some beetle species may lay their eggs and re-infest the wood, continuing the cycle for generations. Heavily infested wood becomes riddled with holes and tunnels packed with dusty frass.

  Woodboring beetles can attack both hardwood and softwood, although lyctids only infest hardwoods. They can infest wooden objects, frames, furniture, tool handles, gunstocks, books, toys, bamboo, flooring, and structural timbers. Examine museum objects that can be infested by woodboring beetles regularly to detect beetle activity early on. Check beneath or the underside of objects for frass or shot holes. Avoid high humidity and/or moisture levels. See Figure 5.16, Sample Action Plan: Powderpost Beetles, for more information.

- **Drywood termites**, unlike subterranean termites, establish colonies in dry, sound wood with low levels of moisture and do not require contact with the soil. They are primarily found in the coastal southern states, California, and Hawaii, but are easily transported elsewhere in lumber, furniture, and wooden objects. Drywood termites seek wooden objects of all kinds for a food source and feed across the grain of the wood, excavating chambers connected by small tunnels. The galleries feel sandpaper-smooth. Dry, six-sided fecal pellets are found in piles where they have been kicked out of the chambers, in spider webs or in the galleries themselves. A swarming flight of winged reproductive termites can occur anytime from spring to fall, mostly occurring at night.

- **Subterranean termites** live in colonies underground or aboveground in secluded, moist areas. They feed on cellulose and attack wooden structures. They are very destructive and capable of collapsing entire buildings.

- **Carpenter ants** (*Camponotus pennsylvanicus*) are large, 3/8 - 1/2" long, with shiny black bodies that sometimes appear reddish-brown. They excavate wood not to feed on it, but to make galleries for nests. Carpenter ants are indicators of a moisture problem as they excavate wood with 15% moisture. Damp wood or wood invaded by wood rot fungi is especially susceptible, but any wood in a structure may be affected if it contains the right amount of moisture. They eat protein, such as other insects, and carbohydrates, such as sweet honeydew from aphids. Carpenter ants can enter structures where tree branches come into contact with the roof, other parts of the structure such as windows, holes in the foundation, foundation vents, heating ducts and air-conditioners, or along power or telephone lines. The frass is very coarse, closely resembles sawdust from a hand saw and has insect body parts in it.

Action threshold *for wood pests is the sighting of one larva or adult insect or any traces of the insect or damage to objects that indicate an active infestation, such as exit holes or frass below objects*. For management actions, refer to Section F, Control Actions.

5. What are stored product pests?

Many museums include objects made in part of seeds, nuts, grains, spices, dried fruits and vegetables, and other foods. Stored product pests, or "pantry pests," can infest objects containing these foods. The most common are the cigarette and drugstore beetle. See Figure 5.17, Sample Action Plan: Stored Product Pests, for more information.

- **Cigarette beetles** (*Lasioderma serricorne*) are named for being a pest of stored tobacco, but are also a serious pest of flax, spices, seeds, dried plants, books, and crude drugs. This beetle has been called the "herbarium beetle" because of the damage it can cause to dried herbarium specimens. They have also been found infesting rodent bait. The adult beetle is light brown, 1/8" long, with a distinctive hump-backed look. The small larva is grub-shaped and whitish, with yellow-brown markings on the head and long hairs that make it appear fuzzy.

- **Drugstore beetles** (*Stegobium paniceum*) feed on a wide variety of foods and spices, particularly paprika or red pepper. They are also a serious pest of books and manuscripts, and have been known to chew through tin foil and lead sheeting. The adult beetle is similar to the cigarette beetle.

- **Saw-toothed grain beetles** (*Oryzaephilus surinamensis*) feed on cereal products and can readily penetrate packaged foods. The adults are 1/10" long, flat, narrow, and dark brown. The larvae are extremely small and rest in a C shape.

- **Lesser grain borers** *(Rhyzopertha dominica*) feed on whole grain products, wood and paper. Adults are 1/8" long and a shiny red brown to dark brown.

- **Red flour beetles** (*Tribolium castaneum*) feed on flour, processed grains and museum specimens. They are 1/7" long and are shiny and reddish-brown. The larvae are 3/16" long and yellowish-white.

- **Confused flour beetles** (*Tribolium confusum*) are principally a pest of stored cereals, flour, and spices, but also infest some museum specimens, including herbaria and freeze-dried animal specimens. They are 1/10 - 1/5" long and are a dark reddish-brown.

- **Foreign grain beetles** (*Ahasverus advena)* feed on mold growth in grains but do not actually damage grain. They are 1/10" long and reddish-brown. They indicate a moisture problem in the museum.

- **Cadelle beetles** (*Tenibrioides maurintanicus*) feed on a wide variety of stored, whole grain and processed products as well as wood objects. They are 1/3" and a shiny black color. The 1/3" long larvae are gray-white with black heads with two horn-like projections.

- **Spider beetles** (Various genera and species) feed on plant and animal materials and processed foods and often bore into wood, textiles, jute, linens, cellophane, plastic, cardboard, and packaging materials. They can digest keratin and commonly infest animal skins, wool, and feathers. Adults are 1/16 - 3/16" long, oval to cylindrical, red to black and shiny. Larvae are small C-shaped grubs.

- **Red-legged ham beetles** (*Necrobia rufipes*) primarily attack animal matter and food materials such as dried and smoked meats and also attack bones, hides, mummies, vegetable matter, museum specimens, silk, cotton, and wool. The adults are 1/8 - 1/3" long, and are dark metallic blue with red legs. The 3/8" long larvae are white with a dark brown head.

Action threshold *for stored product pests is the sighting of one larva or adult insect or any traces of the insect or damage to objects that indicate an active infestation, such as feeding damage or exit holes.* For management actions, refer to Section F, Control Actions.

6. What are moisture pests?

Not only is moisture a threat to collections itself, it may attract a number of moisture-loving pests such as silverfish and psocids that can do additional damage. Molds are a threat in damp conditions and can attract insects that feed on those molds.

- **Silverfish** (*Lepisma saccharina*) and **firebrats** (*Thermobia domestica*) eat fabrics, paper and sizing, and glue and paste in book bindings. They are omnivorous and will eat protein materials as well as cellulose. They are especially damaging in dark, damp storage areas. They have a distinct carrot shaped body, short legs, long slender antennae, and three tail-like appendages. Silverfish hide in cracks and crevices such as in the gap between the floor/wall molding. Their frass is granular to the touch. See Figure 5.18, Sample Action Plan: Silverfish, for more information.

- **Springtails** are an indicator of a moisture problem but are not considered a museum pest. They are wingless insects, about 1/16 - 1/8" long that feed on microscopic mold, and usually target damp or moldy materials, wallpaper, and new plaster. They vary in color and can be white, gray, yellow, orange, metallic green, lavender or red. Springtails often come in through gaps in the door or window on the ground level. See Figure 5.18, Sample Action Plan: Springtails, for more information.

- **Psocids** or booklice, are tiny insects, less than 1/16" long, and range in color from clear to light gray or light brown. Wingless psocids are commonly called booklice because they often infest damp, moldy books and feed on the mold growing on paper and the starchy glue in the binding. Psocids also infest objects such as dried plants in herbaria, insect collections, manuscripts, cardboard boxes, and furniture stuffed with flax, hemp, jute, or Spanish moss. Although psocids cause minimal damage, their presence indicates a moisture problem and the likely presence of damaging molds. See Figure 5.20, Sample Action Plan: Psocids, for more information.

- **Molds** are fungi that can cause damage or disintegration of organic matter. Although they lack roots, stems, leaves, or chlorophyll, molds occur nearly everywhere and fungal spores, essentially the seeds of the fungus, are easily transported. When moisture and other environmental conditions are right, molds can appear and cause significant damage to wood, textiles, books, fabrics, insect specimens, and many other objects in a collection. Their growth can be rapid under the right conditions. Whether molds attack suitable hosts in the museum depends almost exclusively on the presence of moisture. When moisture becomes a problem, molds will likely become a problem too.

To avoid mold and other museum pests, do not house or exhibit museum objects in humidity above 65%. Be aware, however, that some molds can grow at a lower humidity.

"Active" mold is often damp, smeary and varies in color, including black and green, and requires prompt action. "Inactive" mold is dry, often powdery and usually white in color, but can become active again under certain environmental conditions including high RH. Both active and inactive mold can be health risks and require proper personal protective equipment when dealing with infestations. Consult the park safety officer for mold clean-up procedures and protective measures. See Figure 5.21, Sample Action Plan: Molds, for more information.

Action threshold *for moisture pests is the sighting of one larva or adult insect or any traces of the insect or organism or damage to objects that indicate an active infestation, such as feeding damage.* For management actions, refer to section F, Control Actions.

7. What rodents should I be concerned about?

Rodents can cause extensive damage to museum collections through nesting, excreting, chewing, and soiling collections with dirt and grease. Rats in particular have powerful teeth capable of chewing through concrete, aluminum, plaster, and wood but have more difficulty gnawing on smooth surfaces. Mice and rat nests provide habitats to insects, such as carpet beetles fleas, ticks, and bed bugs, which can create a secondary pest issue in the structure.

Rodents present a human health risk to employees and visitors as they are disease vectors and hence cannot be tolerated indoors. Due to rodent related deaths, regular rodent inspections in NPS structures are now required. See Section G.10 for information on diseases spread by mice and rats. **The most effective way to deal with rodents is to *exclude* them from the structure.** See Figure 5.22, Sample Action Plan: Mice and Rats, for more information.

- **Mice** are the most common indoor rodent pests and include house mice, deer mice and white-footed mice. They breed year round and can produce large numbers of young each year so mouse populations can easily explode if conditions are right for their survival. Mice are exceptionally agile; they can jump 12"or more off the floor and squeeze though spaces only 1/4" in diameter, the size of a pencil. They are most active in the night. House mice rarely travel more than 30 feet from their nest to food, while white-footed mice may travel over 200 feet to food. Mice are curious, easy to snap trap, prefer to eat human foods, and chew on many collection materials for food and nesting.

- **Rats** include roof rats, Norway rats, and wood or "pack" rats. They produce less young than mice, about 20 per year. Rats can jump three feet high, climb vertically and swim. They can squeeze through holes 1/2" in diameter. Rats range from 100 - 150 feet of their nest. They damage structures by gnawing corners of doors, infesting attics, basements and crawl spaces, etc. Rats may create large nests, using upholstery materials from furniture and items brought in from outdoors. Pack rats may steal items from collection storage for their nests.

- **Squirrels** primarily damage structures by gnawing their way into attics, damaging insulation, and nesting. They infest attics, wall voids, crawl spaces, and chimneys and enter buildings through trees and branches within ten feet of the buildings, electricity utility lines, fire escapes, chimneys and occasionally downspouts. Squirrels can introduce fleas and ticks into a structure creating potential for secondary pests and human health risks.

- **Chipmunks** cause structural damage by digging under building foundations. They infest basements, wall voids, attics, crawl spaces, and chimneys and enter buildings through trees and bushes close to the structure and openings near the foundation of the structure.

Action threshold *for rodents is the sighting of one rodent or any traces of rodents or damage to objects that indicate an active infestation, such as droppings, fresh gnawing, and grease marks along walls.* For management actions, refer to section F, Control Actions.

8. What other vertebrates can damage museum collections?

Birds and bats can also infest structures housing collections.

- **Birds** may roost or nest on the exterior of structures and on occasion gain access to the interior containing museum collections by entering through attics, eaves and vents. Professional exclusion is key to keeping birds out of, and off structures as bird nests harbor other pests, such as dermestids, mites, and bat bugs, and bird droppings that can damage objects. Birds can present a human health risk through diseases in their droppings such as histoplasmosis. Swallows and pigeons are a particular problem for many museums. Contact your IPM Coordinator, wildlife biologist, and safety officer for assistance. Note that some birds are protected species under the Migratory Bird Treaty Act and removal must be planned accordingly.

- **Bats** should be excluded from human occupied structures. They rarely directly damage collections objects but their roosts provide harborage for potential indoor insect pests and mites. They seek harborage in attics, wall voids and occasionally basements. Their droppings (guano) provide food for insects, stain ceilings, walls, and historic furnishings and cause a strong odor. Bats may carry rabies and their guano may contain histoplasmosis, two serious diseases that affect people. Contact your IPM Coordinator, wildlife biologist and safety officer for assistance, consult a professional and check the Bat Conservation International website. Note that some bats are protected species and removal must be planned accordingly.

Action threshold *for other vertebrates is the sighting of one pest or any traces of the pest or damage to objects that indicate an active infestation.* For management actions, refer to section F, Control Actions.

9. What are general pests?

Any household pest may become a pest in a museum. Many kinds of pests can get into a structure that has a moisture problem or that has not been well sealed. Cockroaches, crickets, spiders, ants, millipedes, lady bugs, flies, wasps, and other common insects can invade and infest museums, visitor centers, historic house museums and other structures. Their nests and carcasses can attract many other kinds of pests that damage the collections. Some are museum pests as they can cause direct damage to collections through nesting and feeding behavior. Other pests, called perimeter invaders, do not eat collections but can indicate sanitation and moisture problems and areas where exclusion measures need to be implemented.

The following general pests are considered **museum pests**, as they will feed on museum collections:

- **Cockroaches** can present risks to museum items by feeding and defecating on items. They can present health risks to people in occupied structures. It is critical to identify the species of roach in order to develop an effective management strategy.

  – **German cockroaches** (*Blatella germanica*) are omnivorous, live indoors and are the most common cockroach found in the U.S. They feed on starches, sweets, grease, meat products, soap, leather, paper, glues, animal skins, and hair. They are especially attracted to objects stained with sweat. They damage objects through chewing and depositing various bodily fluids through fecal spotting and regurgitation. They prefer warm temperatures and are commonly found in kitchens. German cockroaches are the most prolific cockroach.

  – **Brown-banded cockroaches** (*Supella longipalpa*) feed on paper, starchy materials, furniture, clothing and cardboard. Adults are 1/2" long and light brown with two light brown horizontal stripes on the back. These roaches prefer higher temperatures and drier areas. They are often found behind picture frames.

- **American cockroaches** (*Periplaneta americana*) feed on paper products as well as anything else available to them. They vary widely in size from 1 3/8" to 2 1/8" long and have reddish-brown wings with light markings around the perimeter.

- **Oriental cockroaches** *(Blatella orientalis*) feed on a wide variety of food and decaying organic matter and often damage or contaminate paper and starchy goods. They prefer moist environments and can live outdoors in mulch. Adult males are about 1" long and females about 11/4" long. They are usually shiny black but may vary to reddish-dark brown.

- **House crickets** (*Acheta domesticus*) commonly enter structures at the onset of cold weather. Like cockroaches, they are omnivorous and will eat protein and cellulosic materials. These include textiles (wool, silk, linen, and cotton), leather, animal skins and fur. They are attracted to stains.

- **Camel Back crickets** (*Ceuthopilus maculatus*) enter structures in extreme weather (excessive rain, extended heat) and are attracted to cool and humid environments. Although not generally considered a museum pest, these crickets can damage stored objects if the problem goes unchecked for some time and the crickets cannot find suitable food.

The following general pests are considered **perimeter invaders** because they can infest museums but will not eat collections objects:

- **Ants** are social insects, similar to termites and certain bees and wasps. They live in large cooperative groups or colonies consisting of queens, males and workers. The six most common ant species that infest structures are the pavement ant, thief ant, crazy ant, field ant, Pharaoh ant, and Argentine ant. Other than carpenter ants that damage wood, ants are not generally considered museum pests. However, many ants can damage wood, paper, glue, and other organic materials. Most are attracted to foodstuffs and may present health hazards. An ant problem indicates excess moisture and inadequate pest exclusion and sanitation.

  - **Odorous house ants** (*Tapinoma sessile*) eat a wide variety of human foods, particularly sweet food. They are dark brown to black and 1/8" long. Their name derives from the rotten coconut-like odor they emit when crushed. They nest in wall and floor voids and are attracted to warm, moist areas.

  - **Crazy ants** (*Paratrechina longicronis*) will feed on most human foods, though they prefer living and dead insects and seeds. They nest in floor voids and carpeting or next to structure foundations and are attracted to moist conditions. They are dark brown to black, 1/8" long and have long legs and antennae.

- **Spiders** are not considered museum pests but can be a risk to human health and safety. Some medically dangerous spiders include the brown recluse spider, the widow spiders, and the aggressive house spider. Spiders may indicate problems with sanitation and exclusion. The presence of spiders may indicate the presence of other insect pests upon which they feed, and their webs can indicate where insects are entering the structure.

- **Scorpions** are not considered museum pests but are a hazard to human health and safety. They are most common in the Southwest but other species are found in Florida, Hawaii and the Southeast. The bark scorpion is the only type with a life-threatening sting; however, others are venomous.

Action threshold *for general pests is the sighting of one larva or adult insect or any traces of the insect or damage to objects that indicate an active infestation*. For management actions, refer to section F, Control Actions.

10. What kinds of health hazards can museum pests cause?

Mice and rats (commensal and native) are known to spread plague, typhus, rat-bite fever, lymphocytic choriomeningitis virus, trichinosis, salmonella food poisoning, tularemia, leptospirosis, endemic relapsing fever, Rocky Mountain spotted fever, and Q-fever. Rodent parasites, such as fleas and ticks, contribute to the spread of some of these diseases. Deer mice (*Peromyscus maniculatus*) are the most common transmitters of hantavirus, but the virus is also carried by the cotton rat (*Sigmodon hispidus*), rice rat (*Oryzomys palustris*) and white-footed mouse (*Peromyscus leucopus*). Refer to *COG* 2/8 for more information. Microorganisms such as mold also present health risks to those with allergies. Spiders and scorpions can have poisonous bites. Bat and bird droppings are associated with histoplasmosis, psittacosis, and cryptococcus.

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I. List of Figures

Sample Museum IPM Plan

Prepared by:	______________________	__________
	Title	Date
Recommended by:	______________________	__________
	Park Curator	Date
Approved by:	______________________	__________
	Superintendent	Date
Concurred by:	______________________	__________
	IPM Coordinator	Date
Concurred by:	______________________	__________
	Chief, Facilities Management	Date
Concurred by:	______________________	__________
	Public Health/Industrial Hygienist	Date

Figure 5.2 Sample Museum IPM Plan

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Figure 5.2 Sample Museum IPM Plan (continued)

A. Introduction and Objectives

This Museum Integrated Pest Management (IPM) plan was developed to protect collections from museum pests. Museum IPM is essential to eliminating conditions that support pests. It uses a variety of techniques to exclude pests in areas that house collections, including preventive maintenance, effective housekeeping, and mechanical and cultural control actions. Ongoing evaluation is critical to determining the effectiveness of the plan. The plan may be modified based on the results of the evaluation.

The objectives of the museum IPM plan are to:

- Eliminate, reduce, or prevent the presence of pests and pest damage in areas housing collections by modifying human behavior to eliminate food, water, harborage and environmental conditions that support pests.
- Eliminate, reduce or prevent the presence of pests in areas housing collections through proper design of the structure, storage and exhibit areas, and exterior landscaping.
- Reduce pesticide use in collections.
- Define the roles and responsibilities of staff in relation to museum IPM and housekeeping duties.
- Ensure that all staff, including those who do not have specific assigned IPM roles, understands park management objectives, and their roles and responsibilities in implementing IPM.
- Establish a comprehensive inspection and monitoring program and action thresholds.
- Document control actions, inspection, and monitoring, and include the date and person who implemented the action.
- Evaluate the effectiveness of the IPM program and modify the plan based on evaluation results as necessary.

B. Statutes and Mandates

All actions outlined in this plan are in accordance with the Federal Insecticide, Fungicide, and Rodenticide Act(FIFRA), 7 U.S.C 136-136y; the Federal Code of Regulations (40 CFR); President Carter's 1979 Integrated Pest Management Memorandum from the President; Department of the Interior *Departmental Manual (DM)*, Part 517, Chapter 1, Integrated Pest Management Policy; *DM*, Part 411, Museum Property Management; Director's Order (DO) #24 4.3.9, Integrated Pest Management; National Park Service (NPS) *Management Policies* (2006); NPS - 77 Natural Resources Management Guideline; and the NPS *Museum Handbook, Part I,* Museum Collections.

C. Background and Site Description

The park's museum collections are housed in various locations and structures in the park; a storage facility, furnished historic structure, and on exhibit in the visitor center/museum. The structures are composed of different material and have different modifications that exclude pests. All areas housing museum collections are regularly inspected and monitored for evidence of pests, areas of potential pest access and attraction, moisture problems, and identification of susceptible objects. Dataloggers are used to monitor temperature and RH in each structure. Excess moisture is a major contributor to potential pest problems so the RH must never exceed 65%. The RH has fluctuated seasonally in the past but has not exceeded 65%. The park has a *Housekeeping Plan for Museum Collections* (2012) and *Collections Management Policy* (CMP) (2012) that document IPM activities.

- **Collections Storage Facility**
  The collections storage facility is constructed of metal and brick with a pitched roof and a concrete pad floor. It is a standalone, purpose-built structure consisting of one floor with two exterior doors and no windows. Maintenance staff collects all garbage and vacuums the floors with vacuums fitted with HEPA filters. Curatorial staff performs all other housekeeping and cleaning tasks. The collections are housed in well-sealed museum-quality metal cabinets.

- **Furnished Historic Structure**
  The furnished historic house, built in the early 20th century, is constructed of a cement block and stone

Figure 5.2 Sample Museum IPM Plan (continued)

foundation with a slate shingle roof. A steel frame supports the brick walls. There are three exterior doors and several single pane sash windows on both floors. The floors are a mix of original hard wood and carpet. Maintenance staff collects garbage and vacuums with HEPA filters daily. Curatorial staff performs all other housekeeping and cleaning duties. Rooms on the first and second floor are fully furnished with original furnishings, and are on view by the public on self-guided tours. Museum objects are on open display and are not enclosed in cases. A large yard with several trees and garden plots surrounds the structure.

- **Visitor Center/Museum**
  The Visitor Center/Museum is an adapted concrete block structure. Maintenance staff collects trash and vacuums with HEPA filters daily. There are nine exhibit cases in the museum area. The exhibit room is carpet over concrete, with drywall and plaster ceilings and walls.

D. Staffing Responsibilities

The individuals noted below are responsible for the development and implementation of this museum IPM plan:

- *Superintendent* has ultimate responsibility for the park and museum IPM programs and ensures sufficient staffing, training, and funding to effectively implement and maintain a pro-active museum IPM program.

- *Park curator* is responsible for the care of the collections, monitoring for pests in all spaces containing collections, and implementing the museum IPM plan.

- *Park IPM coordinator* establishes pest management priorities for the park, approves or denies proposed pesticide use, assists the museum curator with prevention, detection, and management of potential and current pest problems, periodically reviews museum pest monitoring reports, educates staff to detect evidence of pest infestations, and if necessary, consults with the park natural resources staff.

- *Regional IPM coordinator* is responsible for alerting park IPM coordinators of new pest issues and technology, approves or denies proposed pesticide applications on a case-by case basis and serves as the liaison between the park and the service-wide IPM coordinator in providing IPM training and information to develop management strategies.

- *Maintenance staff* is trained in recognizing the potential signs of pests and contacts the Park IPM Coordinator and curatorial staff if signs of museum pests are detected. Schedules routine maintenance of, and upgrades to structures housing collections, in consultation with park curatorial staff.

- *Park safety officer* is consulted for public health issues and any proposed pesticide use. The park safety officer is aware of what pesticides are being proposed for use in the museum and who is using them and ensures that they are used safely.

All staff working in and around museum collections are responsible for adhering to IPM practices such as prohibiting food in collections areas.

E. Preventive Pest Management

- **Monitoring and Inspection**

Monitoring shows trends in pest activity and allows you to prioritize your management efforts. It allows you to systematically and continuously keep track of all pest activity in collections areas, through routinely inspecting spaces and objects, establishing a pest trapping program to detect pest activity and thoroughly documenting all infestations. Monitoring also tracks by date; housekeeping, modifications on the structure and other activities that

Figure 5.2 Sample Museum IPM Plan (continued)

may affect pest occurrences. Inspection includes close examination of spaces and objects for any evidence of an infestation and is a critical part of pest monitoring programs. Inspecting and monitoring for pests and monitoring the environment and human use of it provides quantitative and qualitative information important to preventing infestations. Staff conducts the steps outlined below to monitor for pests.

– **Routine Inspection of Structure(s)/Area(s) Housing Collections**
  Schedule routine inspections of all areas housing collections. Do a regular and thorough search of the entire structure containing collections at least once every six months. Inspect all doorways and hallways with outside access as well as windowsills monthly. When using an insect sticky trap program, inspect traps weekly.

  Inspect for evidence of museum pest infestations. Search the collections areas and objects for:
  - Discovery of flying adult or crawling larval insects
  - Moth or beetle pupae
  - Pupal tubes or cases
  - Insects captured in traps or in ceiling light fixtures
  - Chewing or gnawing marks
  - Feeding or exit holes
  - "Grazed" surfaces
  - Presence of feeding debris or fecal pellets/droppings/frass (insect waste, which is usually a soft powdery material) around or below objects
  - Presence of frass falling from voids (ceiling tiles, electrical switch plates, etc.)
  - Shed/cast skins
  - Webbing
  - Nest/burrows
  - Food caches
  - Flyspecks
  - Hair falling from fur or pelts
  - Missing pile from rugs
  - Rodent smudge/grease marks
  - Odors or sounds infested or damaged food or food packaging
  - Bait consumption

  Inspect for pests in the following common harborage sites:
  - Areas inside and under drawers, cabinets, and furniture
  - Attics and store rooms where rodents or other pests may have made food caches
  - Above drop ceilings, and inside elevator shafts and light fixtures
  - Fireplaces and chimneys
  - Inside electrical equipment and motors (including computers)
  - Entry points into the structure and into areas housing collections, such as window sills and door jambs
  - Near water sources such as drains and sinks
  - Doorways and hallways with outside access
  - In stored cardboard or wooden pallets housing collections
  - Behind baseboards or wall trim and in inaccessible wall voids which could hold dead animal carcasses. Maintenance staff does this in consultation with a historic architect.

  Use these tools for inspections:
  - Flashlight
  - Magnifying glass
  - Nitrile gloves
  - Tape measure
  - Camera
  - Screwdrivers
  - Step ladder

Figure 5.2 Sample Museum IPM Plan (continued)

- Mirror to view up chimneys
- Sticky labels or marker for numbering traps
- Long wave UV black light (requires protective eyewear)
- Dust mask (NIOSH-approved disposable filtering facepiece respirator with two straps. The park safety officer may require that you wear a respirator for inspections involving mold, bird or bat droppings, or heavy dust. If a respirator is needed, the user must be in a respiratory protection program. For inspections involving rodent infestations, see *COG* 2/8: "Hantavirus Disease Health and Safety Update").
- Talc (sprinkle on expected rodent pathways, such as against floorboards to detect rodent tracks in rooms not open to the public to indicate mice activity. For use in an historic structure, sprinkle talc onto Mylar®. As talc may be a respiratory hazard, consult with the safety officer before using).

Create a separate tool kit for inspections involving rodents. See *COG* 2/8 for more information.

Record any evidence of pests found in spaces housing collections, such as food caches, frass or rodent smudge marks, in Figure 5.7, Sample Pest Trap and Evidence Monitoring Log. Complete a Pest Incident Report, Figure 5.3, with the discovery of any pests, damage, or pest evidence on museum objects. Keep one copy of the Pest Incident Report in the Museum IPM Binder and one copy with the accession or catalog folder.

– **Routine Inspection of Objects in Storage and on Exhibit**
Routinely inspect collections objects on exhibit and in storage for the signs of pest infestations described above. Do spot checks every six months in collections areas in and around objects. Spot check biological, natural history, and ethnographic objects every three months. Document all findings and complete a Sample Pest Incident Report (blank), Figure 5.3, if pest evidence is found on objects.

– **Routine Inspection and Isolation of Incoming Objects**
Inspect and isolate all incoming objects, including new and returning loans, for possible pest infestations or microorganisms before they enter the collections storage or exhibit areas.

- Upon receiving the objects, immediately place them in the isolation room for inspection and isolation.

- Locate the isolation room adjacent to the shipping and receiving area. Do not locate it within the collections area. The isolation room must be well sealed and have good lighting. If this is not possible, isolate objects in a well-sealed cabinet outside of the collections area.

- Inspect objects using good lighting and magnifying lenses on a table with a white surface (or over white paper) where any fallen insects, frass, etc. can be readily noticed.

- Examine the underside of furniture and pallets for webbing and insect eggs.

- Inspect wooden objects for exit holes of wood-boring insects.

- Use a UV black light in the dark to detect some kinds of mold on objects. Place objects with evidence of mold in a lidded cardboard box and isolate them.

- Isolate all objects for at least one month before they enter collection areas. Living pests can usually be detected within this period. However, insect eggs can be dormant for years depending on the species. Mold can also lie dormant. The exception is objects made of metal, glass, ceramic, or stone, which need to be inspected but not isolated. Consult the regional curator, conservator, IPM manager or entomologist to determine the appropriate isolation period.

- Re-inspect objects for signs of an infestation throughout the isolation period.

Figure 5.2 Sample Museum IPM Plan (continued)

- If pests or evidence of pests are found during inspection, follow the steps listed in “responding to Infestations” in Section H below. Remove pest evidence by vacuuming it off with a HEPA filter. Treat potentially infested objects with a freezer treatment, mechanical cleaning, or other appropriate method.

- Similarly handle non-collection materials such as packing materials and exhibit construction materials but house these separately from collection areas. Immediately discard any packing materials that cannot be verified as pest-free, such as cardboard, in an exterior garbage container.

– **Pest Trapping Program**
Physical controls such as traps include insect sticky traps, rodent snap traps, light traps, and pheromone traps. Inspect traps monthly under normal circumstances, and every one to two weeks when infestations are present or suspected. Inspect rodent snap traps daily. Replace traps every few months. Record the following information for each trap:

- Trap number
- Trap location
- Inspection date
- Pest species
- Number of individuals per species found in the trap
- Life stage of the species, unusual conditions and replacement date for the trap and other useful information
- Photographs of unidentifiable species

Refer to the schematic diagram of the building housing collections and for each numbered trap. Record data about pests found in each trap on a trap monitoring log. See Figure 5.11, Sample Floor Plan with Trap Locations, and Figure 5.7, Sample Pest Trap and Evidence Monitoring Log (blank).

Locate traps in collection and non-collection areas:

- Along perimeter walls
- In corners
- Near doors
- Near windows and other light sources
- Under storage and other furniture
- Near water sources
- Near drains
- Near heat sources
- Inside and outside exhibit and storage cabinets
- Near objects out in the open or that are pest susceptible

When using rodent snap traps, place two traps at each trap station parallel with the wall, or place a single trap with its trigger end against the wall. Locate trap stations every six to ten linear feet along walls and runways used by rodents. Place traps behind objects, under furniture, against walls, or in other locations where rodents find concealment. Bait all rodent snap traps with peanut butter or cotton tied to trap’s trigger to catch and control pests. Note that snap traps are also effective without bait.

Regularly empty all types of traps so they do not attract other pests.

– **Documentation**
Retain all IPM inspection and monitoring records permanently in the following:

- **IPM Binder:** file all related data, including printouts of pest monitoring data, environmental monitoring reports correlating to pest monitoring reports, Pest Incident Reports, Freezer Treatment Records, site inspection worksheets, copies of Pesticide Use Proposal forms, annual pesticide use logs, dated control

Figure 5.2 Sample Museum IPM Plan (continued)

actions records (such as pesticides, exclusion improvements, freezer treatment, or anoxic treatment), Material Safety Data Sheets (MSDS), pest identification documentation, and pertinent contacts.

- **Catalog record:** records information about a specific object and its history of pest problems and associated treatments.

- **IPM information system:** includes pest monitoring data, including the species and quantity of pest caught, trap location, type of trap, and date of the catch. Information is recorded in an electronic format such as a computer database or a hard copy such as a paper log. See Figure 5.10, Sample Pest Monitoring Database Report (completed) and Figure 5.8, Sample Pest Trap and Evidence Monitoring Log (completed).

- **NPS Intranet Pesticide Use Proposal System (PUPS) database:** propose/request the use of pesticides and annually report the park's Pesticide Use Log. The system is accessible at: https://irma.nps.gov/PUPS/

– **Environmental Monitoring**

Correlate museum environmental monitoring data with pest monitoring data to determine if environmental conditions are causing pest problems. Note extremes in RH and temperature. Compare pest monitoring data with exterior weather conditions, as extreme conditions can drive pests indoors. Compare trends in pests, especially moisture-indicating ones (such as silverfish, booklice, and springtails) with information from the datalogger records as monitoring continues.

– **Museum Housekeeping**

The IPM plan is an integral part of the museum housekeeping plan. The housekeeping plan outlines scheduled cleaning of the collections and non-collections areas and also outlines policies and procedures to limit pest infestations such as food and plant restrictions.

F. Pest Identification and Injury and Action Thresholds

Identify and document species as specifically as possible (genus, species). Maintain a reference collection of dead pests for identification purposes. Encourage maintenance staff to bring pests to curatorial staff labeled with the date, time, and exact location of catch. Record all finds in the computer database or paper log. See the documentation section above for more information. Create action plans for pests as appropriate.

The action threshold is the point at which pest levels indicate that collections will be damaged if action is not taken. **The action threshold for organisms identified as "museum pests" is the sighting of one larva or adult museum pest, any traces of the pest, or damage to objects that indicate an active infestation**. When action thresholds are exceeded, proceed with control actions.

G. Control Actions

Pest control methods rely on good exclusion, housekeeping, reductions in harborage available to pests, and continual trapping. These usually eliminate the need for pesticides. These include cultural and mechanical control actions, described below.

- **Exclusion**

Exclusion is critical and extremely effective. Pest entryways may be as small as hairline cracks in walls or as large as gaps under a door, holes around pipe traces, uncapped chimneys, open doors, or the complete absence of screens on windows. Entry holes for rodents can be as small as 1/4" in diameter.

Correct exclusion deficiencies by sealing through:

- caulking
- carpentry repairs
- door sweeps
- gaskets

Figure 5.2 Sample Museum IPM Plan (continued)

- screens
- filters on air vents and hot air registers

Use sealant such as:

- caulk
- cement
- urethane expandable foam
- copper wool
- copper mesh
- other suitable sealant

- **Eliminating Pest Food Sources**

Work with staff to ensure that all cultural controls relating to eliminating pest food are followed. Ensure that staff is aware of the policies relating to food and drink in structures housing collections.

- Be alert to possible sources of food available to pests throughout the building while performing inspections.
- Regularly inspect wall voids, attics and interiors of suspended ceilings for possible food sources.
- Regularly check attics for dead insects or animal carcasses. Promptly remove and properly dispose of pests and their traces.
- Remove all possible sources of pest food materials, including decorative live plants, live flowers, food, and dirt. Do not allow live or potted plants in structures containing museum collections. Use artificial plants and flowers.
- Do not allow any food into areas housing collections. Designate an area away from collections where staff can eat, such as a break room. Keep all food sealed in containers with lids.
- Properly dispose of trash in sealed containers and remove from building daily, including trash from staff offices and break rooms.

- **Eliminating Moisture**

- Identify and concentrate inspections on sources of dampness that may attract microorganisms, fungus feeding beetles, flies, mites, silverfish, booklice, springtails, and other pests.
- Promptly repair plumbing, sewer, roof, window, and building leaks.
- Insulate cold water pipes to prevent the formation of condensation.
- Correct sub-floor moisture problems by increasing ventilation or by placing moisture barriers beneath buildings, if appropriate, in consultation with the facilities manager and a historic architect.
- Correct poor drainage slopes away from the building in collaboration with maintenance staff.
- Maintain a stable RH and temperature with an allowable seasonal drift in areas housing collections. Keep spaces cool and dry (below 65% RH). See *MH-I,* Museum Collections Environment, Chapter 4 for more information on environmental controls.

- **Eliminating Harborage**

Work with facilities management and a historic architect where appropriate to find ways to eliminate harborage.

- Remove clutter and debris from areas housing museum collections.
- Move boxes and other items stored on floors to shelving and cabinets and keep them neatly arranged.
- Establish an 18 - 30" wide vegetation-free zone of gravel four inches deep around buildings that house museum collections to create a hostile environment for pests. This may not be appropriate for some historic structures. Work with facilities management to find an alternative solution.
- Keep area next to building foundations free of grass and bushes and trim back tree and shrub limbs that provide shelter and food for insects and other animals or serve as "vegetation ladders." Work with facilities management to find an appropriate solution for historic structures.

- Promptly remove bird and insect nests from building exteriors.

Figure 5.2 Sample Museum IPM Plan (continued)

- Eliminate any animal burrows under buildings that house museum collections.
- Remove piles of wood, stone, building materials, trash, and other material near structures housing collections.
- Work with facilities management to fill low spots in the ground that accumulate water run-off, and eliminate other water-holding sources.
- Keep the areas around garbage dumpsters clean. Regularly remove garbage and immediately clean up spills.

- **Habitat Modification**

- Deny birds roosting or nesting opportunities on or against structures that house museum collections.
- Mount outside lights 30 or more feet from structures housing museum collections rather than mounting on structures to prevent pests from being attracted towards the lights.
- Use high-pressure sodium vapor lamps around buildings that attract fewer insects and are more energy efficient.

H. Actions if Pests are Found

- **Responding to Infestations**

Follow the steps noted below to stop an infestation and prevent it from recurring.

- Document what, where and when you see signs of pest activity immediately.
- Isolate the infested object immediately. Wearing gloves, place infested object in a well-sealed plastic bag and double bag. **Never** carry infested objects through the collection without thoroughly isolating them as eggs or larvae can be accidently dropped and the infestation spread. Move the infested object to an isolation room outside of the collections area.
- Determine the extent of the infestation. Start at the location where the first infested object was found and inspect the collections/areas in ever widening circles. Immediately isolate additional infested objects as they are found and document the findings.
- Identify the pests and pest traces.
- Clean the area surrounding the removed infested object.
- Clean the object.
- Determine object treatment options in consultation with a conservator. Document the treatment.
- After treatment, determine how to long to isolate the object before returning to storage or exhibit.
- Determine the source of the infestation. Collaborate with appropriate staff to address the problem.
- Increase inspection and monitoring of the area to confirm that you have eliminated the infestation.

Note: **Do not follow these procedures if there is a mouse or rat infestation**. Follow the procedures listed in *COG* 2/8 to avoid risk of hantavirus.

- **Treatment for an Infested Object**

Before treatment, identify the pest to determine that it is a museum pest and will cause damage to museum objects. Contact the park IPM coordinator for assistance.

- **Cleaning:**
  - Remove all traces of the pest from the object. Dead pests, larval skins, and nests can attract other pests.
  - If an infestation is limited to a single object and has not progressed too far, careful vacuuming with HEPA filters may remove the problem. Before cleaning, ensure the structure of the object can withstand the stress of vacuuming. Use screening material on the HEPA attachment/tube when vacuuming museum objects. Cleaning will probably not remove all eggs, as some can be microscopic. Review the pest's biology and focus efforts on areas where eggs are likely to be deposited. Remove the vacuum bag from the building immediately so it does not become a source of new infestations. After cleaning, determine if further isolation time is needed.

Figure 5.2 Sample Museum IPM Plan (continued)

- Determine the life cycle of the pest and monitor the object until you are sure no more insects will hatch. Use this method to clean old or non-active infestations.

Note: When addressing a mouse or rat infestation, **do not sweep or vacuum,** as this increases the risk of transmission of hantavirus.

– **Freezer Treatment, also called low temperature treatment:**
  - Freezing is the method of choice for treating most active infestations of objects.
  - However, certain materials can be significantly damaged by freezing. Consult a conservator to determine what materials are appropriate for freezing.
  - See *COG* 3/6: "An Insect Pest Control Procedure: The Freezing Process" for procedures and further information.

– **Anoxic Treatment:**
  - Replacing the oxygen with a gas (nitrogen, argon, carbon dioxide) or using an oxygen scavenger/absorber in a closed space can kill insects and their eggs.
  - Consult a conservator to determine if the anoxic treatment is appropriate.
  - See *COG* 3/8:"Controlling Insect Pests: Alternatives to Pesticides", and *COG* 3/9:"Anoxic Microenvironments: A Treatment for Pest Control" for more information.

– **Fumigation/Pesticides:**
  - **Consult with the regional curator, the park IPM and a conservator when considering any fumigation or pesticide options.**
  - **All pesticide use must be approved PUPS.**
  - Conventional chemical fumigation is only appropriate if objects cannot be treated by other means, and is rarely recommended.
  - In the event fumigation is needed, work a professional applicator. Do not use space fumigants such as naphthalene, paradichlorobenzene, dichlorvos (Vapona, DDVP, No Pest strips), or thymol.
  - **Do not use pesticides directly on museum objects.** Persistent pesticides may leave residuals on objects and cause damage, and/or be a health risk.
  - Document any pesticide use through PUPS.

I. Evaluating the Museum IPM Plan

- Evaluate the effectiveness of the IPM plan through ongoing monitoring and evaluation of all documentation, including comparison of year-to-year and month- to-month inspection, monitoring, and trapping records.

- Review the environmental monitoring data to see if the control actions have successfully changed the environment.

- Evaluate implemented control actions on an ongoing basis to determine if they have been effective. For example, review exclusion actions and determine if the building envelope is adequately sealed by determining if pests are still entering the structure. If so, reevaluate and improve your exclusion methods to ensure that no pests will enter the structure.

- Determine if you have met the objectives stated in the IPM plan. Use this information to guide future pest management measures.

- Modify the IPM plan as necessary, based on the evaluation results.

J. Action Plans
Include an action plan for each relevant pest. Pest photographs or drawings may be included.

Figure 5.2 Sample Museum IPM Plan (continued)

National Park Service
Sample Object Pest Incident Report

Object: ________________________________
Catalog Number: ________________________________
Materials: ________________________________
Affected area of object: ________________________________
Object Location: ________________________________
Building Number: ________________________________
Date: ________________________________
Responsible Individual: ________________________________

Pest Observation

Number of pests observed: ___________
Living: ___________
Dead: ___________

Identification source: ____

	ant		fungus/mold		springtail
	cigarette beetle		mouse		termite
	clothes moth		powderpost beetle		other:
	cockroach		psocid		other:
	cricket		rat		unidentified
	dermestid beetle		silverfish		unidentified
	fly		spider		unidentified

Evidence Observation

	chewing		exit holes		missing rug piles		other:
	carcasses		flyspecks		odor		other:
	casings		frass		pest body parts		other:
	cast skins		grazed surfaces		staining		other:
	droppings		live insect/larvae		tunnels		other:
	eggs		losses		webbing		other:

Control Action Taken

	Control action	**Description**
	anoxic treatment	
	follow-up inspection (list frequency)	
	freezer treatment	
	isolation	
	mechanical cleaning	
	other:	

Description/Comments

____
____
____
____

Figure 5.3 Sample Pest Incident Report (blank)

National Park Service
Sample Object Pest Incident Report

Object: Hat
Catalog Number: PARK2014
Materials: Wool
Affected area of object: Interior, brim
Object Location: Collections Storage, Cabinet 3, drawer 5
Building Number: 1
Date: 9/1/2014
Responsible Individual: Jane Smith, Curator

Pest Observation

Number of pests observed: 1
Living: 0
Dead: 1

Identification source: Park reference collection

	ant		fungus/mold		springtail
	cigarette beetle		mouse		termite
	clothes moth		powderpost beetle		other:
	cockroach		psocid		other:
	cricket		rat		unidentified
X	dermestid beetle		silverfish		unidentified
	fly		spider		unidentified

Evidence Observation

	chewing		exit holes		missing rug piles		other:
X	carcasses		flyspecks		odor		other:
	casings	X	frass		pest body parts		other:
	cast skins	X	grazed surfaces		staining		other:
	droppings		live insect/larvae		tunnels		other:
	eggs		losses		webbing		other:

Control Action Taken

	Control action	**Description**
	anoxic treatment	
X	follow-up inspection (list frequency)	Inspect in 3 months
X	freezer treatment	One week at -4°F, 9/1/14-9/7/14
X	isolation	9/7/2014-10/7/2014
X	mechanical cleaning	Insect was removed, object was vacuumed
	other:	

Description/Comments
Carcass of a black carpet beetle discovered in interior of hat brim, hat has grazing damage and frass present. Object was bagged and moved to isolation room, conservator was consulted and determined that object should be given freezer treatment. Object was isolated in isolation room for one month following freezer treatment. Inspection following the isolation period revealed no further pests.

Figure 5.4 Sample Pest Incident Report (completed)

National Park Service
Sample Freezer Treatment Record

Object: ________________________________
Catalog Number: ________________________________
Materials: ________________________________
Pest: ________________________________
Object Location: ________________________________
Building Number: ________________________________

Date: ________________________________
Responsible Individual: ________________________________

Freezer
Brand name of freezer: ________________________________
Temperature reached during treatment: ________________________________
Time in freezer (calculate based on freezer temperature, object size, materials, and packaging): _______________

Procedures

1. Freezing Process

Wrapped in tissue paper and bagged?	
Date/time in	
Date/time freezer temperature reached	
Date/time out	
Total hours in	

2. Thawing Process

Object left in packaging?	
Temperature of isolation room	
Total time warmed to room temperature (minimum 24 hours)	

3. Isolation/Observation

Dates object isolated for	
Object inspected	
Additional pests observed?	

4. Follow Up

Pest Incident Report completed?	
Object Cleaning	

Comments

____
____
____

Figure 5.5 Sample Freezer Treatment Record (blank)

National Park Service
Sample Freezer Treatment Record

Object: Hat
Catalog Number: PARK2014
Materials: Wool
Pest: Black carpet beetle
Object Location: Collections Storage, Cabinet 3, drawer 5
Building Number: 1

Date: 9/1/2014
Responsible Individual: Jane Smith, Curator

Freezer
Brand name of freezer: X Brand chest freezer
Temperature reached during treatment: - 4°F
Time in freezer (calculate based on freezer temperature, object size, materials, and packaging): 7 days

Procedures

1. Freezing Process

Wrapped in tissue paper and bagged?	Yes
Date/time in	9/1/2014, 9:00 AM
Time freezer temperature reached	9/1/2014, 11:00 AM
Date/Time out	9/7/2014, 11:00 AM
Total hours in	168 (7 days)

2. Thawing Process

Object left in packaging?	Yes
Temperature of isolation room	70°F
Total time warmed to room temperature (minimum 24 hrs)	24 hours

3. Isolation/Observation

Dates object isolated for	9/7/2014 – 10/7/2014
Object inspected	Yes, weekly
Additional pests observed?	No

4. Follow Up

Pest Incident Report completed?	Yes
Object Cleaning	Insect removed, object vacuumed

Comments
Carcass of a black carpet beetle discovered in interior of hat brim, object was bagged and moved to isolation room. Conservator was consulted and determined that object should be given freezer treatment. Object was placed in X Brand freezer at - 4°F for one week. Object was isolated in isolation room for one month following freezer treatment. Inspection following the isolation period revealed no further pests.

Figure 5.6 Sample Freezer Treatment Record (completed)
National Park Service
Sample Pest Trap and Evidence Monitoring Log

Date Traps Set:______________________________ Date Traps Inspected:____________________________

Space Housing Museum Collections:____
Building Number: ___________________ Exhibit Space:____ Storage Space:_________
Name and Title of Inspector:____

List number of each type of pest present in the trap.

Trap number:	#	#	#	#	#	#	#	#
Location:								
ant								
cigarette beetle								
clothes moth								
cockroach								
cricket								
dermestid beetle								
fly								
fungus/mold								
mouse								
powderpost beetle								
psocid								
rat								
silverfish								
spider								
springtail								
termite								
other:								
other:								
unidentified								
Total pests:								

Pest Evidence Observation

	Evidence	**Location**		**Evidence**	**Location**
	bait consumption			live insect/larvae	
	carcasses			nests/burrows	
	casings			odor	
	cast skins			pest body parts	
	droppings			rodent smudges	
	food caches			sounds	
	frass			webbing	
	infested food			other:	

Comments

____
____

Figure 5.7 Sample Pest Trap and Evidence Monitoring Log (blank)
National Park Service
Sample Pest Trap and Evidence Monitoring Log

Date Traps Set: 8/26/2014 Date Traps Inspected: 9/1/2014

Space Housing Museum Collections: Collections storage room in Collections Storage Facility
Building Number: 1 Exhibit Space: Storage Space: X
Name and Title of Inspector: Jane Smith, Curator

List number of each type of pest present in the trap.

Trap number:	**#34**	**#35**	**#36**	**#37**	**#38**	**#41**	**#42**
Location:	W. door	W. wall	NW corner	WIF door	CDS door	NE corner	E. wall
ant							
cigarette beetle							
clothes moth							
cockroach							
cricket							
dermestid beetle						1	1
fly							
fungus/mold							
mouse							
powderpost beetle							
psocid							
rat							
silverfish							
spider	2						
springtail							
termite							
other:							
other:							
unidentified							
Total pests:	2					1	1

Pest Evidence Observation

	Evidence	**Location**		**Evidence**	**Location**
	bait consumption			live insect/larvae	
X	carcasses	Cabinet 3, drawer 5		nests/burrows	
	casings			odor	
	cast skins			pest body parts	
	droppings			rodent smudges	
	food caches			sounds	
X	frass	Cabinet 3, drawer 5	X	webbing	By #34, W. door
	infested food			other:	

Comments

Two spiders found in trap 34 and webbing found by trap 34. One dermestid larva found in trap 41 and one dermestid larva found in trap 42. Infested hat, PARK2014, found in Cabinet 3, drawer 5 on East wall. Infested object was bagged and removed to isolation room. All surrounding cabinets were searched for infested objects.

Figure 5.8 Sample Pest Trap and Evidence Monitoring Log (completed)

National Park Service
Sample Pest Database Report

Catch report for dates: ____________ Building name/number: ____________

Room	**Location**	**Date**	**Pest Name**	**Type Description**	**Trap Number**	**Quantity**	**Comments**
						Total:	

Figure 5.9 Sample Pest Monitoring Database Report (blank)

National Park Service
Sample Pest Database Report

Catch report for dates: 8/26/2014 to 9/1/2014

Building name/number: Collections Storage/1

Room	Location	Date	Pest Name	Type Description	Trap Number	Quantity	Comments
Lobby	West wall by interior door	9/1/2014	Odd beetle	Museum pest	1	1	
Restroom 1	South wall	9/1/2014	Springtail	Miscellaneous	7	1	
Curatorial Workroom	South wall behind door	9/1/2014	Black carpet beetle	Museum pest	10	1	
Museum Technician 1	South wall behind door	9/1/2014	Silverfish	Museum pest	12	1	
Curatorial Workroom	North wall behind door	9/1/2014	Spider	Predator	13	1	
Curator's Office	North wall behind door	9/1/2014	Spider	Predator	17	2	
Collections Storage	South wall behind door	9/1/2014	Spider	Predator	34	2	Webbing found nearby
Collections Storage	South wall behind door	9/1/2014	Dermestid larva	Museum pest	41	1	
Collections Storage	East wall by cabinet 3	9/1/2014	Dermestid larva	Museum pest	42	1	Black carpet beetle found on PARK2014, in cabinet 3, shelf 5
						Total: 11	

Figure 5.10 Sample Pest Monitoring Database Report (completed)

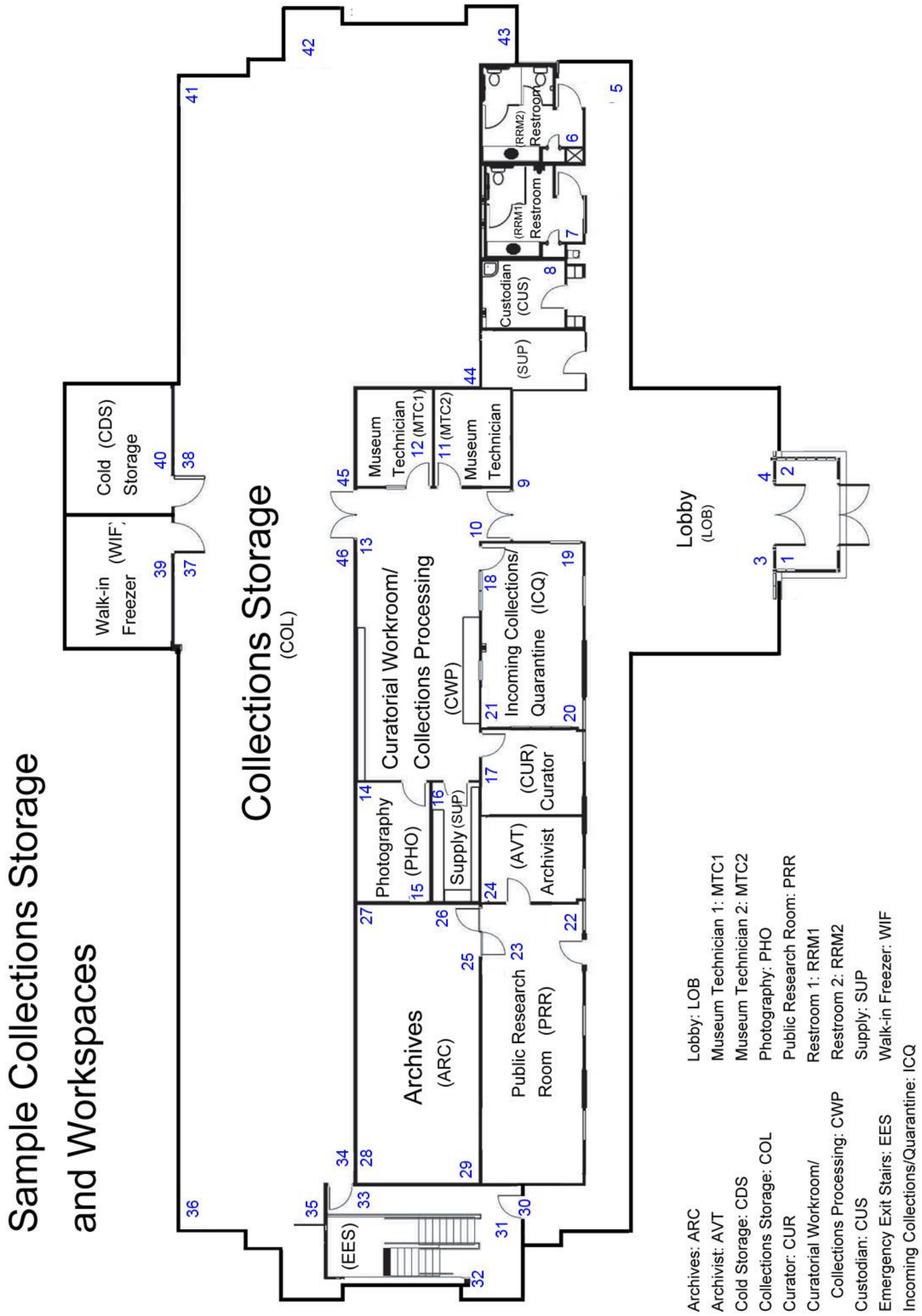

Figure 5.11 Sample Floor Plan with Trap Locations

National Park Service
Sample Pest Identification Request Letter

[Date]

[Name]
[Organization]
[Address]
[City, State Zip Code]

Dear [Name]:

The enclosed insect samples were found during monthly pest monitoring at [Park]. We would appreciate it if you would identify the insects circled in red in the enclosed sticky traps as specifically as possible. We are particularly interested in potential pests to museum objects. Please return the specimens to me so that I can refer to them in the future.

My address is: [Name, Title]
National Park Service
[Park]
[Address]
[City, State Zip Code]

Thank you very much for your help.

Sincerely,

[Name]
[Title]

Figure 5.12 Sample Pest Identification Request Letter (blank)

National Park Service
Sample Action Plan
Pest Type: Pest Name

Pest Description/Biology

Species

Damage

Monitoring and Inspection

Action Threshold

Control Actions

Non-chemical control

Prevention:

Management:

Chemical control

Pest Activity On-site

Known history of pest with date and locations of past infestations

Past control actions: freezer treatment

Figure 5.13 Sample Action Plan: Pest Name (blank)

National Park Service
Action Plan
Fabric Pest: Dermestid Beetles

Pest Description/Biology

Dermestid beetles cause the most damage to museum collections as larvae. Dermestid larvae hide in crevices, find nourishment by eating components of dust and other dead insects, and avoid light by burrowing deep into objects. Adults are attracted to light, come out of hiding to mate, and may collect along windowsills. See *MH-I*, Ch. 5, Biological Infestations, Section G.3, for more information.

Species: black carpet beetle, common carpet beetle, varied carpet beetle, furniture carpet beetle, hide beetle, larder beetle, black larder beetle, odd beetle, cabinet beetle, larger cabinet beetle, warehouse beetle

Damage

Dermestid larvae feed on a wide variety of materials including fur, feathers, wool and silk cloth, wool felt, wool or silk carpets, study skins, and taxidermy mounts. Dermestids also eat hair and horn, as they can digest keratin. Beetle larvae burrow into or graze the surfaces of their food.

Monitoring and Inspection

Ongoing, systematic monitoring is essential to determining if you have an infestation, including inspecting spaces and objects for pests and establishing a pest trapping program. Inspect for feeding damage, such as grazing or raised burrowing lines. Use insect sticky traps to monitor for presence of dermestid beetles. Place traps by windowsills to monitor for adult carpet beetles. Regularly inspect all sticky traps, as dermestid larvae will eat other pests caught in the traps, and they have proven to be among the few insects that can escape from traps. Adult dermestids lay their eggs on or near dead insects as a food source for their young. Look for dermestid frass on sticky traps around other dead insects, which indicates that dermestid larvae are eating the other insects.

Action Threshold

The action threshold is the sighting of one larva or adult insect or any traces of the insect or damage to objects in spaces holding collections.

Control Actions

Non-chemical control

Prevention
Improve sanitation to control dermestids. Regularly vacuum the collections area with HEPA filters, especially in cracks and crevices. Inspect the structure for possible sources of the infestation, such as bird nests or mouse carcasses, and remove them.

Management
Use freezer or anoxic treatments to kill the pests.

Figure 5.14 Sample Action Plan: Dermestid Beetles

Chemical control

If continued monitoring indicates an ongoing infestation after non-chemical controls have been applied, request use of a low-risk pesticide dust as a crack and crevice treatment. Consult with the IPM Coordinator and a conservator and seek approval through PUPS before proceeding with this treatment. See Section F.6 for more information. **Do not apply pesticides directly to museum objects.**

Pest Activity On-site

Known history of pest with date and locations of past infestations
6/15/2010, one adult black carpet beetle was discovered on windowsill of second floor guest bedroom in historic structure. Inspection of guest bedroom led to the discovery of infested deer taxidermy mount. 9/1/2014, black carpet beetle larvae discovered on traps 41 and 42 and dermestid beetle damage and adult black carpet beetle carcass discovered in Collections Storage Cabinet 3 drawer 5 on PARK2014 (hat). Inspection of other objects in cabinet led to discovery of 3 other infested objects.

Past control actions
6/15/2010, infested object was successfully given freezer treatment. Increased inspection and vacuuming of guest bedroom was implemented. 9/1/2014, all infested objects were successfully given freezer treatment. Increased inspection and vacuuming of collections storage was implemented.

Figure 5.14 Sample Action Plan: Dermestid Beetles (continued)

National Park Service
Action Plan
Fabric Pests: Clothes Moths

Pest Description/Biology

The webbing clothes moth and the casemaking clothes moth are the two most common clothes moths found in museums. They are small, silvery-beige moths with a wingspan of less than 1/2". The larvae, small white caterpillars with brown heads, feed on the surface of the infested material. Casemaking clothes moth larvae are rarely seen since they construct a cylindrical case of fabric which they carry around to hide and feed in. The color of the larval case will match the material on which it's feeding. Adult moths avoid light. See *MH-I*, Ch. 5, Biological Infestations, Section G.3, for more information.

Species: webbing clothes moth, casemaking clothes moth, carpet (tapestry) moth

Damage

Larvae cause the most damage to museum collections, as the adults do not feed on collections. The larvae feed on wool, silk, felt, fur, hair, and feathers, upholstered furnishings, piano felts, tapestries, carpets, leather and skin products, taxidermy specimens, felt, hats, horsehair padding or fabric, insect collections, dead insects and nests. Soiled materials are particularly vulnerable. During feeding, larvae produce feeding holes, feeding tunnels of silk and patches of silken webbing on the fabric's surface. Damage can occur quickly.

Monitoring and Inspection

Ongoing, systematic monitoring is essential to determining if there is an infestation, including inspecting spaces and objects for pests and establishing a pest trapping program. Inspect the collections areas for evidence of a clothes moth infestation. Search dark areas such as corners, closets, in fabric folds, in rug lint and hair accumulations behind baseboards and in heating units. Inspect textiles for signs of damage. Any visual evidence of clothes moths, such as the sighting of adults or larvae, silken tubes, or feeding damage, usually indicates a major infestation.

Action Threshold

The action threshold is the sighting of one larva or adult moth or any traces of the insect or damage to objects in spaces holding collections, such as cases from casemaking clothes moth larvae/pupae.

Control Actions

Non-Chemical Control

Prevention
Regularly vacuum rugs and textiles, including furnishings.

Management
Clean infested objects by vacuuming with a HEPA filter and removing webbing and cases. Bag and seal objects in polyethylene and use the freezer treatment to kill clothes moths, larvae and eggs. Objects going into storage should remain sealed to prevent re-infestation.

Chemical Control

Chemical treatments are not appropriate for a clothes moth infestation.

Figure 5.15 Sample Action Plan: Clothes Moths

Pest Activity On-site

Known history of pest with date and locations of past infestations:
2/26/2013, one adult clothes moth was discovered in Collections Storage, Cabinet 4, drawer 2 on PARK2012 (cotton tablecloth) during object spot check. Surrounding objects were inspected and 4 in Cabinet 4 were found to be infested with clothes moth larvae.

Past control actions:
2/26/2013, all infested objects were successfully given freezer treatment. Increased inspection of cloth objects and increased vacuuming were implemented.

Figure 5.15 Sample Action Plan: Clothes Moths (continued)

National Park Service
Action Plan
Wood Pest: Powderpost Beetles

Pest Description/Biology

Powderpost beetles are a group of woodboring beetles. The term "powderpost" comes from the fact that the larvae of these beetles feed on wood and, given enough time, can reduce it to a mass of fine powder. See *MH-I*, Ch. 5, Biological Infestations, Section G.4, for more information.

Species: Powderpost “furniture” beetle, anobiid beetle, deathwatch beetle, true powderpost beetle, false powderpost beetle bamboo powderpost beetle

Damage

Powderpost beetle larvae damage wooden objects, frames, furniture, tool handles, gun stocks, books, toys, bamboo, flooring, and structural timbers, creating narrow, meandering tunnels in wood as they feed. They also damage spices, grains, tobacco, and dried fruits and vegetables. The lower the wood moisture content, the longer the larvae live in the wood. Infestations are often not apparent until adult beetles, attracted to light, emerge from the wood, leaving exit holes behind. They will re-infest wood year after year.

Monitoring and Inspection

Ongoing, systematic monitoring is essential to determining if you have an infestation, including inspecting spaces and objects for pests and establishing a pest trapping program. Inspect the collections for wood objects with small round exit holes, the indicator of powderpost beetles. If you discover objects with exit holes, immediately wrap the object in plastic and place it in the isolation room. Inspect windowsills for adult insects.

Action Threshold

The action threshold is the sighting of one larva or adult insect or any traces of the insect or damage to objects in spaces holding collections.

Control Actions

Non-chemical control

Prevention:
Control RH to prevent powderpost beetle infestations. Powderpost beetles prefer infesting wood with moisture content of 12-15% or greater, and wood with lower moisture content than 12% is not often re-infested. Test wood moisture content with a moisture meter. Lowering high moisture levels in the wood through fixing leaks and/or dehumidification may prevent re-infestation.

Management:
For suspected infestations, bag, remove and isolate objects in the isolation room. Place white paper under the object and monitor for frass appearing below the object for 12 weeks. If frass appears on the paper or the exit holes are light colored, the infestation may be active and you should proceed with further treatments. If possible, isolate the object in the isolation room for a period of one year. If this is not possible and if no frass has appeared after 12 weeks, you may remove the object from the isolation room but double bag it or wrap it in two layers of plastic on white paper. Inspect it regularly for frass and holes in the plastic for a minimum of one year. Holes indicate that the object is still infested. Use the freezer treatment for infested objects, after consulting with a conservator.

Figure 5.16 Sample Action Plan: Powderpost Beetles

Chemical Control

For widespread infestations, large objects that cannot be frozen, or where it is not possible to remove infested items (such as ceiling beams in structures), request approval to use a pesticide surface treatment or injection. The affected wood (if unfinished) can be treated with localized applications of approved pesticides. You must get approval through PUPS to use this treatment. See Section F.6 for more information.

Pest Activity On-site

Known history of pest with date and locations of past infestations:
6/3/2012, fresh, light colored exit holes and frass were discovered during isolation period of incoming object, PARK2008 (wooden box).

Past control actions:
6/3/2012, PARK2008 was effectively given freezer treatment and was isolated for one year in Incoming Collections Quarantine room before being placed in Collections Storage.

Figure 5.16 Sample Action Plan: Powderpost Beetles (continued)

National Park Service
Action Plan
Stored Product Pests

Pest Description/Biology

Stored product pests or "pantry pests" infest objects containing seeds, nuts, grains, spices, dried fruits and vegetables, and other foods. They are also common pests of cellulose materials, such as herbaria, paper, and baskets. The cigarette beetle and the drugstore beetle are the most common museum pests of this type. See *MH-I*, Ch. 5, Biological Infestations, Section G.5, for more information.

Species: Cigarette beetle, drugstore beetle, saw-toothed grain beetle, lesser grain borer, red flour beetle, confused flour beetle, foreign grain beetle, cadelle beetle, spider beetles, red-legged ham beetle

Damage

Stored product pests attack a wide variety of food materials, such as grain, seeds, nuts, corn, tobacco, flour, spices, chocolate, dried fruit, dried and smoked meats and beans. They also infest other materials, including paper, fabrics, books, wood, baskets, herbarium specimens, vegetal matter, upholstered furniture, grain-based rodent bait, leather, hides, bone, hair, feathers, mummies, freeze dried animal specimens, dry pharmaceuticals, medicines, poisons, cellophanes, plastic and cardboard. Many stored product pests can easily penetrate packaging materials. They leave visible feeding damage, shot holes, emergence holes and fine dust around their food sources.

Monitoring and Inspection

Ongoing, systematic monitoring is essential to determining if there is an infestation, including inspecting spaces and objects for pests and establishing a pest trapping program. Thoroughly inspect the objects, cases, and structure for signs of an infestation. Focus inspections on objects that contain food products. Look for feeding damage, shot holes, emergence holes and fine dust around these types of objects. Also inspect for rodent nests, which attract stored product pests. Use sticky traps to monitor for these pests.

Action Threshold

The action threshold is the sighting of one larva or adult insect or any traces of the insect or damage to objects in spaces holding collections.

Control Actions

Non-chemical control

Prevention
Practice good sanitation to prevent any future infestations by vacuuming the collections area with a HEPA filter. Ensure that any food source for these pests is well sealed. Do not store food in structures housing collections. If food must be kept in the structure, store it in a container with a tight fitting lid.

Management
If you suspect that an object or food source may be infested, isolate it in a sealed plastic bag in the isolation room and observe for any signs of infestation. Inspect the structure to find and eliminate the source of the infestation. Eliminate moisture sources and control RH, as humid conditions encourage stored pantry pests, particularly foreign grain beetles. Use the freezer treatment to kill an active or suspected infestation.

Figure 5.17 Sample Action Plan: Stored Product Pests

Chemical control

If continued monitoring indicates an ongoing infestation after non-chemical controls have been applied, request use of a low-risk pesticide dust as a crack and crevice treatment. Consult with the IPM Coordinator and a conservator and seek approval through PUPS before proceeding with this treatment. See Section F.6 for more information. **Do not use any pesticides on museum objects.**

Pest Activity On-site

Known history of pest with date and locations of past infestations
3/1/2006, Cigarette beetle damage discovered by maintenance staff on new object (dried tobacco) in exhibit case 3 in Visitors Center/Museum building. Cigarette beetles and larvae found on two other objects in case

Past control actions
3/1/2006, all infested objects were successfully given freezer treatment. A new policy was enacted to isolate all incoming objects before placing them in collections storage or on exhibit.

Figure 5.17 Sample Action Plan: Stored Product Pests (continued)

National Park Service
Action Plan
General Pests: Silverfish

Pest Description/Biology

Silverfish are one of the major museum pests of starch and paper. Their enzymes and cellulose-digesting bacteria in the gut break down cellulose in paper or other wood products. Silverfish can live for nearly a year without feeding. Due to their small size and reclusive nature, silverfish are seldom seen. If they are seen, populations are probably high and damage can be significant. See *MH-I,* Ch. 5, Biological Infestations, Section G.6, for more information.

Species: (Thysanura sp.) fourlined silverfish, gray silverfish, firebrat

Damage

Silverfish are chewing insects that primarily feed on paper products, including books, stored papers, writing papers, newspaper, wrapping paper, and cardboard. They also eat herbarium specimens, wallpaper or the paste behind it, and starchy human foods. Book bindings show minute scrapings. Typically, paper sizing is removed irregularly ("grazing"), and paper edges appear notched. In cases of high populations, irregular holes will be eaten directly through paper. Feeding habits of various silverfish species are similar.

Monitoring and Inspection

Ongoing, systematic monitoring is essential to determining if there is an infestation, including inspecting spaces and objects for pests and establishing a pest trapping program. Thoroughly inspect for silverfish and signs of damage, focusing on paper collections and possible sources of moisture. As silverfish are thigmotactic and like to wedge their bodies in small spaces, look in small cracks and crevices, such as in baseboards and in corrugations of corrugated cardboard boxes. Look for small dark feces, small yellow stains, scales and signs of feeding on paper objects. Use insect sticky traps along baseboards to confirm their presence. Once a source of food is located, silverfish remain in the vicinity.

Action Threshold

The action threshold is the sighting of one insert or any traces of the insect or damage to objects in spaces holding collections.

Control Actions

Non-Chemical control

Prevention
Silverfish are an indicator species for moisture problems. Control RH and temperature to reduce silverfish. Use air conditioners or dehumidifiers in rooms where documents and books are stored to reduce RH and temperature. Repair any water leaks promptly. Practice good sanitation through vacuum cleaning with HEPA filters, especially around crevices and baseboards. Store paper products, books, and documents in tightly sealed containers and cabinets.

Management
Use the freezer treatment to kill silverfish and their eggs on boxes, books, archival paper, herbarium sheets, textiles, and other similar materials.

Figure 5.18 Action Plan: Silverfish

Chemical control

If continued monitoring indicates an ongoing infestation after non-chemical controls have been used, request use of a low-risk pesticide dust, such as boric acid, silica aerogel, or diatomaceous earth, as a crack and crevice treatment. Consult with the IPM coordinator and a conservator and seek approval through PUPS before proceeding with this treatment. See Section F.6 for more information. **Do not use any pesticides directly on museum objects.**

Pest Activity On-site

Known history of pest with date and locations of past infestations
4/19/2010, three silverfish were discovered in the Archives Room on Shelf 6 on a book, PARK 2009. Inspection of surrounding objects led to discovery of 4 additional infested books.

Past control actions
4/19/2010, all infested objects were successfully given freezer treatment. A portable dehumidifier was used to decrease RH in Archives and environmental conditions were monitored more frequently.

Figure 5.18 Action Plan: Silverfish (continued)

National Park Service
Action Plan
Moisture Pests: Springtails

Pest Description/Biology

Springtails are minute, wingless insects, varying in color, that get their name from the ability to leap through the air three to four inches. Springtails occur in most climates and are attracted to moist conditions. They enter buildings through doorways, screens, or other openings and may also breed indoors with high levels of humidity that occur near leaks and cracks to the exterior. They can easily climb the sides of houses, are attracted to lights and can be brought into homes in the soil of potted plants. See *MH-I,* Ch. 5, Biological Infestations, Section G.6, for more information.

Species: Collembola; Entomobrya spp.; Lepidocyrtus spp.; Heteromurus spp; Orchesella spp.; Sira spp.

Damage

Springtails feed on microscopic mold and usually target damp or moldy materials, wallpaper, and new plaster. They do not feed on collections objects but their presence indicates a moisture problem and the likely presence of mold. They are not museum pests and are seldom found on artifacts.

Monitoring and Inspection

Ongoing, systematic monitoring is essential to determining if you have an infestation, including inspecting spaces and objects for pests and establishing a pest trapping program. Search for springtails where dampness occurs, such as in basements, cellars, bathrooms, and kitchens, especially near drains, leaking water pipes, sinks, and in the soil of over-watered house plants. Use humidity meters around the structure to help identify problem locations. Use sticky traps to monitor for springtails. Place sticky traps near doors and window, where springtails are often found. Due to their very small size, examine sticky traps with a magnifying glass to identify springtails.

Action Threshold

The action threshold is the sighting of one insect or any traces of the insect or damage to objects in spaces holding collections.

Control Actions

Non-chemical control

Prevention
Seal cracks and crevices with caulk and weather-strip around doors and windows to exclude springtails and help control RH. Do not allow live plants in areas with museum collections. If large numbers of springtails are found near doors or windows, check outside to see if there is moisture gathering in the area from poor grading or vegetation or mulch that should be removed.

Management
Springtails are highly sensitive to desiccation. Lower the RH to control springtails. Use a fan or dehumidifier to dry the structure and repair any plumbing leaks and dripping pipes. Vacuum any microscopic mold and springtails using a HEPA filter vacuum cleaner.

Chemical control

Figure 5.19 Sample Action Plan: Springtails

Chemical treatments are not appropriate for a springtail infestation.

Pest Activity On-site

Known history of pest with date and locations of past infestations
1/7/2014, three springtails were discovered on trap 7 in kitchen of historic structure (near window).

Past control actions
1/7/2014, inspection of kitchen led to discovery of improperly sealed kitchen window, resulting in increased RH and water leak. The window was properly sealed and a portable dehumidifier was used to decrease RH.

Figure 5.19 Sample Action Plan: Springtails (continued)

National Park Service
Action Plan
Moisture Pests: Psocids

Pest Description/Biology

Psocids, commonly called booklice, are very small (less than 1/8" long), clear gray to light brown or white in color, semi-transparent and soft-bodied wingless insects. They feed on mold, mildew and a variety of both plant- and animal-based foods such as dried fruit, flour, and grains. Moist conditions enhance growth and longevity and they are most common in structures during spring and summer. See *MH-I*, Ch. 5, Biological Infestations, Section G.6, for more information.

Species: Liposcelis corrodens

Damage

Psocids are also called booklice because they often infest damp, moldy books. They damage paper products and bindings by eating paste, glue or anything supporting mildew. Psocids also infest herbaria, insect collections, manuscripts, cardboard boxes, and furniture stuffed with flax, hemp, jute, or Spanish moss. They damage objects by grazing on the surfaces of paper or plants, and they can leave stains on papers if they are crushed. Their damage is less severe than that of silverfish. Their presence indicates a moisture problem and likely presence of damaging molds.

Monitoring and Inspection

Ongoing, systematic monitoring is essential to determining if you have an infestation, including inspecting spaces and objects for pests and establishing a pest trapping program. Psocids are most commonly found in dark cracks and crevices, and proliferate under damp conditions. They are often found on houseplants and flowers. Inspect books, archives and herbarium sheets with a flashlight using raking light and a magnifying glass. Use insect sticky traps to monitor for psocids. Due to the very small size of psocids, examine sticky traps with a magnifying glass to identify them.

Action Threshold

The action threshold is the sighting of one insect or any traces of the insect or damage to objects in spaces holding collections.

Control Actions

Non-chemical controls

Prevention
Lower the RH or moisture content of objects to control psocids. Do not allow live plants in areas with museum collections.

Management
Vacuum the microscopic mold from objects using a HEPA filter vacuum cleaner at low suction. Use the freezer treatment for infested objects.

Chemical control

Chemical treatments are not appropriate for a psocid infestation.

Figure 5.20 Sample Action Plan: Psocids

Pest Activity On-site

Known history of pest with date and locations of past infestations
1/7/2014, ten psocids were discovered on PARK 2009 (cookbook) on a table next to the window in kitchen of historic structure. Inspection of surrounding area found no other pests.

Past control actions
1/7/2014, discovery of 3 springtails on trap 7 in kitchen led to inspection of kitchen. An improperly sealed kitchen window, which resulted in increased RH and water leak, was discovered. A cookbook, PARK 2009 was nearby was found to be moldy and infested with psocids. The window was properly sealed and a portable dehumidifier was used to decrease RH. PARK 2009 was isolated, mold was vacuumed off after it dried and object was successfully given freezer treatment.

Figure 5.20 Sample Action Plan: Psocids (continued)

National Park Service
Action Plan- Moisture Pests: Molds and Fungi

Pest Description/Biology

Molds are primitive plants supported by excessive moisture. They are found in indoor and outdoor air, soils, food and on plant matter. Airborne fungal spores are practically everywhere and act like seeds, which spread easily and form new mold growth. Presence of mold indicates high RH above 65% or high moisture content in objects. Other contributing conditions are high temperature, darkness, and lack of ventilation. See *MH-I*, Ch. 5, Biological Infestations, Section G.6, for more information.

Damage

Mold damages all organic objects, including cellulose-based materials such as cotton, linen, paper and wood, and proteinacious materials like leather, parchment, freeze-dried animals, and adhesives, through odor, staining, digestion, and structural weakening to complete destruction. Mold also causes odor and stains on inorganic objects. Fungi can produce organic acids that corrode and etch metal and stone. Soiled objects are most at risk.

Monitoring and Inspection

Inspect the collections for signs of microorganisms, including characteristic mildewy odor, irregular stains, color change, fuzzy growths on surfaces, and round colonies of conidia. Mold-feeding insects such as psocids or springtails are indicators of mold. Consult a conservator to determine if microorganisms are present.

Action Threshold

The action threshold is any evidence of active or inactive mold on surfaces, as mold grows extremely quickly under high RH.

Control Action

Non-chemical control

Prevention
Modifying climatic conditions, such as lowering the RH, can inhibit or solve mold problems. Monitor and control temperature and RH. Keep RH below 65% and dehumidify if the RH exceeds this level. Practice good housekeeping and keep museum objects clean, as mold grows on dust. Vacuum spaces and objects with HEPA filter vacuum. Containerize objects in storage to prevent dust and mold spores settling on objects and slow moisture absorption from short RH fluctuations. Maintain air ducts by placing filters over openings and regularly cleaning with a vacuum. Eliminate sources of microorganisms (food, plants) from storage or exhibit areas.

Management
Microorganisms can be a human health hazard, particularly to persons with respiratory conditions, sensitivities (allergies, asthma) or weakened immune systems. Use personal protective clothing while handling mold infested objects including nitrile gloves, HEPA filter dust mask or respirator and disposable or washable over-clothing. If mold is suspected, place object in a covered cardboard box immediately and isolate box in a cool and ventilated space. Do not use a plastic bag and do not reuse the box. Label boxes: "Mold Damaged Objects; Biohazard; Potential respiratory hazard; Protective clothing required." Move objects as little as possible to avoid spreading mold spores and enforce careful and minimal handling of objects. Locate the humidity source, such as water pipes, roof leaks, leaky windows, floor drains, or air ducts. Reduce RH by eliminating the water source, dehumidifying the space and drying the object. Vacuum object with HEPA filter vacuum after mold dries out and becomes dormant

Figure 5.21 Sample Action Plan: Molds and Fungi

(can be done by a conservator or trained staff). A conservator may need to clean object with a biocide or solvent. Freezing will not kill mold but will slow down its growth. Consult experts according to the severity of the mold outbreak, including the park IPM coordinator, regional curator, and a conservator, remediation specialists, industrial hygienists, mycologist, public health or medical personnel.

Chemical control

Chemical controls are not appropriate for molds and fungi.

Pest Activity On-site

Known history of pest with date and locations of past infestations
1/7/2014, mold was discovered on PARK 2009 (cookbook) on table next to window in kitchen of historic structure. Inspection of surrounding area found no other pests

Past control actions
1/7/2014, discovery of 3 springtails on trap 7 in kitchen led to inspection of kitchen. An improperly sealed kitchen window, which resulted in increased RH and water leak, was discovered. PARK 2009 (cookbook) was discovered on table by window to be moldy and infested with psocids. The window was properly sealed and a portable dehumidifier was used to decrease RH. PARK 2009 was isolated and the mold was vacuumed off after it dried.

Figure 5.21 Sample Action Plan: Molds and Fungi (continued)
National Park Service
Action Plan
Rodents: Mice and Rats

Pest Description/Biology

Mice and rats are prolific museum pests with a high potential for causing contamination, damage to historical resources, and disease. They are exceptionally agile. Mice can jump one foot high and can fit through spaces 1/4" in diameter. Rats can jump three feet high and fit through spaces 1/2" in diameter. Because of the known potential for causing damage and disease, an aggressive rodent management program is a high management priority. See *MH-I,* Ch. 5, Biological Infestations, Section G.7, for more information.
Species: house mouse, deer mouse, white-footed mouse, Norway rat, roof rat, rice rat, cotton rat

Damage

Rodents cause damage through feeding and gnawing on objects or structural elements, contaminating collections with feces/urine, damaging electrical wires (sometimes causing fires or malfunction of electrical equipment), rubbing grease marks on objects or structural elements, and contaminating human foods with disease organisms. They also accumulate nesting and food materials inside hollow walls, voids, holes, and cracks that attract other pests.

Monitoring and Inspection

Ongoing, systematic monitoring is essential to determine if there is an infestation. This includes inspecting spaces and objects for pests and establishing a pest trapping program. Routinely inspect structures to identify rodent infestations. Rodent sounds, droppings, burrows, urine stains, smudge marks, runways, tracks, gnawing damage, nests, food caches, and odors are all signs of rodent activity. Place snap traps in strategic locations and document all catches. Sprinkling talc on the floor in non-public areas can help detect presence and runways.

Action Threshold

The action threshold for any rodent is the sighting of one rodent or any traces of rodents or damage to objects in spaces holding collections.

Control Actions

Non-Chemical Control

Prevention
Exclude mice and rats from all structures housing museum collections. Repair any gaps in the structure larger than 1/4". Improve sanitation by ensuring that rodents have no available food sources within the structure. Reduce clutter within and around the structure to reduce harborage.

Management
Use rodent snap traps to kill mice and rats. Rodent glue boards, live traps, and electronic traps are not recommended. Snap trapping is now the primary management tool available to the NPS aside from preventive measures, and it is effective as a control measure especially when many baited snap traps are put out at a time of a known infestation. Use peanut butter or cotton as bait when rodents are known to be present. Note that snap traps are also effective without bait. Follow appropriate protocols for minimizing risk of exposure to hantavirus.

Chemical Control

Rodenticides are not recommended for use inside NPS structures. Mice and rats dying in inaccessible locations in

Figure 5.22 Sample Action Plan: Mice and Rats

museums are likely to cause odor and secondary infestations of museum pests like dermestids. Rodenticides are not recommended for use outside NPS structures. Poisoned rodents can be eaten by predators causing secondary poisoning to non-target animals, or non-target animals can access the poison directly in their outside environment.

Pest Activity On-site

Known history of pest with date and locations of past infestations
11/19/2012, a house mouse was trapped in snap trap 5 in garage of historic structure. Inspection of the garage led to discovery of a mouse nest in a cardboard box in the NW corner.

Past control actions
11/19/2012, the nest and all mice were removed. Increased rodent snap trapping was implemented. The exterior of the structure was inspected and a small gap underneath the exterior door leading to the garden was sealed.

Figure 5.22 Sample Action Plan: Mice and Rats (blank)

J. Index

Note: Italicized page numbers indicate the reference is located within a sample form.

Chapter 6: Handling, Packing, and Shipping

List of Figures

CHAPTER 6: HANDLING, PACKING, AND SHIPPING

A. Introduction

This chapter outlines handling, packing, and shipping guidelines for safely moving museum objects. By following these guidelines, you can prevent damage to the objects in your museum collection. The chapter includes:

- basic practices to ensure object safety
- guidelines for handling objects
- guidelines for moving objects inside the museum
- materials and techniques to properly pack for shipping
- basic directions for shipping objects
- guidelines for unpacking an object
- bibliography of references on handling, packing, and shipping museum objects

Specific guidance for handling different types of objects can be found in the appendices of this volume for each object type.

Figure 6.1. Proper Handling Techniques.
Proper handling techniques are essential to museum housekeeping practices.

B. Handling Objects

When you touch, lift, or hold an object you are handling it. When you work in a museum you will have to handle objects for a variety of tasks. To do this safely and effectively it is important to learn and practice good handling techniques.

1. *Why are careful handling practices important?*

Preventive conservation starts with careful handling. Proper handling is largely a matter of common sense and is necessary for the care and protection of objects. However, good handling techniques are not always obvious. Museum procedures require specialized handling knowledge that must be learned. For example, metals can corrode after being handled without gloves. Paintings may crack as a result of bumping and jarring during movement. Mishandling can cause obvious examples of damage, such as shattered glass in a frame, broken ceramics, torn documents, or dents and scratches in metal objects.

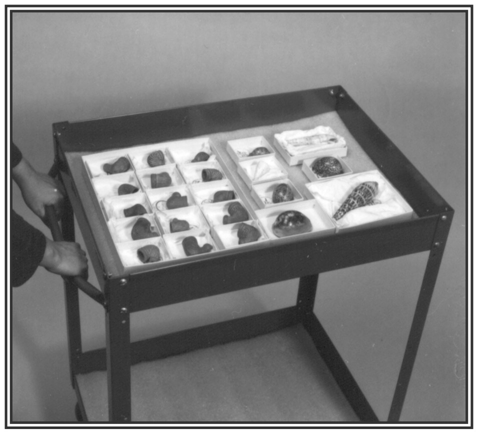

Figure 6.2. Carts and Trays Minimize Handling.
The use of equipment and supplies such as carts and trays minimizes the need to handle objects.

2. *Who needs to learn safe handling practices?*

Anyone who handles museum objects needs to be aware of the guidelines in this chapter. If your day-to-day responsibilities require you to handle objects, you need to be sensitive to their delicate nature. Regular activities like cataloging, photographing, housekeeping, and packing for shipment all require you to handle and work with objects.

3. *What basic practices can I use to safely handle and move objects in the museum?*

Write guidelines.
Establish written guidelines to help foster a professional attitude and respect for objects. Provide **all** staff with a set of written guidelines. Post the guidelines in museum storage areas. Be sure that all staff who handle objects read the guidelines. Researchers who handle objects should read the guidelines when they first use the collections. Staff should read the guidelines when hired and review them periodically. See Figure 6.14 for an example of handling guidelines you can use.

Train your staff.
Don't handle museum objects without training. Training should be an on-going activity, particularly when new types of objects are being handled. Make "hands-on" experience a part of all training for individuals working with collections. Re-training reminds people of the importance of proper handling techniques. You should give a special training session whenever new staff members assist in handling objects.

Use proper supplies and equipment.
Only use equipment that is of good quality and in good condition. Equipment for moving objects includes flatbeds, carts, dollies, pallet lifters, polyethylene tote pans, and object support trays. The supplies you use with the equipment to move objects include polyethylene foam pads for lining carts and trays, quilted furniture pads, acid-free tissue, and clean cotton or plastic gloves. You may need to acquire personal protective equipment such as lab coats and smocks, safety glasses, dust masks, and personally fitted respirators. Supplies and equipment are listed in more detail below.

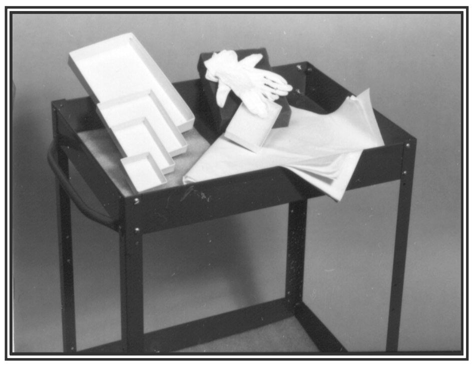

Figure 6.3. Equipment and Supplies.
Equipment and supplies for handling and moving museum objects include trays, padding, tissue, gloves, and carts.

4. *How should I proceed with moving an object?*

Consider safety first.
Before moving an object, inspect equipment to ensure that the object and the handler will be safe during the move. Do you have the proper personal protective equipment? Identify the space where you will move the object. Make sure there is room to house the object in its new location. If you have inadequate equipment, supplies, or space, postpone moving the object.

Plan your move.
Never consider moving an object routine work, even for daily housekeeping tasks. You must plan each step in the process before handling or moving a museum object. Where will you stand before picking up the object? Is there an open space to receive it? Planning helps keep handling to a minimum. When you plan, it helps you remember that each museum object is special. Keep in mind the following factors when you plan to move an object:

- ***Do you need to move the object?*** Is moving the object absolutely necessary? **If not, don't move it.**

- ***What are the object's structural characteristics and condition?*** Is it strong enough to withstand the move?

- ***Is there evidence of previous repairs?*** Review catalog records, condition reports, and photographs and examine the object to identify previous damage that may make the object especially fragile. Is there documentation that gives recommendations on moving hazards or safe moving techniques?

- ***What is the safest way to lift the item?*** How will you need to lift and carry the object to protect it from damage?

- ***How many people are required?*** Do you need help to move the object?

- ***Where is the object's new location?*** Is it large enough to properly house the object? Is the environment appropriate?

- ***What route will you use?*** Is it clear of obstructions?

- ***Will the personal health and safety of the handler be at risk?*** Do you have the proper moving equipment (for example, lumbar support belts or pallet jacks) to avoid physical strain? Do you need to wear a lab coat or dust mask?

5. *What are the basic rules for handling museum objects?*

When you handle objects use common sense and follow these basic rules to prevent damage to objects:

- Treat every museum object as if it were irreplaceable and the most valuable piece in the collection.

- Handle objects only when necessary.

- Move only one object at a time. Note: Small items can be moved together in a tote pan **if** they are separated and supported by padding.

- Never hurry.

- Take no risks.

- Never smoke, eat, or drink while handling objects.

- Avoid wearing anything that might damage objects by scratching or snagging the surface (for example, rings and other jewelry, watches, belt buckles, nametags, service badges).

- Use pencils, **not** pens, when working near objects.

- Keep hands clean, even when wearing gloves.

- Wear appropriate gloves.

  – Wear white cotton gloves when handling most objects.

– Wear plastic gloves (latex or nitrile gloves) when handling these types of objects:

  slick objects like ceramics or glass

  objects with oily or tacky surfaces that can attract cotton fibers

  fragile or damaged paper or other organic materials that may catch on cotton fibers

  some natural history specimens

- Know the condition of an object before moving it.

  – **Don't** lift by protruding handles or rims, which are often structurally weak.

  – Fragile objects should be given additional support, such as a tray or mount, before being lifted.

- Never layer or stack objects when moving them.

- Allow yourself plenty of space in which to work.

- Store objects so they can be easily moved without disturbing other objects.

- Tie on acid-free, cotton string tags or number trays, boxes, and bags so numbers can be easily seen without handling the object.

- Save all information associated with an object (for example, tags or labels).

- Remember to lift items properly.

Figure 6.4. Hold Objects at the Strongest Point. *A teapot should be handled by the base rather than by the handle or spout.*

The less museum objects are handled, the longer they will survive.

6. *What is the best way to protect an object I must pick up?*

When you pick up an object:

- Identify the strongest part of the object and hold it at this point.
- Take your time, handle only one object at a time, and use both hands.
- When an object has more than one part, for example, a teapot and lid, handle each part separately.
- Don't lift objects by protruding parts such as handles or rims.
- Stabilize any loose parts that cannot be removed.
- Move slowly and concentrate on what you're doing.
- Use a support board or tray whenever possible.

7. *When should I wear gloves?*

Gloves protect objects from contaminants such as dirt, salts, acids, and oils on your hands. Even clean hands can transfer these damaging substances. Wear clean, white cotton gloves except when handling ceramics, smooth glass, oily or tacky surfaces, fragile or damaged paper, or some natural history specimens. (Refer to Chapter 11 for a discussion of protective gloves to use when handling natural history specimens.) When handling these objects, wear tight-fitting latex or nitrile gloves for better gripping. Even when wearing cotton gloves, wash your hands frequently. Be careful not to rub your face and hair and then handle objects. Body oils may be transferred to the object and cause damage.

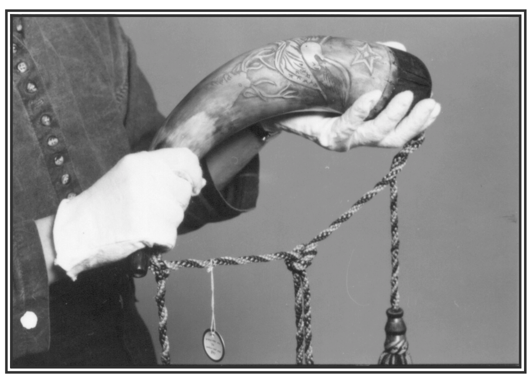

Figure 6.5. Wear Gloves and Use Both Hands.
Use two hands and wear gloves when handling museum objects.

Wear clean, white cotton gloves for handling many museum objects. Wear tight fitting latex or nitrile gloves when handling slick objects like ceramics or glass, objects with oily or tacky surfaces, fragile and damaged paper and other organic materials that can catch on cotton fibers, and some natural history specimens.

8. *What should I do if I damage an object?*

If you damage an object, report the damage. Damage should be recorded in the condition and condition description fields of the ANCS+ catalog record. Follow the instructions in the *ANCS+ User Manual* on reporting condition. See *Museum Handbook*, Part II, Chapter 3, for information on how to

See *Museum Handbook*, Part II, Chapter 3, for information on how to do condition reporting.

Take photographs of the damage if possible. Save all pieces and carefully pack them so that no further damage occurs before a conservator can make repairs. Small pieces may be wrapped and bagged in self-sealing polyethylene bags labeled with the appropriate object identification information.

9. *What personal health and safety issues should I consider when handling museum objects?*

It is very important to follow health and safety precautions when handling museum objects.

- Practice safe lifting techniques. Remember to lift with your legs and not your back. Use proper personal support equipment, such as a lumbar support belt. Don't lift more than you can safely carry. See Figure 6.6 for a list of techniques that will help protect you from injury.

- Be careful how you handle potentially dangerous objects (for example, firearms, ammunition, and medicines). See *Conserve O Gram* 2/5, "Fossil Vertebrates as Radon Source: Health Update"; 2/8, "Hantavirus Disease Health and Safety Update"; and 2/10, "Hazardous Materials in Your Collection."

- Don't touch or inhale fumes or particles from objects treated with pesticides such as arsenic. See *Conserve O Gram* 2/2, "Ethylene Oxide Health and Safety Update"; 2/3, "Arsenic Health and Safety Update"; and 2/4, "Dichlorvos (Vapona) Update."

1. Be sure you have firm footing and keep your legs apart.

2. Bend at the knees.

3. Use your leg and stomach muscles, not back muscles, when lifting from a stooped position.

4. Get close to the object and keep it near your body.

5. Avoid twisting; pivot using your feet.

6. Keep your back straight.

Figure 6.6. How to Lift Properly and Avoid Injury.

Figure 6.7. The Proper Way to Lift a Chair.

Figure 6.8. The Proper Way to Lift a Small, Framed Photograph.

Figure 6.9. The Proper Way to Lift and Carry a Small Textile Object.

C. Moving Objects Within the Museum

Preventive conservation continues with the careful movement of objects. When you move objects you increase the risk of damage and loss because you are both handling them and changing their location.

1. *What should I do before moving objects within the museum?*

Before you move objects within the museum for dusting or cleaning, or any other purpose, be familiar with the rules you should follow that help reduce the risk of damage. Planning is essential before handling or moving any museum objects. Think through your plan so that you lift and move objects properly. With advanced planning, you can keep movement of objects to a minimum.

Moving puts an object at its greatest risk.

2. *What do I need to know before moving objects?*

Evaluate the object's condition and structure before moving it. Review object catalog records for condition reports, photographs, or other instructions that may provide information on the object's stability.

Know the object's condition and structure.

- Check the catalog card for any record of past damages.
- Check for loose parts or fragile surfaces. Careful examination will usually reveal if an object is not stable.
- Do I have to move the object? Constantly handling and moving objects can cause them harm.

Use safe handling practices.

Know the rules for handling museum objects. See Section B of this chapter. When lifting objects:

- Use both hands.
- Lift most objects from the base and/or close to the center of gravity.
- Don't try to push or drag objects across surfaces.
- Don't handle objects by handles or rims.
- Place objects inside containers (trays or boxes) for carrying (see Figure 6.9).
- Make sure objects are padded using museum materials (for example, polyethylene foam or acid-free tissue).
- Secure objects in separate compartments in a box or tray to prevent them from being damaged.
- Don't allow objects to stick out beyond the sides of the containers.

Figure 6.10. Use Trays and Padding to Prevent Damage.
These pipe bowls were placed in individual specimen trays within a larger tray to prevent damage during movement.

Use trained, experienced staff.

When selecting people to move objects:

- Evaluate the experience of the people handling and moving the objects.
- Assign specific tasks to each person.
- Review the move plan verbally with participants before moving the objects so that all understand their duties and assignments.

Use proper equipment.

Make sure you have the proper moving equipment so that the move is safe for both objects and people.

- Use the correct type of equipment. Useful equipment includes trays or baskets to support objects and flatbeds, carts, dollies, and pallet lifters to move objects.
- Inspect the equipment to make sure that it is safe for both the objects and the person handling the objects before you begin.
- Pad carts and other surfaces with polyethylene foam or another stable material to protect the objects.
- Postpone moving the objects if you don't have proper equipment, supplies, space, and trained helpers.
- Use rubber doorstops to prop doors open before you pass through.
- Use personal protective equipment when appropriate.

Clear the new location and the route there.

Before moving the object:

- Make sure the location is ready to safely house the object.
- Know which route to take, which equipment to use, and how much time you'll need to complete the move.
- Provide written instructions if needed.
- Be aware of all surfaces that the object may contact (for example, doors, floors, and walls).
- Study the spaces through which the object may pass (for example, doorways, stairwells, display areas).
- Avoid tight areas.
- Don't move objects during peak visitation periods or open hours, if possible.
- If transporting the object outdoors, move it when the weather conditions are good, with no rain, snow, or extreme heat. If this isn't possible, then take appropriate precautions such as waterproof coverings and packing to provide environmental buffering.
- Be aware of weather conditions at the final destination to determine the type of protective container needed.

D. Packing and Shipping Preparations

1. *When would I need to pack and ship objects?*

Sometimes you must pack and ship objects to send them to a new location. For example, you may need to pack and ship objects for outgoing loans or conservation work.

2. *Why is it important to properly pack objects for shipping?*

The hazards of shipping an object are numerous. Improper packing can cause an object to be permanently damaged or destroyed. A properly packed container is critical to ensure your objects arrive safely.

3. *How can I learn how to pack museum objects?*

Begin by following the rules for the proper handling of objects. See Sections B and C of this chapter. The best way to learn how to pack is to work with an experienced packer. Learn to pack different types of materials, such as textiles and glass. **Each object requires a unique packing solution.** Museum professional associations often offer classes on packing and shipping.

4. *What kind of workspace do I need for packing?*

You need enough room to work comfortably with the objects you are packing. For small objects you will need a table or desk; for larger objects you may need to have a portion of a room. For these larger objects, figure that you will need a space at least three times the size of the object you plan to pack. If you do a lot of packing, you should have a permanent packing area. When setting up a packing area:

- Select an area that can be cleared so you have sufficient room to safely pack the objects.

- Choose an area close to where the objects are stored to prevent unnecessary handling. Avoid continuously moving objects up and down stairways, around tight corners, or through narrow doorways.

- Pad the table with a few sheets of 1/8" polyethylene foam. Cover the polyethylene foam with 4-mil polyethylene sheeting. Securely fasten the sheeting beneath the work surface.

- When packing textile objects, pad surfaces with unbleached muslin over polyester batting.

- Remove all other tools and materials from the table while packing.

5. *How much time should I allow for packing objects?*

Packing can take several hours or even days, depending on the object. Allow yourself plenty of time to pack correctly. Don't hurry. Make sure each object is secure before moving onto the next.

6. *What do I need to consider before shipping?*

When you are preparing to ship an object, plan carefully. A lot of damage can occur during shipping. Movers may jar or drop objects. Airplane vibrations, exposure to bad weather, and rapid fluctuations in relative humidity can damage objects. Proper packing and shipping will limit these and other travel hazards including:

- shock and vibration

- sudden changes in temperature and humidity

- mishandling

- theft, vandalism, and loss

Before moving a museum object outside of the building, consider:

- the object's fragility

- the shipping method

- the climate through which the objects will travel

- the climate at the object's destination

7. *How do I determine if the object can be safely shipped?*

Carefully examine the object to see if its condition allows for safe travel. Be sure to check the condition and structure of items that can be very fragile. These include glassware, photos on glass, wooden musical instruments, paintings on wood, pastel paintings, charcoal drawings, and cracked porcelain. See the appendices in this volume for the particular problems you may find with different materials.

8. *How do I ship hazardous materials?*

To ship hazardous materials, such as nitrate film or firearms, you must follow special shipping requirements. The Bureau of Alcohol, Tobacco, and Firearms (ATF) has specific guidelines for shipping certain types of firearms. Contact the ATF's National Firearms Act Branch at (202) 927-8330 to determine the shipping requirements for your collection. Work with the company that will do the shipping to find out specific requirements for other types of hazardous materials. *Conserve O Gram* 14/8, "Caring for Cellulose Nitrate Film," gives information on shipping nitrate film.

9. *How should I document the condition of the objects?*

It is important to document the condition of an object before moving it. If an object is damaged, the documentation will help you determine the extent of the damage.

See *Museum Handbook*, Part II, Chapter 5: Outgoing Loans, for information about recording condition for loans. You may want to use the Object Condition Report (Form 10-637) to document an object's condition. For insurance and other purposes, when documenting condition:

- Use a portable light source and magnifying lens to help identify markings.
- Note and document areas that have been previously repaired.
- Carefully examine objects for pest infestation.

E. Packing and Shipping Materials

1. *Why is it important to use the right packing and shipping materials?*

Packing materials can adversely affect the object. Some materials are abrasive and can damage objects. Friable objects (for example, ancient glass, charcoal, pastel and conte crayon drawings, corroded metals) are susceptible to mechanical damage from even minor abrasion. Acidic tissue should not come in contact with objects that are acid sensitive. Some plastic bubbles and foams may leave imprints on polished metals, varnished woods, oriental lacquer and other smooth-surfaced objects. Materials that come in direct contact with the object must not stain, be abrasive or acidic, or off-gas damaging chemicals. To prevent these types of damage you should select appropriate materials for each packing situation. Never re-use packing materials on different types of objects as residues and dirt can be transferred.

This section describes materials commonly used in packing objects for transit. The bibliography lists a variety of references that can aid you in selecting proper materials and techniques. You can also contact your regional/Support Office (SO) curator or a conservator if you have questions about a specific material.

2. *What sources of packing materials are available?*

New packing products are continually appearing on the market. Contact museum packers to learn about new materials. If you choose a new material, be sure it has been tested and generally approved by the museum field. See NPS *Tools of the Trade* for some suggestions. You can obtain other supplies from the following sources:

- General Services Administration Federal Supply Schedule (look under "Cushioning Materials" or "Packaging and Packing Supplies")

- *Storage of Natural History Collections: Ideas and Practical Solutions*, put out by the Society for Preservation of Natural History Collections (listed in the bibliography)

- local telephone directories (look under "Boxes," "Packaging Containers," and "Packaging Materials")

- businesses specializing in packaging for high-tech electronic equipment

Ask your regional/SO curator if you are unsure about any materials you want to use.

3. *What are good covering and wrapping materials?*

Good covering and wrapping materials include:

- ***Acid-free glassine paper*** is stiff, translucent, and glossy in texture. You should use glassine only for short-term storage (less than 30 days). Glassine is recommended for covering paintings, bottles with labels, or objects with a friable or oily/tacky surface. Use only new glassine paper since it deteriorates and becomes acidic over time.

- ***Tyvek*** is an alternative to glassine. This material is available in soft textile-like or slick, smooth finishes. Tyvek is a type of high-density polyethylene and is stable for long-term use.

- ***Tightly woven nylon fabric*** can be used to cover cushioning foams to protect the object. Make sure nylon doesn't come into contact with the surface of delicate materials as it can be abrasive.

- ***Cotton knit*** (available in rolls) is another good covering material. It is a good, soft cover for polyethylene foam supports.

- ***Unbleached washed muslin*** can be used for wrapping sculpture and textiles. Wash muslin in hot water several times before using it to remove sizing and make it softer.

- ***Soft, unbuffered acid-free tissue paper*** is used for covering basketry, metal, and textiles. It is also good for making pads to fill empty spaces and covering appendages on objects.

- ***Mylar®*** is a clear, stable polyester film that serves as a good primary protector for paper. Mylar has an electrostatic charge. **Never use it on pastels or charcoal drawings.**

- ***Blanket pads or quilts*** are used for covering large sculpture and furniture.

- ***Acid-free folders*** are used to contain unframed prints, documents, and photographs.

Examples of when and where to use these materials can be found in the references listed in the bibliography.

4. *What are good cushioning materials?*

Cushioning materials are designed to absorb shock and buffer the humidity. These materials are usually foam products that you can use in a variety of cushioning techniques. Use each type of foam correctly to achieve adequate shock and vibration protection. Because each foam product offers different cushioning qualities, you may want to use a combination of foams. The Canadian Conservation Institute (CCI) has designed tools (The Circular Slide Rule for Cushion Design and PadCAD computer program) to help museums estimate how much cushioning material to use. These aids help you evaluate the shock that occurs when a package is dropped from a certain height. This calculation helps you determine how much and what kind of cushioning materials you should use. You can obtain these aids directly from CCI, 1030 Innes Road. Ottawa, ON KIA OM5, Canada (613) 998-3721 <http://www.pch.gc.ca/cci-icc/>.

A few good cushioning materials are listed here:

- **Bubble-pack™** is a plastic sheet with trapped air bubbles. Bubbles can leave impressions on an object's surface so use this product with the bubble side facing away from the object's surface. Don’t use it with sharp objects that can break the bubbles. Use several layers to maximize the padding effect. Always wrap the object first with tissue or muslin to protect the surface and to buffer relative humidity.

- **Polyethylene foam sheets (Ethafoam, Volara)** are light, easily handled, shock absorbing, chemically inert, and a barrier to moisture. Join sections with a heat gun, glue gun, or double-faced tape. These sheets are available in various densities, thicknesses, and textures. Use only white sheets; blue and pink sheets contain additives that may cause deterioration.

- **Polyurethane foam** is one of the best cushioning agents and it cuts easily. Its soft springy nature absorbs shock very effectively. It is very unstable, however, so use it only for **short-term** transport packing. Always put a barrier, such as acid-free tissue or Tyvek, between this foam and the object.

One packing material commonly used is **plastic "peanuts,"** which are expanded polystyrene. These are usually not appropriate for museum objects. They are messy, retain moisture, and they cling to surfaces. They are also difficult to remove if they get caught in appendages. If you must use these peanuts, do so only with small, light objects (<5 lbs.) or as a pad of peanuts collected in polyethylene bags. **Plastic** “**potato chips**” are a better form for providing padding.

5. *What materials make good interior boxes?*

Double boxing gives extra protection to objects (see Section F.5). The interior boxes can be made from a variety of materials. Many objects can be packed inside double-strength fiberboard boxes. You can also use polyethylene or polystyrene boxes. These plastic boxes will also protect objects from water damage.

Sometimes you may need to make a specially shaped box to pack odd-sized objects. There are several materials you can use to produce specialized interior boxes:

- **Foam-Cor®** is a polystyrene foam sandwiched between two layers of clay-worked kraft linerboard.
- **Archival corrugated board** is an acid-free, lignin-free cardboard.
- **Vapor barrier films** are a variety of laminate metal and plastic sheet materials that allow very little penetration of oxygen or water vapor. They make good box liners and can help maintain the interior microclimate.

6. *What kind of tape should I use on the box and the wrapping material?*

- **Cellophane and masking tape** can both be used to attach packing materials. Don't use these for closing the outside of the container, as they are not strong enough to resist damage during shipping.
- **Pressure-sensitive plastic tape** can be used to seal the outside of the container.
- **Water activated paper tape** can be used for sealing containers and attaching kraft paper. The 3"-width tape is best.
- **Nylon reinforced strapping tape** should only be used for closing containers. The adhesive on this tape is very sticky and strong, so be very careful to keep it away from objects or wrapping materials that may contact objects.

Don't allow any tape to contact the surface of objects.

7. *How should I select an exterior container?*

A quality exterior container contributes to an object's safe travel. Select containers prior to packing. Consider the following criteria:

- the physical characteristics of the item you are shipping (for example, size, weight, fragility)
- how much space the object needs inside the container for the object to fit comfortably and securely
- the method of transportation and who will handle the container
- environmental and weather changes that may require humidity and temperature buffering
- the number of times the object will be packed and unpacked

Exterior containers are fabricated from metal, wood, cardboard, fiberglass, and high-density plastics. The best exterior containers are:

- puncture proof
- light proof

- watertight
- protective against shock or vibration
- good environmental buffers

8. *What kinds of containers do I use for objects that have different weights and sizes?*

You should pack objects according to their weight, height, and density. Pack light objects in double strength cardboard boxes. Heavier objects (for example, paintings, sculpture, and furniture) or valuable and fragile items need the extra support of wood, fiberglass, or high-density plastic. You may have to build a special container customized for the object or hire a professional carpenter to build one.

9. *Can I build an exterior container?*

Build a container only if you have good carpentry skills and packing experience. You can use nails and glue to build the container, but use screws on the lid once the object is in the box. Never use nails on the lid because they can accidentally pierce the object. Vibrations from hammering or prying open the lid may also cause damage to the object.

Line the interior of the container with polyethylene sheeting, Tyvek, or vapor barrier film to protect the objects from water and to help buffer the interior microclimate. Add gaskets, skids, handles, and battens as needed for protection. Use castors on large containers to facilitate movement.

For more information on the specifics of making a box for shipping museum objects, see the references at the end of this chapter.

10. *Can I use a reusable shipping container?*

If you frequently pack and ship objects you might want to purchase reusable polyethylene containers. The Museum Management Program can provide more information on reusable containers and where you can get them.

11. *How do I protect objects from environmental changes during shipping?*

Containers will be exposed to temperature and relative humidity changes during the shipping process. These environmental changes can affect the object inside. Hygroscopic materials (materials that readily absorb moisture) used as packing materials can act as a buffer against relative humidity changes within the container. Wood, paper, natural fiber fabrics, and silica gel are good examples of hygroscopic materials that make good packing materials.

12. *How should I store packing materials?*

Keep packing materials in a clean, dust free, controlled environment. Avoid accumulating excess packing materials if you don't have adequate storage space for them because they increase both the risk of fire and the chance of infestation. If possible, store them in an environment with stable humidity between 40-60% RH. Wood crates and packing materials absorb moisture and pollutants. If the crates absorb more moisture than is recommended, allow them to adapt to the same environment as the object for two weeks prior to shipping. Open the lid to speed the process. Before bringing packing materials into the collections area, check all materials for pest infestation.

F. Packing for Shipping

Once you have selected your packing materials and decided on the kind of interior and exterior container you will use, you need to pack your object. This section discusses how to pack and cushion an object so it will not be damaged from shock and vibration. It also describes the documentation that you should include inside the container.

1. *How do I decide which way to position an object in a container?*

Evaluate the object's shape and size before packing. Plan for the worst possible travel scenario. Consider the object's weight and center of gravity. When you position the object:

- Place the heaviest part of the object low and close to the center of the container.
- Place glass-covered framed works of art vertically with padding between each item.
- Separate parts of objects (for example, a teapot and lid) and wrap separately.
- Immobilize and dismember objects with moving parts (for example, a spinning wheel) and wrap parts separately.
- Provide additional support for heavy parts of an object.
- Pack only objects of similar weight in the same container.

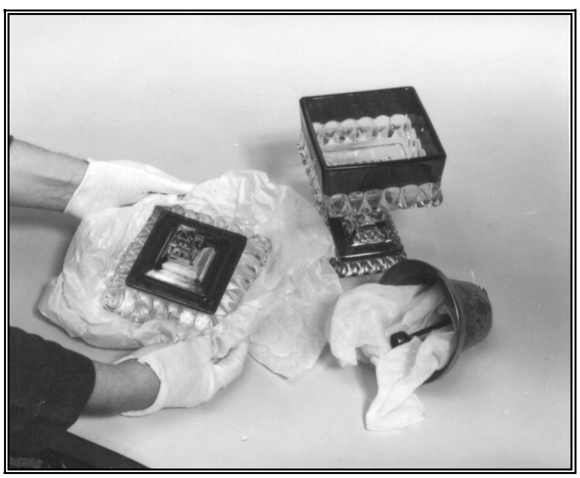

Figure 6.11. Pad and Separate Parts.
Pad moveable parts and separate parts of an object to avoid damage during handling.

2. *How do I cover and wrap an object?*

Use an initial covering to protect objects from abrasive packing materials and to serve as an additional buffer. Use soft, unbuffered, acid-free tissue for most objects. If possible, don’t use tape to hold the covering material closed. Instead, tuck the tissue in on itself or into an appendage. This removes the chance that tape will get stuck to the object. Don’t wedge tissue so tightly that it exerts stress on the object. **Never crumple tissue in wads.** Insert smooth pillows of tissue between parts of an object.

Wrap paintings in glassine paper or Tyvek. Don't use plastic as it can trap moisture if the temperature drops radically during shipping and condensation occurs. This moisture can support mold growth and many other types of deterioration.

After you cover the object, round off all projecting parts and handles with tissue. For example, imagine you are wrapping a teapot. Place soft, unbuffered, acid-free tissue around the spout, inside the teapot, and in the open space under the handle. The end result is a rounded-off ball of tissue where projecting parts are protected by the whole. Wrap the entire teapot in one sheet of tissue or bubble-wrap to hold padding in place. Label the exterior wrapping with object identification information (for example, object name and catalog number).

3. *How should I cushion the object inside the container?*

There are several ways to properly cushion objects inside the packing container:

- Use packing materials (for example, bubble-wrap, polyurethane, or polyethylene foam blocks) that help absorb shock and vibration and create a thermal barrier.
- Always provide at least two inches of cushioning between objects in the same container.
- Provide at least two inches of cushioning between objects and the walls of the container.
- Allow three to four inches between very fragile items like ceramics and glass and between heavy objects.
- When determining the number of objects you may pack in one container, use common sense. Consider weight, fragility, and sensitivity to environmental conditions. For example, do not pack heavy metal industrial parts with china. Likewise, environmentally sensitive ethnographic objects require more buffering material than historic metals.

Figure 6.12. Wrapping, Padding, and Packing for Shipping an Object.

4. *What other techniques can I use to cushion objects and provide shock absorption?*

There are a variety of techniques that you can use to cushion objects. These techniques include:

- double boxing
- cavity packing
- padding negative spaces
- cushioning braces

You should base your selection on the fragility, size, and construction of the object as well as the modes of transportation during shipping.

Double Boxing

Double boxing is the process of packing an object in two sequential boxes. It's an excellent way to cushion objects. Follow these steps:

- Wrap the objects and cushion them inside one box.
- Pack the first box inside a second box at least two inches larger on all sides.
- Completely fill the spaces between the boxes with newspaper or foam, or use corner blocks or plastic rings between the boxes.

Figure 6.13. Objects Double-boxed for Shipping.
The straps make it simple to remove the interior box.

Cavity Packing
Cavity packing is the process of placing small to medium-sized objects in hollows cut into layers of polyethylene foam. This technique is clean and easy to use in repacking. To cavity pack:

- Trace the shape of the objects.
- Mark the shape on the foam with a pencil.
- Cut out the contour with a bread knife or electric carving knife.
- Protect the object against abrasive polyethylene material by covering the cavity with soft, unbuffered acid-free tissue, Tyvek, or another smooth inert material.

Padding Negative Space
Use this technique for less fragile objects. Surround the object with tissue paper and then wrap it with successive layers of bubble wrap. Place the object inside the container and use pads of tissue, bags of packing peanuts, or soft foam to fill in the excess area. Allow several inches between each object and between the objects and the inner container. Larger, heavier objects will need more separation than small, lightweight objects. When using this technique for open objects (for example, pots or baskets) fill them with tissue to prevent collapse caused by the pressure of surrounding objects.

Cushioning Braces
A cushioning brace holds the object in place and may be necessary to immobilize the object when padding negative spaces. To make a cushioning brace, measure the distance between the object and the container. Build polyethylene blocks to fill in the space. Cover the polyethylene with a less abrasive material such as soft acid-free tissue to protect the object. Place packing material on top of the object to prevent it from moving during shipping, but don't overfill the box. Overfilling places too much compression on the object.

5. *What should I do before closing the container?*

Before you close the container, place packing material above the object to prevent movement if the box is overturned. Avoid too much compression so that padding material does not damage the fragile objects. Cushioning material should support and enclose but not compress the object. After you finish packing, lightly jar the container to determine if objects can shift. If they can, you must repack the container

You should create an inventory of all contents inside the lid of each packing container. If the procedures for unpacking are complicated, include written unpacking instructions or a sequence of photographs showing the proper packing or unpacking procedure. Unpacking in an incorrect order can cause damage. Place a label with the address neatly typed or printed inside the box in case the exterior address is lost or destroyed.

6. *Should I wrap and label the shipping container?*

After a box is packed you may want to wrap it in paper to give it a finished, clean appearance. If you must wrap a box, do it carefully and neatly. A poorly constructed and shoddily wrapped container invites people to mishandle it. A neatly wrapped and properly labeled container encourages handlers to be careful. Kraft paper is an excellent exterior wrap for containers. Tape all open edges and folds of the paper.

7. *What should I put on the label on the exterior of the container?*

Prepare the exterior label as follows:

- Always print the name and address of the recipient in permanent ink.
- Write the recipient's name and address directly on the outside of the box as well as on any wrapper. This way, if the wrapper is torn, the package will not have to be opened to get the name and address of the recipient.
- Place the typed or neatly printed address in the center of the box. Place a duplicate label with this information inside the box. If the address is a P.O. Box, include the telephone number on the label.
- Always include the name of the recipient on the address label. Phone before you ship so that the recipient will be expecting the shipment.

8. *What kind of identification markings should I put on the box?*

- Write neatly on the top, "OPEN THIS SIDE."
- Put arrows on the sides to let the handlers know which end is up.
- Add necessary labels to warn handlers and give them information they may need to know to properly handle the box. For example:
  - Label the package "FRAGILE" if the contents are delicate.
  - Add the proper hazard label for nitrate film and other hazardous materials.
  - Print specific instructions such as, KEEP DRY, DO NOT TILT, HANDLE WITH CARE.
- Mark the total number of boxes on the address labels (Box 1 of 2, Box 2 of 2).
- Make sure all labels are secured with strong tape or adhesive.
- **Don't** attract thieves by writing "Works of art" or "Museum objects."

G. Shipping Objects

1. *What things should I consider if I use a professional packer/shipper?*

You may decide to contract for packing/shipping service. However, be aware that professional packers/shippers seldom have knowledge of and sensitivity to the delicacy of museum objects. Use shippers who've handled museum collections before or who specialize in museum collections. The reputation of a particular art packer or carrier is an important factor to consider. Get referrals from your regional/SO curator and other parks or local museums. Check references of any firm you plan to hire. After you select a company, discuss and confirm the following points of information about the shipment:

- size and weight limitations
- insurance coverage
- costs and payment terms
- pick up and delivery times

The park should also be specific with the carrier about meeting NPS standards. Finally, be prepared to supervise and give specific instructions for packing/shipping the objects.

Park curatorial staff should inform the regional/SO curator of positive and negative experiences with particular art packers and carriers. This information will help to maintain a current list of available packers and carriers for referral to other parks.

2. *What transportation alternatives are available for shipping museum objects?*

There are several options for transporting museum objects. These include:

- U.S. Postal Service
- package delivery services (for example, United Parcel Service (UPS) or Federal Express)
- motor freight
- airfreight
- courier

Your selection depends on:

- size
- weight
- distance
- object fragility
- extra services required

Specific features and limitations of each alternative are described below.

3. *When should I use the U.S. Postal Service?*

Use the U.S. Postal Service (USPS) for objects that are not fragile or of special significance (for example, high monetary, associational, or research value). Always mail "priority" class to reduce transit time. Send by registered mail, return receipt—the most secure service offered by the USPS. With registered mail the USPS monitors the movement of your package from the point of acceptance at the post office to delivery. You will receive a receipt when you mail your package and a delivery record is kept at the post office at the other end. When you request a return receipt, you will receive a receipt showing who signed for the item and the date that it was delivered. Completed packages must weigh less than 70 pounds and measure less than 108 inches in combined length and circumference.

4. *When should I use commercial package delivery services?*

Use commercial package delivery services such as United Parcel Service (UPS), Federal Express, or Airborne Express for shipping sturdy objects. These companies have limits on the value of objects they will ship and insure. Talk to the company you choose to find out:

- value limits (companies often will not ship objects worth more than $50,000) For more information on appraisals, see *Museum Handbook*, Part II, Chapter 4: Inventory and Other Special Instructions.
- insurance requirements (most companies have a basic insurance coverage, but require you to purchase higher limits)
- size and weight limits

- pick up and delivery alternatives (for example next day, second day, weekend)

Be sure to require the service to sign and return an Acknowledgment of Delivery form. When shipping to a large institution, specify that a specific person or department must sign for the delivery. This is to ensure that the package is not left at a loading dock or reception desk.

5. *When should I use an art shuttle van or special product truck?*

Art shuttle vans and special product trucks offer another form of transportation for museum objects. Some national van lines and specialized art handling companies offer these services. However, they are subject to side routing, delay, and transfer between vehicles. When choosing this shipping method, discuss in detail the route and process that the transport will use. Ship only in air-ride suspension trucks that can absorb road shock. Transport objects sensitive to temperature and relative humidity changes in a climate controlled van. Cost is based on size of shipment, weight, distance, and extra services such as pick-up, non-stop delivery, climate control, and daily progress reports. You can find other information about specialized shippers in the AAM Products and Services Directory under "Shipping and Moving Companies."

6. *When should I use airfreight?*

Airfreight is a fast transportation method, but it can be expensive. Airfreight also subjects objects to considerable handling. However, with airfreight, the object is out of your control for the least amount of time.

A typical airfreight-shipping scenario looks like this:

1) Truck or van transports the object to the airport.
2) Objects sit on the loading dock.
3) A forklift carries objects to the plane.
4) The objects fly on one or more planes.
5) A forklift unloads the objects. They may sit for a time on the loading dock:
6) A van takes the objects to the final destination (airfreight companies generally contract for pickup and delivery services).

Plan routing carefully to minimize stopovers and plane changes. This prevents unnecessary loading and unloading or an unattended crate at the loading dock. Be mindful of pressure differences between ground and flight level that may affect pressure-sensitive objects. Size limitations are related to airplane configuration. Weight and dimension of the shipment normally determine air shipment charges. Seek out an airfreight forwarder to help you coordinate air and ground transport.

7. *Should I use a courier?*

All of the above techniques have some level of risk. You can reduce this risk by using a courier. Using a courier decreases the possibility of loss. Because of the fragility, sensitivity, and high value of most museum objects, consider having a courier accompany the object during transit. A courier is also recommended if the trip is complex with many carrier changes. Someone with knowledge of conservation, museum documentation, and object handling techniques may serve as a courier. This person might be either a hired agent or a NPS employee.

As a courier on an airplane, you must:

- Make all arrangements in advance with the airline. Explain what you will be carrying, loading, and unloading.
- Check on airline size limitations before planning for a hand-carried shipment.
- Purchase an extra seat for the object if necessary.
- Secure the object (container) with a seat belt unless it will fit under your seat or overhead compartment.
- Never let the object out of your sight.
- Do not carry hand luggage that gets in the way of the object.
- Do not reveal the contents of the package to other passengers.
- Try to board before and disembark after other passengers.
- Supervise the loading and unloading of objects in the cargo hold and accompany the object from the plane to the cargo shed.
- Deliver the museum object as soon as possible.

If traveling by car:

- Be sure someone is always with the object in the vehicle.
- Stop only when necessary.

H. Receiving and Unpacking the Container

1. *How should I unpack a container?*

You should use as much care unpacking a box as you use in packing it. Follow these basic instructions:

- When you receive a shipment, don't open the box for 24 to 48 hours to allow the contents to acclimate to the new environment.
- If the box exterior is damaged, note the problem on any receipt of acceptance that you sign. This identifies the fact that damage occurred before the box arrived at the park.
- Cut tape carefully to avoid excess pressure on and damage to the object.
- Check for unpacking instructions that may be included with the box.
- Check the contents of the box against the packing list to ensure that everything is present.

- Flatten all packing materials completely to be sure that no object pieces or small items are still inside.

- If the object has to be repacked to return it, place the packing materials inside the box or crate and save the container.

- Take careful notes on the unpacking sequence and label all packing boxes and supports so they can be reused properly.

- Never permanently store museum objects in packing containers. Such containers are for short-term transportation needs.

2. *Should I check for insect infestation?*

As soon as you unpack the box you should check for pests:

- Thoroughly check the object for signs of infestation such as shed larval skins or live insects.

- If infestation is noticed, immediately isolate the object and develop a strategy for dealing with the infestation. If the item does not belong to you, contact the owner and solicit their input when developing your strategy. See Chapter 5: Biological Infestations, in this handbook, or contact your regional/SO curator for additional information.

3. *What do I do if an object is damaged, lost, or destroyed during shipping?*

All shipments should be insured with wall-to-wall insurance coverage. See *MH-II*, Chapter 4, for information about insuring shipments. If an object is damaged when it is returned, document the damage. Damage should be recorded in the condition and condition description fields of the ANCS+ catalog record. Follow the instructions in the *ANCS+ User Manual* on reporting condition. See *MH-II*, Chapter 3: Cataloging, for information on how to do condition reporting.

Take photographs of the damage if possible. Save all pieces and carefully pack them so that no further damage occurs before a conservator can make repairs. Small pieces may be wrapped and bagged in self-sealing polyethylene bags labeled with the appropriate object identification information.

If the damage occurred during shipping, report the damage to the shipping company and submit an insurance claim. You will have to provide evidence that the object was not damaged before shipment.

If an object is lost or destroyed during shipping, report the loss and deaccession the object. Follow the procedures outlined in the *MH-II*, Chapter 4: Inventory and other Special Instructions, Section III, “Reporting Loss of Museum Objects,” and Chapter 6: Deaccessioning, Section H, “Loss, Theft, Involuntary Destruction, Abandonment or Destruction.”

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Rules for Handling Objects in Park Collections

1. AVOID wearing anything that might damage objects by scratching or snagging the surface, such as rings and other jewelry, watches, belt buckles, nametags, and service badges.

2. NEVER smoke, eat, or drink around the objects.

3. Handle objects only when necessary.

4. LOOK carefully at an object before lifting. Ask yourself:
   - Is the surface fragile?
   - Are there any clues to make me think it is damaged?
   - Where am I going to put the object, and is there a clear space set aside for it?

5. Use BOTH HANDS to lift an object.

6. If an object is in a container, lift only the container.

7. WEAR GLOVES when lifting objects

8. Wash your hands before putting on cotton gloves. Oils and acids can soak through gloves.

9. If you break something, tell the Curator.

Figure 6.14. Example of Written Handling Rules for NPS Park Collections

CHAPTER 7: MUSEUM COLLECTION STORAGE

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CHAPTER 7: MUSEUM COLLECTION STORAGE

A. Overview

1. *What is museum collection storage?*

Museum collection storage is both a physical space and an ongoing process.

- It is a dedicated space used for storing museum objects, natural history specimens and archival materials. This space is designed or upgraded to meet standards and requirements for the preservation, protection, and accessibility of the collection.
- It is the ongoing process of containing, organizing and caring for the collection while it is in storage. This involves evaluating and implementing strategies and techniques to improve the condition and long-term preservation of the collection.

Each decision you make about storage should take into account how the consequences of the decision will improve the protection and preservation of collections.

2. *Where does collection storage fit in my park's preventive conservation program?*

Good collection storage is a major component of your park's preventive conservation and collections care program. It is essential to the long-term preservation of your park's museum collection. A well-planned and organized storage space reduces risks to the collection and provides accessibility. Deterioration, damage, or loss will be minimized if you implement:

- proper storage space, strategies and techniques
- good handling practices (see Chapter 6: Handling, Packing, and Shipping)
- effective security and fire protection (see Chapter 9: Security and Fire Protection)
- good housekeeping practices (see Chapter 13: Museum Housekeeping)
- appropriate environmental conditions (see Chapter 4: Museum Collections Environment)
- an effective Integrated Pest Management program (see Chapter 5: Biological Infestations)

3. *What is a multi-layered collection storage system and how does it protect my collection?*

A well-designed collection storage space that readily accommodates your collections combined with a rational, systematic approach to collections management and good housekeeping will minimize or block risks to the collection. It will provide the collection the best possible protection from all agents of deterioration. See Chapter 3: Preservation: Getting Started for more information about the agents of deterioration.

A multi-layered collection storage system is composed of successive layers of protective envelopes or enclosures, from the building itself to the equipment and containers that surround an object. The greater the number of layers, the more protection. Figure 7.1 illustrates the multi-layered approach to protecting an object with successive levels of containment. Although museum collection storage situations vary, the variables that need to be considered to properly house a collection are the same. Evaluate each layer of the system and adapt it to meet your collection's preservation and protection needs.

In the multi-layered approach, each level adds another layer of protection to the collection by shielding it from the agents of deterioration. The more layers, the greater the level of protection or "buffering" from the agents of deterioration. The layers of protection are:

- *Building/facility envelope:* exterior (outside/external) walls of the structure housing the collection.
- *Room/space envelope:* walls of the room or space immediately enclosing the collection.
- *Equipment/storage furniture:* storage furniture such as a cabinet with gaskets, map unit, or shelving unit housing the object.
- *Container/housing:* container housing the object such as a box, tray, or other fully enclosed container.
- *Packaging/wrapping materials:* museum quality materials that cover and/or support the object inside of its container/housing, such as tissue, muslin, or polyethylene foam.

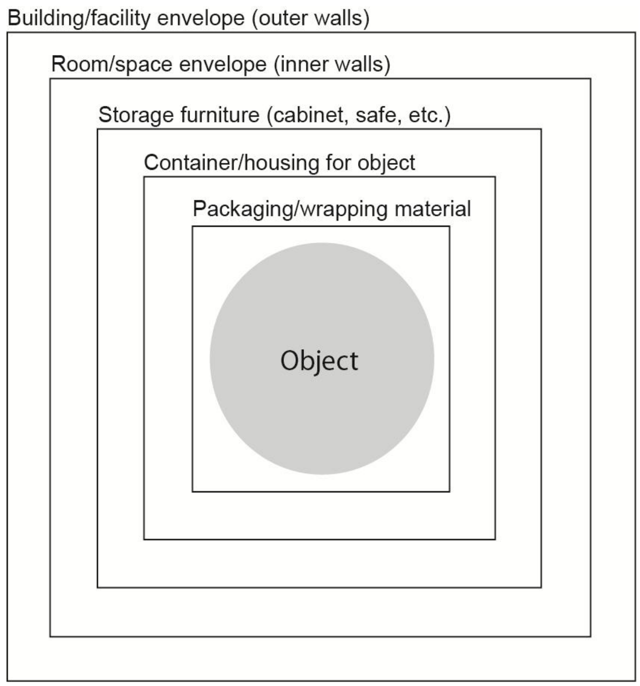

Figure 7.1. Multi-layered protection of an object

4. *How do I determine my collection storage needs?*

Become familiar with your collections and storage space. Evaluate each layer of protection. Become familiar with this chapter and complete the "NPS Checklist for Preservation and Protection of Museum Collections," in Appendix F: NPS Museum Collections Management Checklists. This checklist will help you evaluate your collection storage needs in the following areas:

- facility and space requirements
- protection requirements (physical security and fire protection)
- environmental requirements
- museum equipment and container requirements
- housekeeping requirements
- Integrated Pest Management (IPM) requirements

5. *Who should I consult with when developing or upgrading my storage space?*

Complete the Checklist by using the Automated Checklist Program of the Management Reports module of Interior Collections Management System (ICMS). See Appendix J in the *ICMS User Manual* for more information. Use this checklist when making changes or additions to collection storage space.

Consult with your regional curator, park facility manager, and a structural engineer and architect with experience in this area when building or updating your storage space. They will provide specialized knowledge and guidance on new buildings that are designed to hold collections (purpose built structures), structures that are adapted to store collections (adaptive use) and historic structures that house collections.

B. Standards and Requirements for Storage Space

Standards and requirements for collection storage space are based on National Park Service (NPS) policies and standards, Department of the Interior (DOI) and professional museum best practices.

The NPS *Management Policies*, Section 5.3.1, states:

> *"The National Park Service will employ the most effective concepts, techniques, and equipment to protect cultural resources against theft, fire, vandalism, overuse, deterioration, environmental impacts, and other threats without compromising their integrity or unduly limiting their appreciation by the public."*

The Interior *Departmental Manual* Part 411 Policies and Standards for Managing Museum Collections, Chapter 3, provide departmental standards for museum property storage.

1. *What are the standards and requirements for collection storage space?*

The essential elements of NPS collection storage space standards and requirements are summarized below.

- Safe and secure storage of museum collections requires dedicated space. Museum storage areas must only house museum collections. **Separate museum storage from all other uses**, including office space and research and work areas.
- House collections in a dedicated space that has minimal penetrations and optimum thermal performance.
- Museum storage space must be adequate to accommodate the particular characteristics and quantity of objects, specimens, and archival items in your collection. It must also provide adequate space to accommodate reasonable

growth of the collection over the next ten years.

- Organize the space to allow for the efficient use of curatorial equipment and techniques, and to provide for effective access and optimum preservation of the museum collection.

- House objects in appropriate containers and package objects with appropriate materials.

- Containerize collections to the extent possible to minimize the negative effects of relative humidity and temperature fluctuations.

Ensure the collection storage space is both *suitable* and *sufficient* for proper storage. *Suitable* space is planned space that has been determined to be adequate for storing museum objects. *Sufficient* space is expandable space that provides room for safe, non-crowded storage of the collection and allows room for future growth.

Outbuildings, closets, and unimproved basements and attics are not suitable space. These inadequate spaces do not contribute to the preservation and effective use of a collection. See Chapter 4: Museum Collections Environment for further information.

Note: Recommendations provided in this chapter generally apply to structures that are purpose built and or adapted to house museum collections, followed by recommendations that apply specifically to historic structures.

The "NPS Checklist for Preservation and Protection of Museum Collections" provides a detailed checklist of standards and requirements for collection preservation and protection, including collection storage space.

2. *Why should my collection storage space be used exclusively for storing collections?*

By separating curatorial office, work, and research spaces from the space housing the collection, you minimize environmental impacts on the collections and lessen security risks. Do not combine storage space with other functions for reasons noted below.

- Collection security generally decreases; theft, mishandling, and vandalism increase with storage room visitation and use.

- People working in the storage area increase the number of air exchanges the area must undergo. Air exchanges cause temperature and relative humidity levels to fluctuate, resulting in accelerated deterioration of objects. More air exchanges increase the load on climate control systems, leading to higher energy costs and stress on passive control systems.

- Work areas often require lighting levels that may cause damage to unprotected light-sensitive objects due to the specific wavelength of the radiation, intensity or duration of the lighting. Lights are generally "off" in storage only spaces.

- Office equipment (copiers, computers) generate ozone, a pollutant damaging to collections.

- Movement of people into and within the area tracks in soil and disperses dust into the air, which in turn is deposited on surfaces of objects and equipment .

- Potential for pest infestation increases.

- Accumulation of non-collections items increases the risk of fire and pest infestation, and creates clutter that can lead to dirt/dust accumulation.

Store flammable liquids and materials, curatorial supplies, audiovisual equipment, and other interpretive materials outside the museum storage space to lessen clutter and thereby reduce the risk of fire.

3. *Where should I locate research, work and office spaces?*

Locate all research, work, and office spaces convenient to but *not* within the collection storage space. Research is a fundamental use of a museum collection and collections research space has its own specific requirements. Refer to the *Museum Handbook* Part III, Appendix D: Guidance on Planning for a Research Space, for guidance on a planning research space.

4. *How do I ensure that I have adequate space to store the collection?*

The storage space must be large enough to accommodate the existing collection as well as the projected growth of the collection over the next 10 years. When designing or upgrading your storage space, be sure that your space:

- houses individual objects appropriately and safely
- allows for the use of proper storage equipment and techniques
- incorporates aisles at least 48" wide between rows of equipment; this width allows safe handling and movement of drawers, cabinet doors, and larger objects
- ceiling height is sufficient to accommodate raised and stacked cabinets without interfering with lighting and protection systems
- provides adequate access to the collections that is safe for staff and the collections

Make sure the space allows movement of personnel, equipment and objects in and out without hindrances such as inadequately sized doors; narrow, winding, or steep stairs; or passageways with low ceilings. Plan and organize your storage space to facilitate access to the collection.

5. *What do I need to know about the type of structure that houses the collections?*

Different types of structures have different construction requirements. Therefore, installation of equipment such as fire and security systems, and storage furniture needs will also vary. A *purpose built structure* has different requirements than a structure that is adapted to house collections (*adaptive use*) or an *historic structure* that houses collections. Consult with your facility manager, regional curator, historical architect and structural engineer during planning and implementation of a storage or construction project.

In a historic structure, the best approach to providing suitable collection storage space is to create a "room within a room." This creates another layer of protection for the collections and protects the historic fabric of the structure. Particularly when strict environmental control is required, this strategy

improves the prospect of success because the equipment that controls the storage facility environment has only the benign interior environment of the historic structure to temper rather than the harsher exterior environment.

In pursuing such a strategy, configure the interior room in such a manner as to be as reversible as possible. Also, set it sufficiently away from the historic structure's exterior envelope to provide a maintenance access passageway around its entire perimeter. This avoids inadvertent damage to the historic envelope attributable to altered temperature or moisture gradients. It also allows for easy inspection and repair of any other moisture or structure-related issues developing in the exterior envelope. Moreover, by providing an access passageway avoids the need to block or alter the appearance of windows in the exterior envelope.

6. *What structural load capacity should my storage space or facility have?*

Collection storage space requires a greater structural load (weight) capacity than office or living space. Storage equipment filled with museum objects can become extremely heavy. When housing collections in historic structures, remember these structures may not be able to bear large loads. Consult with your regional curator, park facilities manager, and a structural engineer and architect.

Design or modify your storage facility or space to meet the following guidelines:

- Always consult a structural engineer to determine the suitability of a floor and the placement of supports and equipment. Follow the *International Building Code®* all new purpose-built structures, and the *International Existing Building Code®* for existing buildings. Various chapters within the *International Existing Building Code®* deal with historic structures. For facilities not under direct ownership of the National Park Service, codes adopted by other jurisdictions may apply.

- Determine whether the load capacity of the existing structure is adequate to accommodate your collection. The load will depend on th*e types and quantity of materials* you plan to store. Use space capable *of sustaining a live floor load of at least* 150 pounds per square foot.

  Note that in historic structures it is often not possible to achieve the prescribed uniform live load capacity without unacceptable alterations. Floors constructed to a lesser load capacity may be considered if you install spot load supports (usually post supports from below) and arrange equipment to take advantage of existing structural supports (usually equipment arranged around the perimeter of a room close to load bearing walls). To use this strategy, it is essential to engage in a continuous dialog with an historical architect and structural engineer to attain an acceptable arrangement of storage furniture through an iterative process. Once such an arrangement is established, it should not be altered without re-engineering.

- A live floor load of 350 pounds per square foot is desirable, especially for particularly heavy collections such as paper-based materials such as archives and herbaria, some fossil collections, metals, heavy equipment, and if you plan to install a moveable aisle (compactor) storage system.

  Note that such a load capacity is rarely achievable in an historic structure. Consult a structural engineer and the equipment manufacturer when determining the required load rating for a floor supporting a moveable storage system or have objects of exceptional weight

- Design, construct and/or retrofit storage facilities to accommodate local or regional considerations, such as seismic activity or snow loads to minimize damage to the collections and structure.

- Consider reinforced concrete or masonry construction with a wind load rating of 110 miles-per-hour or higher for new construction of stand-alone purpose-built storage facilities in areas susceptible to severe wind conditions. Fasten roofs to the wall and/or foundation structural components so the roof can withstand hurricane force winds.

7. *What are the requirements for the location, layout, and structural features of storage space?*

To adequately preserve and protect the collection, locate and construct collection storage facilities and spaces to meet the following requirements:

- Locate the storage space outside the 100-year floodplain. This is in accordance with Executive Order 11988, "Floodplain Management," May 24, 1977 (42 USC 4321) and Procedural Manual 77-2: Floodplain Management.

- Store only collections in the space. Local and national building codes usually rate collection storage space as “storage occupancy.” Locate work, office, research (“human occupancy”), and supply storage areas close to, but not within, the storage space.

- Space is sufficient for the movement of staff, equipment, and objects in and out without hindrances (e.g., low ceilings; inadequately sized doors; or narrow, winding, or steep stairways). Space is large enough to accommodate the current museum collection and anticipated growth for at least the next ten years.

- Use space that is constructed of fire-resistant or fireproof materials. Cover interior wood framed walls and ceilings with gypsum wallboard or other material to achieve a minimum one-hour fire rating (some codes may require a two-hour fire rating). In historic structures, consider creating a “room within a room,” using fire-resistive materials for the newly-inserted construction.

- In a purpose built structure, do not include windows on an external envelope wall. Use as few doors as practical to enhance security and environmental control, but not so few as to be in violation of health, safety and fire codes. See National Fire Protection Association *NFPA 101,* “Life Safety Code,” 2009 Edition, and *OSHA Standard 1910.36,* “Design and construction requirements for exit routes.” Create a “room within a room” to house collections away from the exterior envelope to minimize environmental fluctuationsand condensation and place offices adjacent to exterior walls.

- If the space has windows, make sure they are physically blocked and insulated in a reversible manner to eliminate natural light, reduce environmental fluctuations, and enhance security. In an historic structure, this must be accomplished in such a manner as to be undetectable from the exterior, and to allow ready access to the window for maintenance purposes.

- Insulate the space so it will maintain a stable environment that protects the objects from adverse temperature and relative humidity conditions and damage from biological infestations. Insulate walls to a minimum R-19 rating and the ceiling to a minimum R-30 rating.

- Install an adequate vapor barrier in walls, ceilings, and floors in a purpose built museum structure.

  Note: Consult with a specialist in this area before installing a vapor barrier in an extant facility as vapor barriers can inadvertently create moisture and mold problems. .

- Use space with as few exterior walls as practical. This will minimize the chance of condensation on walls and windows during seasonal and diurnal temperature changes, enhance security, and increase energy efficiency.

- Keep areas adjacent to the structure's exterior free of trees, shrubs, or other plants. Plantings close to or touching exterior walls provide a habitat for pests that may then migrate into the structure. Install a sanitary barrier of small pebbles over a geotextile and have surrounding dirt slope away from the structure to minimize moisture seepage into the structure.

  Consult with a specialist before installing a vapor barrier in buildings, in particular, ones that have crawl spaces with exposed dirt to avoid introducing moisture problems. The specialist will need to determine whether a vapor barrier in this location will have the unintended effect of encouraging additional capillary uptake of ground moisture into adjacent masonry elements. Also, the specialist will need to recommend a means for removal of moisture that accumulates on top of the vapor barrier due to infiltration or condensation. If possible, install a slab on grade as described below. However, in a historic structure, use a more reversible approach.

- Install rigid foam insulation and a vapor barrier in concrete floors on grade for purpose built structures. Make sure the level of the top of the concrete slab is at least 6" above the grade level of the soil. Consult a specialist before installing a vapor barrier to avoid inadvertently creating a moisture problem.

- Require frame walls to be a minimum of 6" thick, constructed with 6" metal or wood studs. This thickness of wood-frame wall construction provides structural strength and is capable of accommodating the required insulation.

- Use metal hollow-core or wooden solid-core doors with a good fire rating. Equip entry doors with a mortise lockset or a key-in-knob lock combined with a separate deadbolt lock. Place door hinges on the interior side of the door. If hinges are located on the exterior of the door, use non-removable hinge pins.

- If the historic or adapted structure requires wood underlayment beneath new resilient flooring, use only softwood plywood as it produces minimal off gassing or use products that have minimal or no noxious gases. Other types of underlayment material may contain adhesives that off-gas significant amounts of formaldehyde, which can damage objects. Note that wood subflooring is inappropriate for use with compact/mobile storage systems which require carefully leveled flooring with the rails installed in concrete.

8. *What are the requirements for building systems and utilities in storage space?*

Use the following structural features, layout, and building materials to provide safe and secure conditions for storing objects:

- Alarm and/or monitor space 24/7 to detect fire and unauthorized entry.

- Locate HVAC (heating, ventilating and air conditioning) and other climate control equipment outside the storage space. This reduces the possibility of damage to the collection from system leaks. It also avoids the need for non-curatorial staff to enter the space for maintenance or repair. Install monitors and sensors for system control in the space itself to ensure that the storage environment and not the air in the ductwork controls the environment.

- Make sure all electrical systems and equipment are UL listed and installed in full compliance with local and national electrical codes. Include sufficient electrical outlets to power supplemental environmental conditioning equipment, vacuum cleaners, and task lighting.

- Verify that space is free of water and sewer pipes and valves that can burst or leak and cause damage. **Note**: Water lines associated with fire suppression systems are allowed.

- Spaces equipped with fire sprinkler systems should have adequate floor drain(s) with backflow check valve(s). Consult with a structural engineer on how to handle potential water damage that might result from the fire suppression system. Take precautions to avoid creating a pest habitat by keeping drains dry and adding fine mesh screening over drain opening(s). Include routine maintenance checks in your housekeeping plan.

- Space is not susceptible to flooding if pipes or drains in adjacent spaces (e.g., a bathroom on the floor above) leak or backup.

- Space is free of water, gas, or electric meters, electrical panels, and utility valves that require monitoring and servicing by non-curatorial personnel. This will limit the need for access by non-curatorial staff and minimize security concerns.

9. *What features and materials are required for the walls, ceilings, and floors in storage spaces?*

Use the guidelines below to ensure that walls, floors and ceilings have the appropriate features and are made of safe materials that do not damage collections.

- Do not install dropped ceilings in storage areas, and avoid using them elsewhere in the structure. They obscure leaks, provide a habitat for pests, and the acoustic tile material can generate dust and debris.

- Paint walls and ceilings using acrylic emulsion latex, vinyl acrylic, or acrylic urethane coatings. Other coatings may off-gas at unacceptable levels. Do **not** use any oil-based paints.

- Paint walls and ceilings white or a light color. Paints with titanium dioxide (most white paints) absorb ultraviolet light emitted by ambient or artificial lighting.

- Treat concrete floors with a sodium silicate sealing/curing agent. This hardens and increases the density of the surface of the concrete, helping protect it from cracking, dusting, and other damage. The floor should be easy to clean without the use of chemical cleaners or water.

- Seal concrete floors with a water-borne sealer. Select a product that does not off-gas during or after cure. Make sure that the product can be reapplied when it becomes worn without the need to remove collections from the space.

- Use deck grey colored sealer so that you can determine when the finish is dirty or scuffed. Avoid other types of floor coverings, as they require wet cleaning and/or are a source of off gassing.

- Cover plywood subfloors with a highly durable, chemically inert, and stable floor covering such as true wood plank flooring (not particleboard or OSB) covered with a moisture-cure epoxy sealer, or impervious ceramic tiles with 100% epoxy resin grout. Ceramic tiles can also be used over concrete. Consult with your park facility manager, a flooring specialist and a conservator before making a selection.

10. *What type of lighting is required in storage spaces?*

Damage from visible light and ultraviolet (UV) radiation is cumulative and irreversible. Select the appropriate type of lighting and always minimize the intensity and duration of lighting in collection storage spaces. Use the guidelines below to provide appropriate lighting for your collection storage space.

- Eliminate ambient light sources that can damage objects (i.e. unblocked windows and skylights) that can damage collections.
- Use LED or UV-filtered fluorescent lighting. Remove or replace incandescent lighting to reduce energy costs over time. Do **not** use quartz or halogen lights; they emit unacceptable levels of UV and infrared radiation. Lighting levels should not exceed 200 lux or 20 footcandles.
- Install lights in multiple zones controlled by individual light switches. This allows lights to be activated only in areas where there is activity. When storage space is unoccupied, turn **all** lights off.
- Provide indirect (diffuse) lighting by aiming fixtures at walls or ceilings. This reduces light intensity, and light reflected off the surface of white or light-colored walls reduces UV radiation levels.
- Avoid using mercury vapor or tungsten lighting on or near the exterior of structures containing collection storage space. These types of lighting attract insects.
- Mount exterior lighting at a distance from the building itself. Focus lights towards walls but avoid windows and doors. Light focused on these features will attract pests.
- Place a central lighting control panel at a convenient location at the entrance of the storage area.
- Use emergency lighting that is triggered by occupancy to save energy where codes permit.

11. *How do I establish proper physical security for the collection storage space?*

Conduct an assessment of the security risks to the stored collection to determine what is needed. Refer to Chapter 9, Security and Fire Protection, of this handbook for details on conducting a risk assessment and for specific security guidance.

12. *How important is fire protection in the storage space?*

Collection storage houses the majority of the park's museum collection. This space must have an early fire detection and suppression system installed to guarantee the safety of the collection and the personnel who use and care for it. Refer to Chapter 9 of this handbook for information on conducting a fire risk assessment and for specific fire protection guidance.

13. *What role does housekeeping play in the collection storage space?*

Housekeeping is a vital part of museum collection storage. Establish and follow a museum housekeeping plan to ensure that collection storage space is properly maintained. Refer to Chapter 13: Museum Housekeeping and the *ICMS User Manual* for guidance on establishing a housekeeping plan.

- Routinely and thoroughly dust and vacuum the entire storage area using a High Efficiency Particulate Air (HEPA) vacuum. Be sure to include areas in, underneath, and on top of cabinets and shelving.
- Do not wet clean floors, equipment, or any other areas in the collection storage space. This interferes with relative humidity control and can cause metal storage furniture to rust.
- Do not use any kind of chemical cleaner or spray, as they may introduce pollutants to the storage space.
- Prohibit smoking, eating, and drinking in the storage space.
- Implement and follow an IPM program

Make sure that all areas within the storage space are identified and addressed in the housekeeping plan. This includes storage equipment and supports create areas where dust and debris gather, such as underneath or on top of cabinets.

14. *Where do I find additional guidance on collection storage spaces?*

For additional information in this handbook, see Appendix T, Curatorial Care of Biological Specimens, Section D, Storage of Biological Collections and Appendix U, Curatorial Care of Paleontological and Geological Collection, Section F, Handling and Storage of Paleontological Specimens.

Refer to the NPS *Conserve O Gram* series for additional information and specific guidance for planning collection storage space and to the bibliography of this chapter,

C. Standards and Requirements for Storage Equipment and Containers

Standards and requirements for storage equipment and containers are based on Department of the Interior (DOI) and National Park Service (NPS) policies, and professional museum practices. The Interior *Departmental Manual* Part 411 Policies and Standards for Managing Museum Collections, Chapter 3, provide departmental standards for museum property storage. The NPS *Management Policies*, Section 5.3.1, states:

"The National Park Service will employ the most effective concepts, techniques, and equipment to protect cultural resources against theft, fire, vandalism, overuse, deterioration, environmental impacts, and other threats without compromising their integrity or unduly limiting their appreciation by the public."

1. *What are the requirements for collection storage equipment and containers?*

The use of appropriate specialized, museum quality storage equipment and containers promotes preservation, access to, and effective management of your museum collection. These storage containers are constructed of chemically stable, neutral materials. They protect objects by providing physical and environmental protection (buffering).

NPS collection storage equipment and container standards and requirements follow below.

- Sufficient quantities, number and appropriateness of equipment and containers are used to house museum objects without crowding.

- Museum storage cabinets, shelving units, racks, and equipment are in working order and good overall condition.

- Museum cabinets are not stacked more than two high and cabinet drawers are not loaded beyond the manufacturer's recommended weight capacity.

- Museum cabinets, shelving units, and other equipment are raised off the floor at least 4” preferably 6”on metal risers as a precaution against potential flooding and to facilitate cleaning of floors and inspection for pest problems.

- Museum cabinets, shelving units, and other storage equipment are made of metal. Wood is not used even when painted, as it can off gas harmful acids.

- Museum cabinets, shelving units, and other storage equipment are arranged so that access to objects and interior spaces is not impeded, allowing for safe access and inspection and cleaning.

- Museum objects that are not enclosed within cabinetry are protected and covered and/or cushioned by appropriate materials and mounts.

- Open shelving is stabilized (e.g. bolted to the floor, wall, or adjacent equipment) to prevent it from tipping over. Install restraining bars or cords to edges of shelves to prevent objects from falling, in particular, for collections in earthquake zones.

- Objects in museum cabinets, shelving, or other storage furniture are properly cushioned, mounted, or stored in trays using museum quality materials.

- Natural history specimens stored in fluids are housed separately from dry specimens and are housed in a space that provides appropriate ventilation and fire protection.

- Spaces and/or cabinets housing specimens stored in fluids, objects containing fluids, specimens and objects treated with pesticides, rocks/minerals/fossils that are radioactive, or nitrate film are identified by appropriate health and safety signs.

- Nitrate film is housed in buffered sleeves or envelopes, placed in sealed polyethylene bags, and stored in appropriate frost-free freezers in separate space from all other collections. See *COG 14/10*: Cold Storage for Photograph Collections – An Overview, 12/11: Cold Storage for Photograph Collections – Using Individual Freezer Unit, 14/12: Cold Storage for Photograph Collections –Vapor-Proof Packaging.

- The “NPS Checklist for Preservation and Protection of Museum Collections" provides a detailed checklist of standards and requirements for collection storage equipment and containers. See Appendix F: NPS Museum Collections Management Checklists.

2. *What is considered "museum quality" for storage equipment, containers and materials?*

Museum quality, equipment and containers are made using inert, non-reactive materials that do not off gas (emit) substances that accelerate or cause deterioration of objects. Terms such as "pH neutral" or alkaline-buffered are used to describe museum quality materials. The term "archival" was widely used in the past but is no longer used to describe storage materials.

Using materials that are not museum quality can damage objects and shorten their lifespan. The NPS *Tools of the Trade* provides a list of materials and equipment suitable for managing museum collections. It also provides a vendor address list. Refer to the bibliography of this chapter for additional information on collection storage equipment, containers and materials.

Storage equipment: Museum quality storage equipment is usually constructed out of steel that is powder-coated with an epoxy, acrylic or polyester finish. Testing suggests that only the epoxy powder coating is durable. Anodized or powder-coated aluminum, although less common, is also an acceptable material for storage equipment. Older steel equipment was finished using a baked enamel coating. Because of the solvents used in the curing process, all coatings off-gas harmful substances until they are cured. Consult a conservator if you believe your older steel equipment with baked enamel is off gassing.

Storage cabinets, shelving units, and other equipment built of wood, especially unsealed wood, pose a high risk to sensitive collections. Even after many years, wood off-gasses harmful organic acids and peroxides. Replace wood equipment with newer steel equipment.

For guidance on selecting storage equipment, see *COG* 4/1: Museum Storage Cabinets and 4/10: Determining Museum Equipment Storage Needs.

Containers: Storage containers are often made of corrugated paper-based boards or plastics. They come pre-made, ready-to-assemble, or can be custom material made. Museum quality corrugated boards are made of acid-free paper and are available in neutral pH (unbuffered) or alkaline pH (buffered) varieties. Museum quality corrugated plastic is usually made polyethylene or polypropylene plastics, which are stable and non off gassing.

Other storage materials*:* Other paper and paper-based materials include tissue paper, folders, and many forms of paper-based board. To be museum quality, they must be acid-free and of neutral or alkaline-buffered pH.

Certain plastics are considered museum quality storage material, such as polyethylene and polyester. These are available in a variety of bags and folders. See *COG* 8/4*:* Care and Identification of Objects Made from Plastic. Note: These plastics can generate static electricity at low RH and should not be used with objects that have friable surfaces.

3. *Where do I find additional guidance on storage equipment and containers?*

For guidance on selecting storage containers and other materials, see the following *COG*;4/9: Buffered and Unbuffered Storage Materials, 13/3: Polyester Encapsulation, 14/2: Storage Enclosures for Photographic Prints and Negatives, and 18/2: Safe Plastics for Exhibit and Storage.

Refer to the NPS *Tools of the Trade* listing of materials, equipment and suppliers for managing museum collections, the bibliography at the end of this chapter and the NPS *Conserve O Gram* series.

D. Assessing the Collection and its Storage Needs

1. *How do I assess the collection?*

To assess the collection:

- Examine the entire collection, focusing on objects in, or designated for storage. Include all objects that may be returned to storage, including those currently on exhibit, awaiting processing or outgoing loan.
- Note the types of objects by discipline and material, quantities of each object type, relative sizes, and required volumes for safe and accessible storage. For example, consider a hammer and a wagon. Both are history objects and made of more than one material, however, each has different storage requirements and containment needs.
- Note object types by discipline and material makeup and their ranges of sensitivity to agents of deterioration such as temperature and relative humidity, light, and air pollution.
- Identify the types and approximate quantities of objects that the park plans to acquire in the future. Consult the park's approved Scope of Collection Statement for this information.

Consider future archeological and natural history projects that are likely to generate collections that will need to be accommodated in storage.

2. How do I assess collection storage equipment needs?

Use the following guidance to assess current storage equipment and what is needed:

- List the types of existing storage equipment (museum storage and specimen cabinets, map cabinets, file cabinets, shelving, painting racks, specialty racks, high-density storage systems). See NPS *Tools of the Trade* for equipment types and descriptions.
- Note the manufacturer and model number of each type of equipment. If the equipment is non-standard, note its size (width, depth, and height).
- Note the condition of the equipment (operation of locks, condition of gaskets, evidence of rust, dents, holes, scratches).
- List any equipment that will need replacement due to poor condition or functionality.
- Note if additional museum equipment is needed.
- Determine if you will need specialized equipment or adaptations to equipment to house specific types of objects or make more effective use of the space. For example, installing a high-density (compactor) storage system or racks to make optimum use of vertical storage or wall space.
- Determine if a rearrangement of the equipment could better use the existing space.
- Note the types, numbers and location of devices used to monitor temperature and relative humidity and types of environmental equipment used to assist or

take the place of a central HVAC system.

- Note the types of supplies or equipment used in the housekeeping program for the space (vacuum cleaners, brooms, dust mops, etc.).

3. *How do I assess storage techniques and methods?*

Use the following guidance for assessing object storage techniques and methods:

- Note the condition and appropriateness of equipment used.
- Note how types of objects are organized in cabinets, racks and shelves. Indicate if objects are crowded or stacked; these are conditions that must be fixed.
- Note how individual objects are contained. Indicate whether containers are appropriate and provide adequate physical protection.
  - Are objects stable and set securely in their containers?
  - Are objects adequately secured and cushioned to prevent them from moving or sliding when being accessed?
- Make recommendations for improving storage techniques and methods.

The assessment worksheet and observation/recommendation codes in Figure 7.2a and 7.2b can help simplify the assessment process. Figure 7.2a contains the sample worksheet. Figure 7.2b contains the assessment codes to be used in the worksheet.

E. Assessing the Current Storage Facility or Space

1. *How do I assess the existing storage facility or space overall?*

Examine the existing structure(s) and space(s) that are used for museum collection storage to identify how well they meet storage space standards and requirements covered in this chapter. Work closely with facilities management staff to assess your storage facility or space. In particular:

- Note the structure's construction and fabric (wood, masonry, single-story).
- Record the overall dimensions of the space, including the ceiling height and type (for example, 8' drywall ceiling).
- Note the number and size of access doors (measure all doors that objects will pass through).
- Determine, with the assistance of an architect or engineer, if the structure has the strength to safely withstand the loads associated with the collections to be stored. This is especially important for second floors in a structure.
  Note: Paper, ceramic, metal, glass, and wood objects in great volumes are very heavy.
- Note any characteristics of the structure that would hinder the movement of objects or equipment. Stairs and structural posts impede the movement of objects, especially large and heavy ones. Such access routes also increase the risk of accidental breakage.

- Note sizes and directional orientation of windows, overall condition, and type of glazing such as glass, acrylic or polycarbonate).

- Note any electrical service and plumbing fixtures and determine if existing electric service has capacity for add-on functions such as air-conditioners, humidifiers, dehumidifiers, or additional lighting.

- Note wall coverings (dry wall, plaster, brick, paneling). Some wall coverings and construction are more fire-resistant and secure than others.

- Note type and location of light fixtures (incandescent, fluorescent, etc.).

2. *How do I assess physical security?*

Your collection must have appropriate security. You will need to conduct an assessment of the security risks to the collection. Use the following guidance in assessing physical security:

- Conduct a physical security risk assessment as described in Chapter 9, Security and Fire Protection.

- Note any extant intrusion alarm system (type, location of sensors, nature of monitoring, who responds, and response time) serving the space.

- Note the construction and locking mechanisms of doorframes and doors (e.g. metal, solid-core wooden, wooden hollow core, mortise or dead bolt locks).

- Note how windows are secured (latches, plywood-covered, bars).

- Identify the park staff who have keys to storage areas and park staff who require access but are not issued keys. Note whether staff members from other divisions need to enter or pass through the area to access major junction boxes or cleaning supplies.

- Note any other functions that occur in the storage space.

- Note any areas in the storage space where security is compromised. For example, easy access from an adjoining space through the area above a dropped ceiling.

- Note if a visitor/researcher log is used and maintained.

Refer to Chapter 9 of this handbook for details on conducting a risk assessment and for specific security guidance.

3. *How do I assess fire protection?*

Use the following guidance in assessing the fire protection system:

- Conduct a fire protection risk assessment as described in Chapter 9.

- Note any extant fire protection system. Include type of system (wet pipe sprinkler, water mist, ionization, smoke, heat activated) serving the space.

- Determine how the detection alarm is monitored, the responsible party for responding to an alarm, and the response time.

- Check to ensure that the park's Structural Fire Plan is current and consistent with *Director's Order #58: Structural Fire Guidelines.* The plan should clearly identify the pre-suppression actions for the responding authorities (for example, how to enter the storage space or the priority list for evacuating objects).

- Identify the number, types, and locations of hand-held fire extinguishers. Check extinguisher inspection tags and labels to be sure extinguishers are regularly maintained.

- Identify the closest water supply (fire hose or hydrant) available for large-scale suppression of a fire.

Refer to Chapter 9 of this handbook for further information on conducting a fire risk assessment and for specific fire protection guidance.

4. *How do I assess environmental monitoring, evaluation and control?*

To assess collection storage environment:

- Become familiar with the information on environmental monitoring and control in Chapter 4, Museum Collections Environment.

- Monitor and analyze readings on duration, time and location of readings within the facility or space for temperature and relative humidity.

- Note the type of existing environmental monitoring equipment (data logger, hygrothermograph, etc).

- Check to ensure that environmental monitoring equipment is properly calibrated and maintained.

- Answer the following questions:

  – Do the records indicate a proper environment is being maintained?

  – Do building features such as the climate control system (heating, ventilating, air-conditioning (HVAC) or superior insulation and vapor barrier contribute to maintaining the environment?

  – Do the records indicate diurnal or seasonal changes?

- Obtain and reconcile readings for the local climate (outside temperature and relative humidity readings) with your interior readings. The local climate impacts your ability to maintain a the storage space environment. For more information, see Chapter 4: Museum Collection Environment.

- Note the type of HVAC (air-handling) system in use (oil-fired furnace, heat pump, central air). Indicate whether the system is dedicated to controlling the environment within the storage space or the entire structure. In particular, note the following information:

  – location of the thermostat (or humidistat)

  – location of air supply and return registers

  – how the air is filtered

- Obtain manufacturer's equipment operating manual. Work closely with facilities management staff to determine maintenance history of equipment.

- Examine the data on visible light and ultraviolet radiation levels in the storage space. If fluorescent lighting and ultraviolet filters are installed, use a light monitor to take readings to ensure that filters are blocking ultraviolet light.

- Note levels of dust and possible sources of dust. Note the types of dust covers used to protect objects stored on open shelving (for example, plastic or cotton muslin).

- Note any current evidence and/or history of biological infestation. Determine if the park has an Integrated Pest Management (IPM) program in operation. Note any data that staff has recorded on types of pests found in storage.

If available, obtain measurements for sulfur dioxide, hydrogen sulfide, and oxides of nitrogen from the Environmental Protection Agency or a local agency. Attempt to identify industry in the area that could produce pollutants that affect the collection. If appropriate, examine data available on pollutant readings from a number of years. Note any trends and describe the existing and potential threats to the collections.

5. *How do I record-and represent information about the storage space and structure?*

Prepare a floor plan that indicates the following information:

- dimensions and arrangement of storage areas, including structural features that may restrict arrangements of equipment and must be worked around (structural posts, beams, conduit, drains)

- location of doors, stairs, and windows

- location of electrical service (conduit, outlets, switches, fixtures, and panel boxes) and plumbing (pipes, valves, and drains)

- dimensions and existing location of museum specimen cabinets and shelving, including aisle widths

- location of fire detectors/suppression system detectors and sprinkler heads, fire extinguishers, stand pipes, and any other fire protection equipment

- location of environmental monitoring and control equipment

Security systems and devices are generally not indicated on the floor plan because dissemination of the plan could jeopardize security.

Refer to Figures 7.3, 7.4, and 7.5 for sample floor plans.

F. Planning for New or Upgraded Storage Space

Use the information you gathered in your assessment of storage needs (Section X) and your assessment of the current storage space (Section X) to plan your new or improved storage space. Only after you determine how much equipment you need, and the space you need to house that equipment, will you be able to adequately assess storage locations and spaces.

1. *How do I determine the storage equipment needed?*

Refer to *COG* 4/10, "Determining Museum Storage Equipment Needs," for guidance on determining equipment needs.

2. *How do I determine how much space is needed to store my collection?*

Refer to *COG* 4/11, "Determining Collection Storage Space Requirements," to determine your space requirements

3. *What process do I use to evaluate potential storage locations?*

If you find that your current storage space is too small to house the collection or if the current space is unsuitable for other reasons, conduct a value analysis of the collection storage function. A value analysis is a process of defining the problem, exploring solutions to the problem, and deciding on the best solution in terms of overall value. See NPS Director's Order #90, Value Engineering Guideline, for information on conducting a value analysis.

Policy requires that you complete a formal value analysis for renovations or new facilities costing over $500.000. You may also do an informal value analysis for small- to medium-sized collection storage spaces costing less than $500,000.

A value analysis includes an informational phase, a creativity phase, an evaluation phase, a development phase, and a recommendation phase. The informational phase includes a full examination of the collection storage function. You will need to fully understand and state the needs of the collection storage function. The standards and requirements for collection storage should guide the informational phase.

4. *Who should I consult with when considering building, renovating or upgrading a space for storage?*

Consult with a structural engineer or other structural design expert, an architect or an historical architect as appropriate, the facility manager and your regional curator when building, renovating or repurposing a space for use as storage. A significant addition of new storage equipment and/or collections to existing storage space also requires expert consultation. Discuss the following considerations:

- type of materials in the collection that will be stored
- quantity of materials in the collection that will be stored
- type and quantity of storage cabinets and other equipment, including size and weight, and whether multiple units will be stacked on top of each other
- use of moving equipment (power lift stackers, pallet trucks, forklifts, etc.)

5. *What storage space alternatives should be examined?*

The creativity phase of the value analysis presents alternatives for achieving the collection storage requirements. Consider the alternatives below.

Modify or retrofit the existing storage space.
This alternative may range from re-arranging storage cabinets to removing/modifying walls and ceilings. Projects might include:

- installing new environmental, fire protection, and security systems;
- installing a mobile or compactor storage system;
- repainting or replacing the flooring.

Use floor plans and other drawings to plan and represent the changes to the space.

Document all changes. Describe how existing conditions can be corrected to conform to NPS requirements.

Retrofitting may involve the use of an insulated modular structure (see description in the NPS *Tools of the Trade,* VI:6) and Section H "Using Storage Equipment to House Objects" (question 2).

Locate other storage spaces in the park.
This alternative involves looking at and evaluating other spaces in the building or in other buildings in the park. Provide a description of the actions needed to adapt space(s) to conform to NPS storage standards and requirements. You may use an insulated modular structure to adapt an alternate location such as a historic structure into acceptable space.

In each instance, gather and record the pertinent information to assess the appropriateness of the space. Use floor plans and other drawings to detail use of the space. Refer to Section E "Assessing the Current Storage Facility or Space" (question 6) for information to put on the floor plan.

Develop new space.
Develop new space, either in a dedicated facility or in an existing facility where it would share, but be separated from, other park functions such as a visitor or research center.

Use floor plans and other drawings to detail proposed usage of the space. Refer to Section E "Assessing the Current Storage Facility or Space" (question 6) for information to put on the floor plan.

Investigate off-site storage in new or leased space.
Use floor plans and other drawings to detail use of the space. Refer to Section E.2 for information to put on the floor plan.

Store the collections in a NPS center or regional repository.
You may house collections in off-site storage centers or repositories. Several NPS centers specialize in storing collections from archeological projects. These centers provide space and manage materials loaned from parks. The centers also conduct archeological research and provide scholars with access to the collections. Centers that specialize in archeological collections include the Southeast Archeological Center in Tallahassee, Florida; the Midwest Archeological Center in Lincoln, Nebraska; and the Western Archeological and Conservation Center in Tucson, Arizona.

Other repositories accommodate all types of collections. It may be necessary for you to store your collection off-site in a NPS regional repository when your park lacks:

- acceptable space to house objects safely

- qualified curatorial staff to provide day-to-day care for the collection

Store the collections at a university, college, museum or other non-NPS institution.
Your regional curator can assist in making arrangements with non-NPS repositories for the storage and curation of collections. ***Institutions that house park museum collections must meet NPS standards and requirements for museum object preservation and protection***. NPS collections should be clearly identified and kept as separate as possible from the institution's own collections.

Consolidate storage with another park.

You may find it necessary or advantageous to arrange to store your collection with a park that has available space and staff to care for it. Some larger parks also provide storage and care for the collections of nearby smaller parks. Contact your regional curator for information.

Make no changes to the existing storage space.
List the reasons why your current storage area meets requirements. Or, if your storage area does not meet storage requirements, list possible consequences to the collection.

6. *What occurs in the evaluation, development, and recommendation phases of a value analysis?*

In the evaluation phase, you assess alternatives for meeting the storage requirements. Consider all alternative locations for museum collections storage. Visit and examine each possible location and record pertinent data. Indicate the potential of each alternative space to satisfy the collection storage requirements. You may use the evaluation process used by the NPS called "Choosing by Advantage" (CBA) at this phase. Incorporate start-up and life cycle costs. Document the alternatives you evaluate.

In the development phase, you *reevaluate* the best alternatives.

In the recommendation phase, you *select* the best alternative.

7. *What other factors should I consider?*

Consider the following when planning collection storage:

- Phase the project to allow improvements to occur as funding becomes available. For example, rehabilitate the space one year; install environmental control equipment and security and fire protection systems in the second year; purchase replacement and new equipment in the third year.

- Prepare appropriate programming documents. Refer to Chapters 1 and 12 of this handbook for guidance on NPS planning documents for programming and funding curatorial projects.

- Maintain and store only museum collections that are identified in the park's approved Scope of Collection Statement.

- Maintain museum collections for easy access. The park can make better use of the collection if it is readily accessible on-site.

- Store archival and manuscript collections in boxes on shelves or in folders in map cases (for oversize items). Do not store archive collections in file cabinets or fireproof cabinets.

G. Developing Storage Planning Documents

1. *Why should I create planning documents for my collection storage space?*

Planning for museum storage is essential to ensure maximum preservation and optimum access to the collection. Creating planning documents for collection storage will help ensure that the necessary requirements are met. The process of collection storage planning may focus on:

- the development of a new facility

- the rehabilitation or upgrading of an existing space or facility
- a specific aspect of museum storage such as determining equipment and space requirements for a collection, determining a special layout of equipment, or outlining specific techniques for housing museum objects on shelves or in cabinets

In the National Park Service, the product of collection storage planning may be a Collection Storage Plan (CSP), a chapter or section on museum collection storage in a Collection Management Plan (CMP), a Collection Condition Survey (CCS), or an archival assessment. Regardless of the product, some or all of the elements of a CSP, described below, are incorporated into the planning process.

2. What is a Collection Storage Plan (CSP)?

A Collection Storage Plan (CSP) is an official stand-alone document developed to help a park or center improve the storage conditions for a museum collection. It may be prepared to solve specific storage problems, guide renovation of an existing space into collection storage, or guide the design of a new facility.

A CSP must include the following core elements:

- a determination of the size of storage space needed
- a determination and listing of specialized storage equipment needed
- a floor plan illustrating a recommended layout of equipment
- an assessment of object storage techniques and methods and recommendations for improvement
- a solution for park-specified or urgent storage problems

A CSP may also include the following:

- an assessment of the nature of the collection
- an assessment of the existing collection storage facility and/or space(s)
- an assessment of the existing storage conditions in comparison with NPS standards and requirements for storage
- identification and discussion of storage space alternatives

The specific nature of the collection and the availability of funding and staffing are factors to consider when selecting alternative storage options.

3. *What does the collection storage chapter or section of a CMP, CCS, or archival assessment contain?*

The storage chapter or section of a CMP, CCS, or archival assessment contains some or all of the elements of a CSP. It is incorporated into the larger report rather being a stand-alone document.

4. *Who can write a collection storage planning document?*

For objectivity and diversity of views, NPS curatorial staff from outside the park usually prepare a collection storage planning document. You can also procure the services of a museum professional or architectural/engineering firm with expertise in collection storage planning. Contact your regional curator for guidance on writing a storage planning document. The Park Museum Management Program can provide examples of a CSP.

5. *How do I calculate the cost to prepare a storage planning document?*

Determine the cost to produce a basic CSP (incorporating the core elements) by calculating what funds are required for:

- approximately 2-4 weeks of the preparer's time
- travel and expenses for a 1-2 week site visit
- printing and duplicating the document

To produce a CSP with more than the core elements will require additional time and increased costs. Consult the Cost Estimates Figure in Appendix F: NPS Museum Collections Checklists, for a current estimated cost to produce a CSP or storage planning document.

6. *Where do I get funding to do a collection storage planning document?*

Possible funding sources to produce collection storage planning documents include:

- Cultural Resources Fund. All project funds, including the Cultural Resources Preservation Program (CRPP) and the Museum Collection Preservation and Protection Program (MCPP) are now grouped together within this fund.park or center base funding
- park cooperating association donation account
- special funding initiatives that may be announced

To obtain storage planning project funding, you must identify the need for a collection storage planning document:

- in the "NPS Checklist for Preservation and Protection of Museum Collections" using the Automated Checklist Program in ICMS.

  Identifying the need in the checklist links the project to the NPS Strategic Plan (Goal Ia6) and the Government Performance and Results Act.

- as a project statement in the Resource Management Plan (RMP).
- as a project statement in the Performance Management Information System (PMIS).

7. *Where do I include technical supporting information and drawings such as floor plans in the storage planning document?*

Use appendices or attachments for technical information such as product/source information, environmental monitoring data, illustrations for constructing specialized equipment, and floor plans. Preparers should consult their regional/curator and the Park Museum Management Program for assistance in gathering material for appendices.

H. Using Storage Equipment to House Objects

1. *Why is it important to use specialized museum storage equipment?*

Specialized museum storage equipment provides vital "front line" protection for museum objects, reducing or eliminating exposure to many of the agents of deterioration. Equipment for storing museum collections is specially designed and fabricated to protect collections.

Museum cabinets have synthetic gaskets that help create an interior microclimate to minimize climate fluctuations.

> ***A well sealed cabinet creates a stable interior climate that buffers against temperature and relative humidity fluctuations, and deters damage caused by light, dust, airborne pollution, and pest infestations. It provides an extremely efficient "passive" way to house collections and minimize energy costs***

Shelving units provide physical protection for objects too large, awkward, or heavy to fit within museum cabinets. Specially designed racks accommodate and provide physical protection for hard-to-store objects.

Special building systems create quality space inside other structures, such as historic structures without adequate insulation or a vapor barrier. See prefabricated modular structures below.

Equipment made from unstable or sub-standard materials may harm objects rather than protect them. Do not use cabinets, shelves, and other equipment designed for non-museum purposes unless they are made from materials that can be identified as safe (i.e. non-reactive, not off-gassing)

2. *What types of equipment does the NPS use to store museum collections?*

The NPS uses the following types of equipment to house collections:

Cabinetry
The NPS generally uses three primary types of cabinets to form a basic modular system that facilitates efficient organization and access to objects. Refer to *COG* 4/1, "Museum Storage Cabinets." These three cabinets are the standard museum cabinet, the doublewide museum cabinet, and the wardrobe cabinet. In addition, a wide variety of specialized entomology and herbarium cabinets, map cabinets, large flat storage cabinets, and utility cabinets are available from reputable vendors. Require that cabinets have an Air Exchange Rate (AER) of no more than one (1) per every two to four (2-4) days. These will maintain a stable microclimate without additional buffering. Use ultrasound leak detecting for welds and doors. Refer to the NPS *Tools of the Trade* for descriptions and sources for available types of museum cabinetry

Shelving
Several types of *fixed shelving* are available. Refer to the NPS *Tools of the Trade* for descriptions, uses, and sources of available museum shelving. Steel shelving units, pallet racks, and slotted angle racks are frequently used. Steel shelving is recommended for boxed archival and manuscript collections. Pallet racks and

slotted angle racks are useful for storing furnishings and other larger, heavier items. Slotted angle racks are constructed using lengths of metal angle that can be custom cut. You can configure and construct a slotted angle rack for objects with specific support or space requirements. The shelf decking can be made from metal panels or other appropriate materials.

Shelving on casters that allows for limited but convenient movement, is used to house a variety of materials, including painting racks, rolled textiles, and large objects.

Prefabricated modular structures

A prefabricated building system can be used to create a collection storage facility that is economical to construct, efficient to operate, and effective in creating appropriate environmental conditions. The building system is made of highly insulated, foam-core, metal sheathed panels. It should be used only inside a host structure and will require an internal fire protection system. For information on these structures, consult the following NPS publications:

- NPS *Preservation Tech Note*, "Museum Collection Storage in an Historic Building Using a Prefabricated Structure."
- *CRM* Supplement, "Collection Storage – Making a Case for Microenvironments."
- *COG* 4/7, "Museum Collection Storage Space: Is an Insulated Modular Structure Right for your Collection?"
- *COG* 4/8, "Selecting Environmental Control Systems for Insulated Modular Structures."

These publications provide discussions and give guidance in using this special building system for museum storage. The NPS *Tools of the Trade* provides information on sources for this building system.

3. *What are some other considerations when using museum storage equipment?*

Consider the following when using museum storage equipment:

- In planning for cabinets and shelving, examine all objects in the collection. To the extent possible, organize objects by material type and size rather than by accession or catalog information.

- Ideally, do not install cabinets and shelving units against exterior walls. This arrangement may lead to condensation inside the cabinets.

- Ensure that museum cabinets are free of rust, have intact gaskets to provide good sealing action, have smooth operating doors, and have working keyed or combination lock mechanisms.

- Keep loads in museum cabinet drawers below 50 pounds. Do not stack museum cabinets more than two high.

- Raise museum cabinets and shelving units off the floor 4 inches, preferably 6 inches. Raising cabinets off the floor reduces the chances of damage to objects in case of flooding and facilitates the cleaning of floors and inspection for pests

- Use metal risers to raise cabinets and shelving units off the floor. Level the sanitary bases and check the leveling of cabinets once installed on the bases.

Adjust cabinet doors using manufacturer supplied washers so that doors close properly and seal well.

Housing objects in well sealed, gasketed cabinet is an effective way to create a stable microclimate within a larger storage space that may be prone to relative humidity and temperature fluctuations.

After receiving new cabinets, carefully inspect and test all drawers, doors, and gaskets. Make sure there are no cracks or gaps in the cabinet. Test this by placing a flashlight (or other portable light source) inside of the cabinet and turning off the lights in the room. If any light shines through, contact the manufacturer to correct the problem.

4. *How does layering or containerizing create a stable environment?*

The more layers or containerization, the more stable the object's environment and the greater its protection. Each successive layer or enclosure further stabilizes the object environment. See Figure 7.1. Multi-layered protection of an object.

5. *How should I organize the equipment in my collection storage area?*

Organize equipment to maximize space while maintaining easy and safe access to collections. Number and label the storage space, furniture/equipment, and all shelves, drawers, and racks in a thoughtful, consistent manner. Maintain a current floor plan of your organizational schema. Uniquely identify each piece of furniture (cabinet, shelf, rack, etc.). Use letters or numbers (or a combination of both) to sequentially number cabinets, drawers, and shelves. For example, a collection storage space might contain:

- Ten storage cabinets (C1 - C10), each with shelves 1-5 or drawers 1-9
- Three open shelving units (A - C) with shelves 1-6

An organizational system such as this makes identifying object locations easy and allows you to record object location on the catalog card. Sequentially number equipment to accommodate any additions or removals without compromising the numbering scheme.

6. *What role does housekeeping play when selecting and organizing storage equipment?*

Proper housekeeping is essential to a park's preventive conservation program. Select and arrange your storage equipment to facilitate good housekeeping by following the guidelines below..

- Equipment should have white or light colored finishes (inside and out) to provide easy detection of dust or pest debris.

- Ensure cabinetry has 4" or higher legs to allow vacuum cleaning of the floor underneath

- Arrange equipment with doors so that they do not prohibit the doors of neighboring equipment to fully open (for proper access during cleaning).

I. Using Containers and Supports to House Objects

1. *Why is it important to use storage containers and supports?*

Museum storage containers and supports provide a buffer between the object and its surrounding environment. A multi-layer storage system, provides increased protection. See Figure 7.1. The use of boxes, bags, or other sealed containers creates an internal microenvironment that protects the object from environmental fluctuations, as well as physical forces, pollutants, and light.

Supports such as specimen trays and cradle mounts reduce the potential for damage or loss when storing or handling items requiring special support. Consistent use of specialized, quality containers and supports can also help organize and increase accessibility of the collection.

Cover objects stored on racks or shelving units in the open with muslin, Tyvek or flame retardant plastic to protect the objects from dust. Where possible, cover the entire shelving unit like a tent, see *COG* 4/2, Creating a Microclimate for Oversized Museum Objects.

2. *What kinds of containers and supports should I use for storing museum collections?*

The containers and supports listed below are widely used to store museum collections:

Boxes*:* Museum quality boxes come in a variety of types, shapes, and sizes. Most are made of acid-free, corrugated paper board. They are available in pH neutral (unbuffered) or slightly alkaline (buffered) varieties. Corrugated polypropylene or polyethylene boxes are also used to store materials and are generally more rigid and durable. Archival boxes can house documents files, records, rare books, prints, photographs, and textiles. See Appendices J, K, and R as well as *Tools of the Trade.*

Specimen trays*:* Specimen trays are made of alkaline (buffered) acid-free board. They can be used to hold natural history specimens in museum cabinets and can provide layered storage in archival boxes. A variety of sizes are available.
Note that alkaline (buffered) board paper can damage pigments and proteins in bird and mammal specimens. For these types of specimens, use unbuffered, pH neutral trays or line buffered trays with polyethylene sheeting (to block the direct migration of alkalis). See *MH-I*, Appendix T and *Tools of the Trade*.

Folders*:* Museum quality folders are composed of acid-free, buffered or unbuffered cardstock material and are used to house and protect historic documents. Folders come in many types, including file folders (both letter and legal size), herbarium sheets and folders, manuscript and map folders for oversize items. See Appendix J and *Tools of the Trade*.

Note: Alkaline (buffered) folders can damage blueprints and other pH sensitive papers with acidic print processes.

Photo enclosures*:* Photo enclosures of made of acid-free, unbuffered paper are used to house photographic prints and negatives. Various sizes and varieties including sleeve type (sealed on three sides) and folding type (4 fold) are available. See *MH-I*, Appendix R and *Tools of the Trade*.

Bags*:* Polyethylene interlocking “zipper” seal bags can be used to house archeological materials and other small objects for storage in archival boxes and cabinets, for cold storage of some photographic materials, and to provide protection from pests. Bags without “zipper” seals are also available for objects that do not require or should not be stored in a sealed container.

Avoid the use of bags developed for food storage and home use because of printing inks and dyes. These contain butylated hydroxyl toluene (BHT) which leaches into specimens and objects and renders scientific analyses invalid. Bags for the storage of museum objects are available through *Tools of the Trade*.) See *MH-1*, Appendix I and *Tools of the Trade*.

Liners*:* Protect objects from coming into contact with metal drawers or shelves with 1/8" or 1/4" thick polyethylene foam as a liner. This foam is inert, closed-cell, and resistant to moisture. See *Tools of the Trade*, IV:4.

Cavity packing*:* Planks of polyethylene foam together with a smooth liner, such as Teflon, can also be used to cavity pack certain objects. Cavity packing creates secure compartments for objects. Spaces the size and shapes of the objects are cut into the foam to create a cavity that separates objects and restricts movement, providing support/cushioning and still allowing for easy access. See *MH-I*, Appendix I and NPS *Tools of the Trade*, IV:4.

Cradle mounts*:* Polyethylene foams are also used to create cradle mounts. These mounts are used to support structurally weak objects in order to alleviate stress on the weakest points. The foam is cut to the shape of the object and provides it a secure base to rest on. See *MH-I*, Appendices I and P.

Ring supports*:* Polyethylene foam can be used to provide stability for round or spherical objects stored on shelves or in cabinets. A circle of foam is cut out, then the interior is cut out (like a donut) to the appropriate size and shape for the object to be supported. Vases and pots are commonly recipients of ring supports and together with smooth liners if they have friable surfaces.

Tie-down supports*:* Objects are secured to platforms of polyethylene foam or corrugated board. Then, using Teflon tape, the objects are tied to the platform to prevent movement. Long, slender objects with a tendency to roll can be secured using this method.

3. *What role can specialized microclimates play in housing objects*

The creation of local, specialized microclimates with a humidity-buffering agent (such as pre-conditioned, enclosed packets of gel or silica gel) can be an effective part of a multi-layered storage approach for certain materials. Specialized microclimates are useful in protecting selected objects from inappropriate and damaging relative humidity. The buffering agent placed inside the microclimate regulates the amount of humidity in the enclosed space housing the objects.

Note: A well sealed case rarely needs a specialized microclimate. However, microclimates can be created for certain types of materials, such as actively oxidizing pyritic fossils or metals corroding due to the presence of chloride salts that need to be maintained at 20% RH. Once installed, closely monitor the microenvironment.

Before deciding to create a specialized microclimate, first monitor and determine what the microclimate is inside a cabinet over a period of at least 6 months to determine if the object(s) need a specialized microclimate. Evaluate your findings to determine whether a specialized microclimate is needed or if the cabinet environment is sufficiently stable.

For guidance in the creation of microclimates, see the following *Conserve O Grams*:

- *COG* 1/8, “Using Silica Gel in Microenvironments.”
- *COG* 4/4, “Creating a Microclimate for Oversized Museum Objects.”
- *COG* 4/16, “Creating a Microclimate Box for Metal Storage.”

4. *Where do I find additional information on techniques for storing museum objects?*

The appendices in this handbook as well as the *Conserve O Gram* series provide information on the curatorial care and housing of different types of objects, specimens, and archival collections. Figures 7.6-7.11 below illustrate some of the equipment and techniques for storing museum objects.

See also the selected bibliography in each appendix for additional references. *Tools of the Trade* and the appendices list the recommended materials to use.

J. Collection Storage in Historic Structures

NPS *Management Policies* 2006, Section 5.3.1.4 states:

"When museum collections are housed in a historic structure, the needs of both the collection and the structure will be identified and evaluated, weighing relative rarity and significance, before environmental control measures are introduced."

It is critical to be aware of, and balance the needs of the objects and the historic structure in which they are housed in order to avoid damage to one or both.

1. *What are the concerns about storing collections in historic structures?*

Storing collection objects in historic structures poses a number of challenges. These include:

- Stabilizing and controlling temperature and relative humidity
- Blocking ultraviolet radiation
- Blocking and/or minimizing exposure to visible light
- Pest exclusion
- Logistic and structural issues (moving and housing objects and/or storage equipment)
- Safety (security and fire protection)

Difficulty in controlling these variables, in particular temperature, relative humidity, light levels and pests can result in severe damage to the objects, the structure itself, or both.

Temperature and relative humidity
Most structures pre-dating the mid 20th century were not designed to accept modern HVAC systems. In many cases, the installation of complex HVAC systems can introduce a new set of problems to walls, ceilings, and floors that were not well-insulated. The introduction of vapor retardants (moisture barriers) may also create problems. The installation of modern HVAC systems as well as attempts to control and maintain a specific climate (temperature and humidity) can result in moisture condensation, mold, warping, and other problems within the walls of the structure.

Light

Most historic structures were designed for human use and comfort. Most have windows that allow in large amounts visible light and ultra-violet radiation. UV and visible light causes irreparable damage to objects and also makes control of temperature and RH difficult. Given that many historic furnished structures are routinely opened to the public, it is important to work with park staff, including interpreters and the facilities manager, to find viable and historically appropriate and sympathetic ways to block light, such as shutters or curtains, or UV filtering film.

Pests

Historic structures are generally not well-sealed against pests. Sliding or rolling doors, gaps under doors and roofs, and around windows, cracks in floors and ventilation openings in floors and walls allow intrusion of insects, rodents and other pests. A good IPM used in conjunction with exclusions, including steel and bronze wool, hardware cloth, door sweeps and other barriers, is essential in combating pests. Work with the cultural resource manager, facilities manager and building maintenance staff and your IPM co-coordinator to ensure damage to the fabric of historic structures and use of chemicals is kept to a minimum, and exclusions are maintained.

Logistics

Narrow doors, hallways, and steep stairs can make it difficult to move cabinets or other equipment into the building. They also make moving large collections or unwieldy objects hazardous. Historic structures are likely to have limited load bearing (capacity) and may not be able to accommodate heavy weights.

Security

Historic fabric, such as doors or locks may not be modified without damaging the historic fabric of the building. Work with your facilities manager to provide unobtrusive and non-damaging ways to secure the collections.

2. *Should I store collections in a historic structure or send them off-site?*

Moving collections to more environmentally secure off-site storage can greatly enhance their long-term preservation. However, it makes collections less accessible to staff and visitors on-site. Consider and carefully weigh the following:

- Long-term preservation needs of the object
- Long-term preservation needs of the structure
- Accessibility of collections for interpretive or program needs
- Costs and risks of transporting objects between sites
- Security of the site
- Concerns within the local community about relocating objects of great interest or significance

When long-term preservation is the only consideration, a modern, off-site storage facility is preferable to on-site storage in a structure that lacks adequate environmental, security, or other controls.

3. *How can I create the best possible collection storage in a historic structure?*

There are a number of practical measures that can be taken to improve the storage environment in a historic structure:, including:

Containerization

Placing objects within layered and enclosed containers will minimizes the impact of temperature and relative humidity fluctuations. For example, house objects within sealed containers within a museum cabinet that is placed away from the exterior wall or windows. See Figure 7.1. Multi-layered protection of an object. This approach, combined with sustainable, modest efforts to control extremes in temperature and relative humidity, can greatly improve the long-term preservation of collections stored in historic structures.

Microclimates

When combined with containerization, the use of humidity-buffered microclimates (e.g. using silica gel) can further deter damaging fluctuations in relative humidity.

Blocking agents of deterioration

Light, whether visible or ultraviolet, can be readily blocked in storage spaces without damaging the historic fabric of a building. UV filtering film and shutters or heavy curtains sympathetic to the period provide a sustainable way to control light and minimize temperature and relative humidity extremes and fluctuations.

Pre-fabricated modular storage

The use of a modular, pre-fabricated storage facility constructed within a room inside the existing building, allows you to maintain collections at optimum conditions with minimal impact on the historic fabric of the building. See NPS Preservation Tech "Museum Collection Storage in an Historic Building Using a Prefabricated Structure" and the following:

- CRM Supplement, "Collection Storage – Making a Case for Microenvironments"
- COG 4/7, "Museum Collection Storage Space: Is an Insulated Modular Structure Right for your Collection?"
- COG 4/8, "Selecting Environmental Control Systems for Insulated Modular Structures."

When storing or exhibiting collections in historic structures, work closely with your facilities manager, the park interpreter and the regional curator, as well as colleagues at other historic structures to find practical, sustainable, and historically sympathetic solutions that best balance the needs of the collection, the historic structure, and the interpretive programs that serve visitors.

K. Storage of Museum Collections Subject to the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA)

1. *What is NAGPRA?*

The Native American Graves Protection and Repatriation Act of 1990 (25 USC Chapter 32) addresses the rights of lineal descendants, culturally affiliated Indian tribes (including Native Alaskan villages or corporations), or Native Hawaiian organizations to certain Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony with which they are affiliated. The law requires federal agencies and museums that receive federal funds to:

- conduct inventories and summaries of such items in their collections
- repatriate (return) items identified pursuant to NAGPRA to the appropriate lineal descendants, culturally affiliated Indian tribes, or Native Hawaiian organizations if requested

Items repatriated pursuant to NAGPRA must be deaccessioned in accordance with Museum Handbook, Part II (MH-II), Chapter 6, Section N: Native American Graves Protection and Repatriation Act.

For additional information concerning NAGPRA, see *MH-I*, Appendix A, *MH-II*, Chapter 6, Section N, and *Cultural Resource Management Guideline*, Appendix R.

2. *What types of items subject to NAGPRA are found in NPS museum collections?*

Your park's museum collection may contain items subject to NAGPRA, such as human remains, pottery, beads, prayer bundles, clothing, weapons, pipes, or other funerary, sacred, and cultural objects that are determined to belong to one or more lineal descendants, Indian tribes, Native Alaskan villages or corporations, or Native Hawaiian organizations. The culturally affiliated organization or lineal descendant with standing may request the repatriation of these items.

The individual, tribe, or organization requesting repatriation may be unable to take immediate possession of the materials, or they might prefer that certain items continue to be housed at your park. Under these circumstances, the individual, tribe, or organization with standing may want to be involved in determining how the items are preserved and stored at your park. Park management and staff will need to consult with parties with standing. Confer with your park and regional NAGPRA coordinator once such a request is made.

3. *Are there any special storage requirements for items subject to NAGPRA?*

Treat collections subject to NAGPRA with great sensitivity, because of their cultural significance, sacred importance to descendants, tribal leaders, elders, and traditional religious leaders.

Because of their special status, you may need to separate collections subject to NAGPRA from other museum collections. Consult with the lineal descendants, culturally affiliated Indian tribes, Native Alaskan villages or corporations, or Native Hawaiian organizations concerning access, storage, and use. Accommodate the affiliated organizations' or descendants' requirements where possible, and institute any needed revisions to your park's Museum Collection Access Procedures, planning documents, and standard operating procedures.

4. *How should I store collections subject to NAGPRA?*

Protect collections subject to NAGPRA from fire, theft, pests, and environmental and other threats as you would any other museum object. However, you may need to use additional and/or alternative handling and storage methods and materials to show sensitivity and proper respect for these items in accordance with the affiliated individual's or group's request.

Consult with the lineal descendants or culturally affiliated organization with standing. Ascertain their preferences related to proper handling and storage techniques and materials, and defer to their wishes where possible. You may be asked to use some of the following storage methods, procedures, and materials when caring for culturally affiliated items:

- Store human remains aligned in a particular direction (such as the cranium toward the east).

- Construct special storage containers (possibly using wood, plant, or animal products native to the tribe's homeland).

- Ensure that only organic materials touch the items. Possible methods to avoid direct contact with archival foams include:

  – covering the foam's surface with archival tissue paper or unbleached muslin

  – wrapping the item in archival tissue paper or unbleached muslin

- Store newly collected natural plant materials (such as bundles of tobacco) with the items. (You can construct special outer enclosures or boxes to house these materials separately from other collections and to protect against pest infestations.)

- Allow tribal members access to storage areas for relevant religious or ceremonial purposes. This may include actions to protect:

  – individuals working with or viewing the items

  – the facility, collections, and items from a negative force

These are just a few of the possible techniques and procedures that you may be asked to follow with items subject to NAGPRA. This list is not all-inclusive or universal, as one tribe's methods may not be appropriate for another. Consult with the lineal descendants or culturally affiliated organization with standing for guidance.

Document all new or revised procedures and guidelines for handling, storage, and use of collections subject to NAGPRA following the consultation process. This may include notations, additions, or revisions to catalog records, catalog or accession folders, planning documents, access procedures and other standard operating procedures, or other relevant park documents.

5. *Whom should I contact for assistance?*

Contact your regional NAGPRA liaison, regional curator, regional ethnographer, or local tribal members for assistance. Before beginning the consultation process, determine the proper protocol and be sure to follow it whenever you contact tribal authorities, council members, elders, and traditional religious leaders. (Consult with your regional NAGPRA liaison, regional curator, regional ethnographer, or local tribal members with issues of protocol.)

Consult with the lineal descendant, tribe, or culturally affiliated organization with standing concerning proper handling and storage guidelines, appropriate storage materials, and other procedures related to collections subject to NAGPRA at your park.

Many tribal governments have cultural resource management specialists, NAGPRA coordinators, museum staff, or archeologists who can help you. Contact your regional NAGPRA liaison, regional curator, regional ethnographer, or the appropriate tribal headquarters for contact information.

When asking for help or guidance during the consultation process, members of the culturally affiliated organization may not provide it willingly because the discussion of such topics may be offensive or uncomfortable for them. Even within one tribe there may be different views on procedures. Be aware that this might happen and always show proper respect for these views.

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M. List of Figures

Levels of Containment

Level I. Facility

- structure
- spaces within the structure
- systems or infrastructure:
  - mechanical
  - electrical
  - utility

Level II. Museum Equipment (Furniture)

- cabinets
- shelving
- specialized furniture and racks

Level III. Containers

- folders, sleeves, envelopes
- specimen trays
- boxes
- mounts, supports

Figure 7.2 Levels of Containment in a Collection Storage System

Findings and Recommendations for Upgrading Storage Techniques for Existing Storage Units

Storage Unit/Type	Drawer/Shelf	Code
Cabinet A		*
Standard Cabinet	1	M,O
	2	M,X
	3	*
	4	N
	5	K
	6	U
Cabinet B		*
Standard Cabinet	1	*
	2	M,O,X
	3	X
	4	M
	5	X
	6	*
Cabinet C		A
Standard Cabinet	1	*
	2	J
	3	K,S
	4	K,S

Figure 7.2a. Sample Assessment Worksheet

Assessment Codes

Cabinet/Shelving Unit Specific (indicate cabinet or shelving type.)

A Gasket is damaged, wrong type, or ineffective. Install retrofit gasket kit. See *COG* 4/3.

B Cabinet has no lock. Install sash lock or other locking device.

C Cabinet or unit is damaged. Repair or replace as required.

D Cabinet or unit is dusty or dirty. Vacuum or dry wipe interior and exterior of cabinet or unit.

E Cabinet or unit paint surface is chipped or scratched. Contact manufacturer for touch-up kit or replace if damage is severe.

F Cabinet is directly on floor or shelving unit bottom shelf is not adequately raised off the floor. Raise cabinets on platforms, appliance rollers, or caster bases so that they are 4"–6" off the floor. Adjust shelving unit bottom shelf to be at least six inches off the floor.

G Wooden rack or shelving unit components are being used. Replace or seal with impermeable, inert material.

H Drawer not being held in place by glides. Consult with manfucturer to repair or replace drawer hardware.

I Shelving unit in earthquake zone lacks shelf retainers. Install shelf retainers to prevent objects from falling off shelves during earthquakes.

J Objects in open or on shelving units are coated with dust. Install appropriate dust covers (See *COG* 4/2).

Drawer/Shelf Specific

K Objects are loose and unprotected in drawers or on shelves. Place objects in specimen trays and/or cavity pack.

L Objects too large for specimen trays rest directly on drawers or shelves. Place polyethylene foam pads under objects to form an inert cushioned surface on which the objects can rest.

M Objects in cabinets or on shelving are unstable and are in danger of damage by sliding or rolling. Pad, cavity pack, or cushion objects with appropriate tissue or foam.

N Objects are stacked and/or overcrowded. Rearrange or move objects to allow adequate separation.

O Weight of objects exceeds fifty-pound drawer weight limitation of standard and double wide cabinets. Remove objects as needed.

P Objects stored in inappropriate cabinet or rack. Place objects in appropriate cabinet, rack, or shelving unit as indicated.

Figure 7.2b. Assessment Codes for Collection Storage Techniques

Object Specific

Q Documents or books are loose and unprotected. Place documents in archival folders or envelopes and then in document boxes. Place books in book boxes (see *COG* 19/2). Place document or book boxes in cabinet or on shelving.

R Photo positives and negatives are loose and unprotected. Place photos in appropriate neutral pH photo enclosures and in photo enclosure boxes. Boxes can be placed in cabinets or on shelving. See *COG* 4/9 and *Tools of the Trade* for appropriate usage of enclosures.

S Maps and oversized prints are stored loose and unprotected. Place objects in appropriately sized neutral or alkaline-buffered pH map folders (blueprints and cyanotypes go *only* in unbuffered folders) and store flat in appropriate cabinet. See *COG* 19/9.

T Framed artwork is stored horizontally or stacked leaning against each other. Place artwork on a rack that will separate pieces and store them vertically. See *COG* 12/1. Use dust covers.

U Unframed artwork or large documents are stored loose and unprotected. Interleave with pH neutral, inert storage materials and/or store in boxes or cabinets as appropriate.

V Artwork framed with acidic mat board. Consult with conservator regarding re-matting with archival mat board.

W Incompatible objects stored in close proximity. Off-gassing or chemical properties of objects could harm others nearby. Separate materials according to type and consult a conservator; a Collection Condition Survey (CCS) may be necessary. See Chapter 3 for information on conducting a CCS.

X Objects stored in containers or labeled with tags made of acidic materials. Replace acidic containers or tags with ones made of archival materials.

Y Objects have active deterioration, mold or physical damage. Conservation survey should be requested.

Z Evidence of pest infestation observed. Integrated Pest Management program needs to be implemented or improved.

XX Other as indicated

* Proper Storage

Figure 7.2b. Assessment Codes for Collection Storage Techniques (continued)

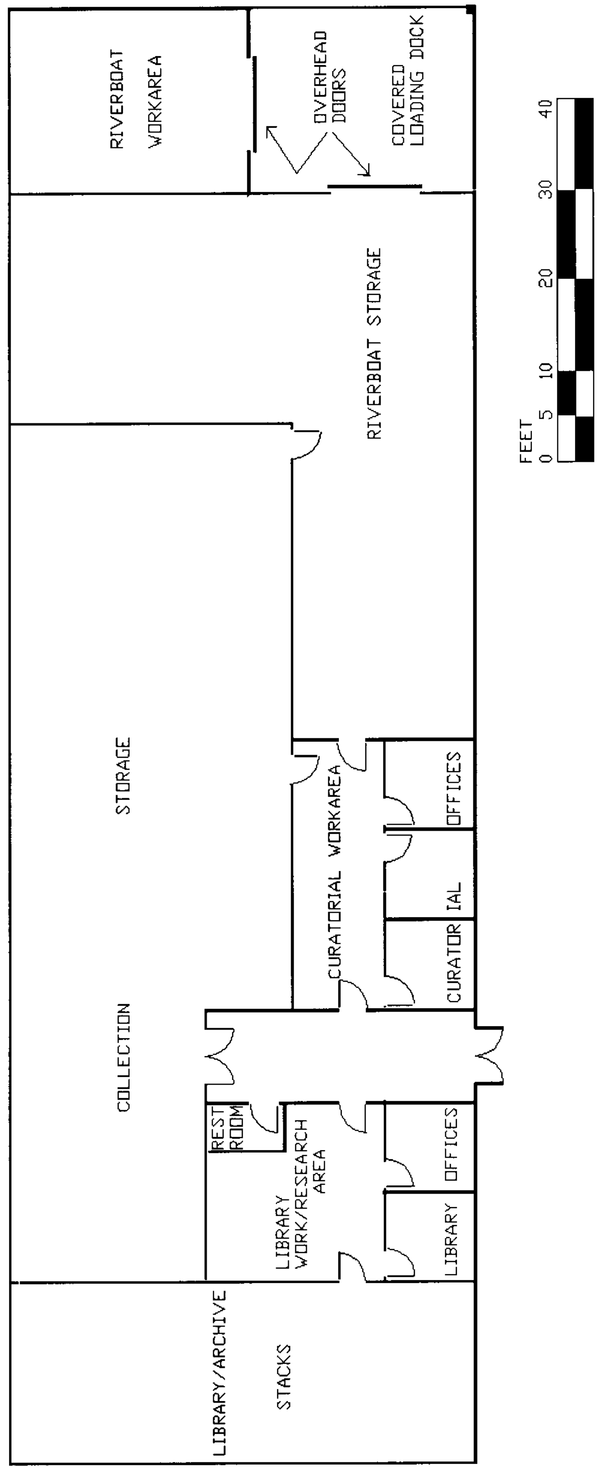

Figure 7.3. Sample General Floor Plan of a Museum Collection and Library

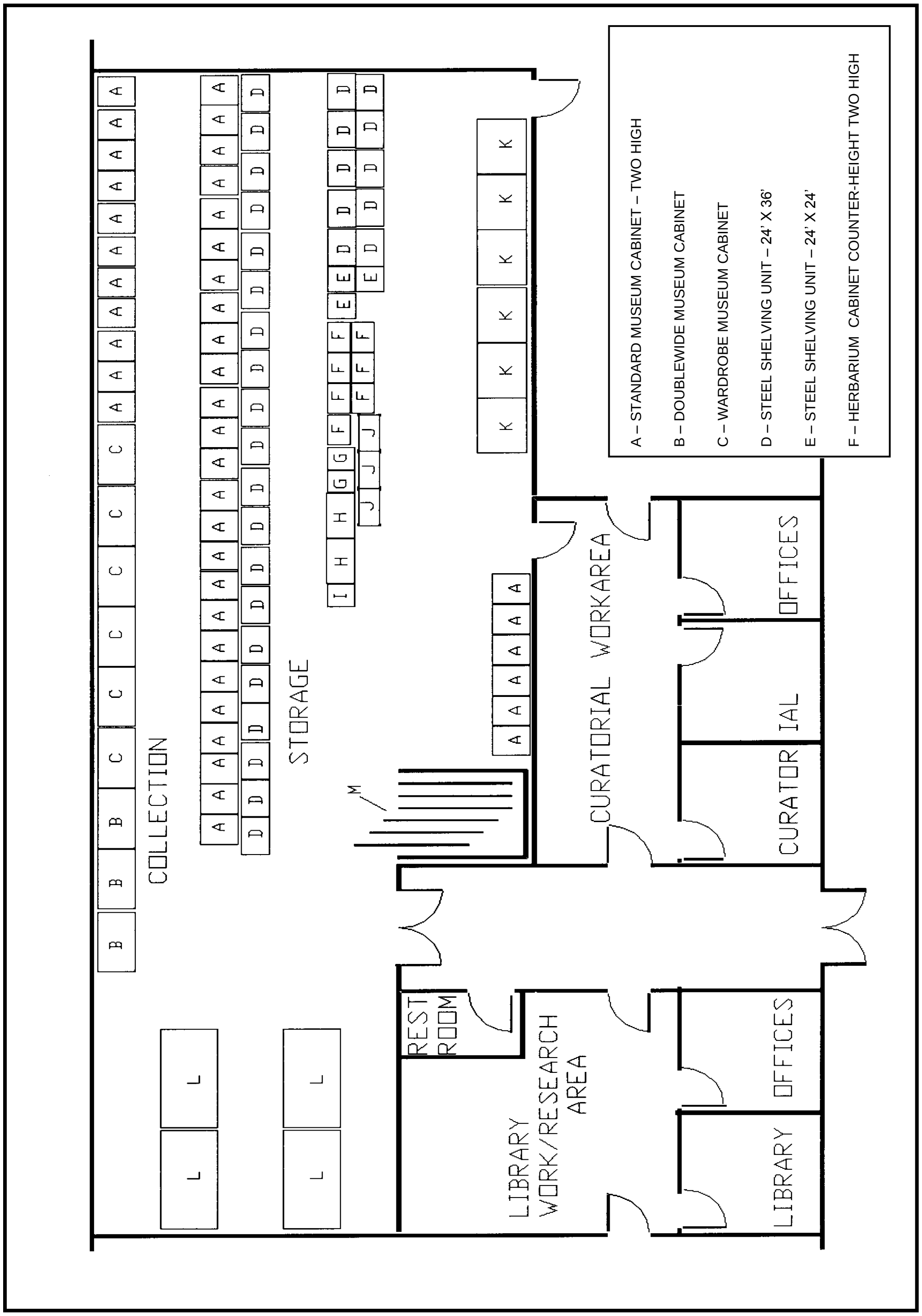

Figure 7.4. Sample Detailed Floor Plan of Museum Collection and Work Space

Figure 7.5. Cavity Storage. Small objects cavity packed in individual boxes within a standard museum cabinet drawer.

Figure 7.5a Cavity Storage (detail)

Figure 7.6. Basket Storage. Round bottomed baskets on fitted custom made ethafoam supports in an acid free box.

Figure 7.7. **Clothing and Footwear Storage**. Padded clothing and footwear attached with cotton ties to mat board covered with acid free paper in a cabinet drawer.

Figure 7.8. Bottle Storage. Bottles anchored in custom made ethafoam at the neck in a cabinet drawer.

Figure 7.9. Ceramic Storage. Round bottomed certamic vessels on ethafoam rings on open shelving. Tags containing information minimizes handling.

Figure 7.10. Wood and Jewelry Storage. Wooden paddles and jewelry attached tied to ethafoam supports in a cabinet drawer.

Figure 7.11. Specialized Microclimate Storage. Objects housed in plastic containers in a cabinet drawer. Containers provide buffering against RH and temperature fluctuations.

Figure 7.12. Large Objects Housed on Mobile Storage Shelves (l) and Steel Shelving on Wheels (r). Metal surfaces are lined with polyethylene foam. On open shelving, muslin and fire resistive plastic covers can protect objects from dust. Wheels allow the unit to be moved.

Figure 7.13. Rolling Unit for Large Objects. Movable custom designed storage equipment fabricated from slotted angle iron.

Figure 7.14. Racks for Large Objects. Slotted angle iron is used to construct racks for large objects.

Figure 7.15. Painting Rack Storage. Painting and framed2-D items rack constructed of slotted angle iron and 2" mesh welded wire fencing.

Figure 7.16. Lithic and Stone Storage. Large stone lithic material in bottom shelves and boxed materials on upper shelves in mobile storage.

Figure 7.17. Rolled Textile Storage. Textiles rolled on acid free core and covered in plastic, tied with cotton ties.

Figure 7.18. Map Cabinet. Map cabinet holding blue prints separated by neutral pH, unbuffered paper.

Chapter 8: Conservation Treatment

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CHAPTER 8: CONSERVATION TREATMENT

A. Overview

This chapter explains what conservation treatment is, when it is appropriate, and how to obtain the services of a professional conservator. Care of NPS museum collections is based on a **preventive conservation** approach (See *Chapter 3: Preservation: Getting Started* for more information). **A good preventive conservation program minimizes the need for conservation treatment**. However, preventive measures are sometimes inadequate and interventive conservation treatment performed by a conservator is necessary to help preserve an object:

- If an object has inherent vice and preventive measures are insufficient to reduce the rate of deterioration to a tolerable level, an appropriate conservation treatment can prolong the life of an object. For example, a paper conservator can wash deteriorated wood-pulp paper to remove acidic by-products.

- If an object is extremely fragile due to advanced deterioration, appropriate conservation treatment can increase its stability and durability. For example, a paintings conservator can re-attach flaking paint.

- If an object is to be used for exhibit, research, or publication, conservation treatment may be needed. For example, a textile conservator may construct a special mount for a flag to allow it to be exhibited vertically, or an archeological conservator can clean a metal artifact to reveal important markings.

Conservation treatment is hands-on, alterative ("interventive") work performed in order to preserve and/or restore objects. Only trained conservators who have experience in the appropriate material (such as paintings, textiles, furniture, photographs, books, paper, archeological objects, ethnographic objects, natural history specimens) should perform conservation treatments on objects.

If conservation treatment is required, the park staff must ensure that:

- objects, archives, and specimens receive the most appropriate treatment for their continued preservation and use

- treatment is appropriate and takes into consideration an object's condition, history, significance, and use(s)

- treatments are performed by skilled, experienced conservators and properly documented

Anyone who carries out a treatment on NPS museum collections must agree to follow the principles and practices specified in the Code of Ethics and Guidelines for Practice of the AIC (American Institute for Conservation of Historic and Artistic Works, 1994). Refer to Appendix D for a copy of the Code of Ethics. Include this requirement in all contracts.

1. *What is preservation and how is it accomplished?*

NPS policy emphasizes *preservation*. *Management Policies*, Section 5.3.5.5.1 states that "an item in a museum collection will be preserved in its present condition through ongoing preventive care if:

- that condition is satisfactory for exhibit or research; or
- another treatment is warranted, but it cannot be accomplished until some future time."

Preservation encompasses all actions taken to prolong the life of an object.

Ongoing preventive conservation (preventive care) is always the preferred way of ensuring preservation of museum collections. Conservation treatment carries inherent risk and is generally more resource and time intensive.

However, if preservation cannot be satisfactorily accomplished through preventive conservation, interventive measures (conservation treatment) may be considered.

After a conservation treatment is carried out, treated objects should be returned to storage or exhibition conditions that reflect good preventive conservation practices. If objects are returned to substandard conditions, they cannot be effectively preserved.

Many of the chapters and appendices of the *Museum Handbook*, Part I, contain additional information on collection preservation, including establishing a good preventive conservation program. In particular, see *Chapter 3: Preservation: Getting Started*.

2. *What is conservation treatment?*

Conservation treatment is the deliberate alteration of the chemical and/or physical aspects of museum objects aimed at prolonging their existence. NPS policy recognizes two types of conservation treatment. These are:

- *Stabilization* to slow or prevent further deterioration. The American Institute for Conservation (AIC) defines stablization as "treatment procedures intended to maintain the integrityof cultural property and to minimize deterioration." See the AIC web site, "Definitions of Conservation Terminology."
- *Restoration* to an earlier appearance. The AIC defines restoration as "treatment procedures intended to return cultural property to a known or assumed state, often through the addition of nonoriginal material."

Although conservation treatment is by definition interventive, the overarching goal is to minimize the amount of intervention. This reduces the possibility of compromising the object's historical, scientific, or cultural significance or inadvertently causing unanticipated deterioration in the future

Well-intentioned efforts to repair, stabilize, or restore objects have often proved detrimental to their long-term preservation. Earlier treatment techniques, including those performed by conservators, have negatively impacted or even destroyed important features of objects. In some cases, no treatment would have been a better choice. This is why a preventive care approach to preservation is preferable.

When deciding whether to pursue conservation treatment or to maintain an object through preventive conservation practices, it is your responsibility to always opt for the approach that best serves the long term well-being of the object. Base your decision on close consultation with conservators as well as your regional curator, park superintendant, and other knowledgeable colleagues..

3. *What is stabilization?*

Stabilization is a type, or level, of conservation treatment intended to stop or minimize an object's deterioration while maintaining its integrity.

Stabilization treatments are generally the least invasive (interventive) form of conservation treatment. NPS *Management Policies*, Section 5.3.5.5.1, states that "an item will be stabilized if:

- preventive measures are insufficient to reduce deterioration to a tolerable level; or
- the item is so fragile that it will be endangered under any circumstances."

Stabilization treatments are not, however, without risk. Information can be destroyed with any interventive treatment, even if performed only with preservation as the goal. New analytical techniques are always being developed and later generations often re-evaluate objects and have different ideas about what makes them significant. Even simple cleaning permanently changes an object and can result in the destruction of information about the object.

4. *What is restoration?*

Restoration is treatment procedure intended to return objects to a known or assumed former state, often through the addition of non-original material. NPS policy on restoration is very specific (see NPS *Management Policies*, Section 5.3.5.5.2). An item may be restored to an earlier appearance if:

- restoration is required for exhibit or research purposes;
- sufficient data about that item's earlier appearance exists to enable its accurate restoration; and
- restoration will not modify that item's known original character.

Additionally:

- restoration will be accomplished using the techniques and materials that least modify the item
- restoration materials should be removable at a later time with minimal

adverse effects

- restored areas should be distinguishable from original material and thoroughly documented

- restoration efforts will take into account the possible importance of preserving signs of wear, damage, former maintenance, and other historical and scientific evidence

- take 'before, during, and after' photographs of the object to document conservation needs, treatment, as well as any discoveries.

5. *Why use reproductions?*

The use of reproductions is a preservation strategy. By making a reproduction of an object that can be used for interpretive and/or educational presentations, the original can be safely stored in conditions conducive to its long-term preservation. Reproductions are often used when the originals are too fragile, or would be subject to undue deterioration or loss, or the length of the exhibit will cause damage to the original.

See *Museum Handbook*, Part III, Chapter 4: Two-Dimensional Reproductions, and Chapter 5: Three-Dimensional Reproductions for further information.

6. *Why should treatments be reversible?*

No treatment is completely reversible. Some cannot be reversed at all, for example, you cannot replace the stain you have cleaned from a textile or dirt from a painting surface. However, conservators must use, wherever possible, treatments and materials that can be reversed or removed without damaging the original material of the object.

The principle of reversibility is important for a number of reasons:

- Objects may need to be treated again and the materials used in a prior treatment may need to be removed first.

- A treatment may not produce the desired outcome and may need to be reversed.

- In the future, a better and/or less invasive treatment may be developed, and the current treatment may need to be reversed.

7. *What NPS guidance is available to help me make decisions about conservation treatment?*

Refer to *Chapter 3: Preservation: Getting Started* for information on the roles of the curator/collections manager and the conservator and for information on the Collection Condition Survey (CCS). For specific information about common preservation issues for different types of materials and collections, see the appendices in this handbook. In addition, *Management Policies* (Chapter 5: Cultural Resource Management) discusses NPS policy for conservation treatment of museum objects.

8. *When do I need a conservator?*

A professional conservator must undertake all interventive conservation treatments. A conservator is trained and skilled in the theoretical and practical aspects of preventive conservation and interventive conservation treatment.

Most conservators specialize in the treatment of specific types of materials or objects. This includes specialists who work on archeological materials, books, ethnographic objects, natural science specimens, fine and decorative art objects, photographic materials, paintings, paper, sculpture, textiles, or wooden artifacts. There is some overlap among these specialties; one conservator may work on a range of these materials.

For more information on the roles that collection management specialists, curators and conservators play in the preservation of museum objects, see Chapter 3: Preservation: Getting Started.

B. Factors to Consider Before Conservation Treatment

1. *How will I know what conservation treatment is appropriate?*

Treatment choices for objects and collections will vary based on the reasons the objects were collected and their planned use. Identify what you consider to be important about the object for the purposes of research, education and exhibit, now and in the future. Be sure to share your reasons for preserving an object or collection with the conservator and put them in writing. Consult with the regional curator and other museum professionals to learn more about your treatment options. Discuss any proposed conservation treatments with the regional curator.

Appropriate treatment is developed through discussion between conservator and curator:

- Consider all technical, historic, scientific, cultural, religious, and aesthetic aspects of an object.
- Explain why you think conservation treatment is necessary.
- Talk about the planned use(s) of the object.
- Explain where the object will be exhibited or stored.
- Discuss the wishes of affiliated ethnic groups.

Developing a shared understanding of the object and its problems will lead to a treatment that takes into account all of the above factors. Do not approve a treatment simply to make an object look “like new” or meet a purely subjective aesthetic standard.

Discuss treatment options thoroughly with a conservator. Carefully consider the following before discussing treatment options with a conservator:

Reasons to opt for a *stabilization* treatment:

- *Collections may document the history of a technology*. Objects preserve various kinds of information that indicate how they were made and used. These include:
  - design features
  - composition
  - source and processing of raw materials

– fabrication and manufacturing techniques

– accretions

– signs of wear

– repair or alterations

In discussions with the conservator, pass on information you may have about paint, markings, signatures, grime, metallurgical features, residues of associated materials, and other easily lost remnants.

- *Collections may have scientific research value.*

  Most systematic archeological and natural history collections, archival collections, as well as certain ethnographic and historical collections are preserved as evidence or as information for research and study purposes. For these collections, appropriate treatment always involves the bare minimum of intervention, and only if absolutely necessary to preserve the object.

- *Objects may be culturally or legally significant.*

  Many park collections contain objects that have special significance to American Indians, Native Alaskans, Native Hawaiians, or other associated cultural groups. Identify the culturally relevant group, if any, for all items in your collections. Consult with a qualified anthropologist to help identify relevant groups, materials, community consultants, and questions that should be raised when considering conservation treatment. Consult with representatives of American Indians, Native Alaskans, Native Hawaiians, or other associated groups to help identify significant objects and determine appropriate treatments. If there are questions about the acceptability of a treatment, *do not proceed* until the questions can be satisfactorily answered.

  Collections may also have associations with eminent individuals, groups, events, or sites. You should be sure that treatment does not destroy evidence of that association. For example, you would not remove bloodstains on the coat Abraham Lincoln was wearing when he was assassinated.

  There may also be legal issues to consider. For example, some documents (such as land records) may be used as legal proof and treatment may affect their legitimacy. Consult with the regional curator and a solicitor. See also, *Museum Handbook*, Part III, Legal Issues.

Reasons to opt for a *restoration* treatment:

- *Objects may have a special function.*

  Some objects are collected because they serve or perform a special function. For example, a certain musical instrument may produce a quality of sound worth preserving. To preserve the functional capability of an object, worn out or defective parts may require replacement. (If the part is replaced, retain the original part that was removed together with the object.) When considering a treatment for this kind of object, determine the answer to the following question: “Is preservation of function more important than preservation of the original material?”

- *Appearance of the object may be important.*

  Restoration is often carried out to improve appearance, especially when an object is prepared for exhibit. You may have to make a decision either to leave signs of wear and tear or to restore an object closer to its original appearance. Determine the answers to the following questions:

  – Why do I want to restore the former appearance? For example, when deciding whether to replace a missing leg on a chair to be displayed in a historic house, consider that the inhabitants probably did not use a chair with a missing leg.

  – When would restoration go too far and be fraudulent or unethical? For example, overpainting original material so that some of the original is hidden would be misleading and unethical~~.~~

2. *What guidelines should I follow when considering restoration?*

The line between stabilization and restoration is not always clear. For example, a torn map can be stabilized by encapsulation between two sheets of Mylar®. This is stabilization. If the conservator in-paints around the tear and mends the tear this is considered restoration..

Follow these guidelines when reviewing a treatment proposal that suggests restoration:

- Restoration should be based on known facts, not conjecture.

- Restoration should not modify the original character (shape, size, information, visual aesthetic) of an object or item.

- Restoration should be minimally interventive. Agree on techniques and materials that cause the least modification to an object and that can be removed most completely, if necessary, with minimum effect.

- Restored areas should be distinguishable from original material upon close visual inspection, but need not be conspicuous. Ensure that all restored areas are fully documented in the treatment report.

- Restoration should take into account the significance of wear, damage, former maintenance, or other historic or scientific evidence.

3. *What is routine maintenance and how does it affect an object?*

Many of the objects in NPS collections were once used in the everyday world. As utilitarian objects, they required repair and routine maintenance in order to function properly. However, once removed from regular use, continuing the same maintenance procedures can actually cause deterioration. For example, while it may be appropriate to apply leather dressings to horse tack to keep pieces flexible and clean while they are being used. However, when tack is in storage or displayed in a museum, the application of leather dressings causes buildup on the leather and can accelerate deterioration.

Once collections enter the museum collection, they are no longer used and subject to the same wear and tear. In the museum setting, they may be subject to different risks of deterioration in storage, on exhibit or during study. Therefore, the procedures and materials appropriate for their care are likely to be different.

> **Note**: ***Routine maintenance that was once necessary for an object's upkeep may be detrimental to its long-term preservation in a museum collection. Consult with a conservator and your regional curator***.

Work with a conservator to ensure that routine care and maintenance procedures are appropriate for the long-term preservation of the object. For examples see:

- *Conserve O Gram* 9/1, Leather Dressing: To Dress or Not to Dress
- *Conserve O Gram* 10/3, Preparing Historic Motorized Vehicles for Storage and Exhibit

C. Documentation of Conservation Treatment

Document all conservation treatment in writing. Make sure that treatment records include visual documentation such as photographs, drawings, analytical results, spectra, and digital images. NPS conservation treatment policy follows the guidelines for documentation in the *Code of Ethics and Guidelines for Practice of the American Institute for Conservation of Historic and Artistic Works* (AIC) (see Figure 8.1).

File all hard copy of treatment documentation in the appropriate accession or catalog folder and append electronic data to the ICMS. See the *ICMS User Manual* for guidance on how to import and append data and scanned files into ICMS.

1. *Why is conservation documentation important?*

Documentation is important for these reasons:

- Conservation documentation is a written and visual report of the work that is done. It provides the park staff with detailed information on the condition of the object, including how it has been altered, what parts are composed of original material, and what has been added or removed during previous treatments or restorations.
- It serves as a permanent record of the treatment procedures performed and the materials and methods used.
- It spells out the understanding reached between the curatorial staff and the conservator on the treatment, including the extent and type of any stabilization or restoration treatment.
- It provides information that will help future conservators to assess the condition of an object and devise further treatment
- It makes it possible to assess the success or failure of treatment methods and materials over a long period of time.
- It may last longer than the object itself and become the only record.

2. What is the ICMS Conservation module?

The Conservation associated module (or Conservation module) is a feature of the Interior Collections Management System (ICMS) that allows parks to link conservation documentation to object catalog records. Basic catalog record information automatically populates the new conservation records when they are created and the catalog number is entered. The new conservation record is then linked to the object's catalog record, where it can be accessed through the supplemental information tab under "Conservation."

The simplest way to incorporate conservation information into the module is to copy and paste the information from the conservator's documentation directly into the appropriate fields or add a scanned image of the conservator's report. To do this, the conservator must provide their documentation in an accessible electronic format.

Complete instructions for using the Conservation module can be found in the *ICMS User Manual,* Chapter 4: Associated Modules.

3. What information can be recorded in the Conservation module?

The Conservation module can record:

- conservation needs of the object
- statement of work for treatment
- previous conservation treatments
- materials used for treatment
- results of treatment

Parks use the Conservation module to:

- ensure that critical information is maintained in electronic format so documentation does not get lost over time. Paper reports are more difficult to track over time. Data in ICMS remains associated with the objects for the long-term In addition, the National Catalog maintains a backup of each park's data through their annual submission.
- guide the conservator to provide specific kinds of information in their documentation; the default and customizable fields in the module facilitate this.

Conservators use the Conservation module to:

- easily incorporate information they generate into park catalog records.
- ensure that their documentation is readily available to future curators, conservators, and researchers.
- integrate conservation information in the primary database used to make management decisions about collections.
- assist in managing conservation for the object.

  ICMS facilitates:

- estimation of hours for treatment projects on multiple objects
- documentation of the amount of work accomplished in a year
- word searches on treatment materials or types of objects treated
- searches to find similar objects from past work
- searches to find all work done for a park over numerous projects

4. *What documentation should the conservator provide?*

In addition to information recorded in the Conservation module, be sure to have the conservator provide printed and electronic copies of all documentation including:

- *Written reports:* The conservation profession requires documentation of all examinations, scientific investigations, and treatments through the creation of permanent records and reports. These written reports often contain information on research into materials and technology that are beyond the scope of the fields in the ICMS Conservation module. Reports are prepared either in a narrative style or checklist format (or a combination of both). See Figures 8.2, 8.4, and 8.5 for sample reports. For multiple object treatments, summary reports may be also included.

- *Photographs:* Treatment documentation should include detailed photography. A complete series should include photos taken before, during, and after treatment. Photographic documentation includes digital images saved as lossless TIFF files and museum quality hard copy full color prints Specialized photographic and lighting techniques may be used. These include use of:

  - *ultraviolet light*—some restorations fluoresce and become more visible
  - *infrared light*—may reveal details under layers of grime and old coatings; may improve the legibility of difficult-to-read inscriptions
  - *raking light*—shows surface irregularities by illuminating the surface from an acute angle
  - *reflected light*—shows variation in gloss or texture by recording the reflection of a light source
  - *x-ray radiography*—may reveal internal features
  - *transmitted light*—may show missing areas in translucent objects
  - *photomicrography*—shows details too small to see with the naked eye

- *Drawings and illustrations:* These media are used to note changes or significant features that are hard to illustrate with photographs (for example, on textiles: repairs, selvage edges, and changes in sewing threads).

- *Analytical records:* If analysis is undertaken to identify materials or techniques, additional types of information may be generated, such as analytical reports and interpretation, spectra, and graphs. Parks must keep complete sets of the data as part of the record of conservation work.

	MINIMUM DOCUMENTATION REQUIREMENTS	**RECOMMENDED DOCUMENTATION REQUIREMENTS**
All Documentation	Include: • purpose • documentation by (name) • date • object name • catalog number • catalog number • object description/unique information • medium/materials • measurements • marks/labels/features	Include associated records such as: • previous treatment • excavation reports • curatorial reports • scientific reports
Examination Reports	Include: • observations • present condition [Cond Descrip]* • notation of accessory materials or associated elements • past treatment evidence [Original Cons] • methods of examination and testing	Include: • drawings/photos to illustrate condition and relevant details (include control numbers) • size scale • gray/color scale (photos) • light direction (photos) • object ID
Treatment Proposals:	Include: • treatment plan [Cons Descrip] • materials to be used [Cons Materials] • time estimate [Est Hours] • cost estimate (when appropriate) • documentation of approval for recommended treatment by curator	Include: • objectives and limitations of treatment, benefits, and risks • general description of properties of materials to be used • statement that minor variations in treatment may be required as treatment progresses
Treatment Reports:	Include: • conservator name [Cons By] • report date/treatment date [Cons Date] • all procedures used [Results] • all materials, including chemicals, used • procedures used that deviate from proposal • added materials that remain on object • materials used on object that do not remain • removed materials and their disposition • materials obscured by treatment • new information about object revealed in treatment (including features hidden by assembly) • changes in object as a result of treatment	Include: • procedures and materials considered, but not chosen • recommendations for subsequent care and maintenance • treatment time • treatment cost (when needed)

	including its state after treatment • names of assisting conservators, consultants, and contractors • dated visual documentation • recommendations for subsequent care and maintenance	

*Equivalent ICMS Conservation Module field names in [parenthesis]

Figure 8.1. Information Required in Conservation Treatment Documentation
(Adapted from *Code of Ethics and Guidelines for Practice of the AIC)*

5. *What documentation steps are taken when an object is treated?*

Most object conservation treatment documentation includes the following steps:

1. Park staff provides the conservator with relevant historical information, including records of any prior examinations or treatments.

2. The conservator prepares an *examination report* (see Fig. 8.2). This examination report can be based on information generated in a previously completed Collection Condition Survey (CCS). (See Chapter 3: Preservation: Getting Started.) The examination report should include:

- a description of the materials, structure, and construction of the object
- an analysis of materials, as appropriate
- a description of the condition of the object and evidence of past treatment, with reference to any previous documentation
- any deductions, interpretations, or comments

At the discretion of the park curator, the conservator may combine the *examination report* with the *treatment proposal* to form one document containing the above information as well as the proposed treatment.

3. The conservator prepares a *treatment proposal.* See Figure 8.4 for a sample treatment proposal. This document outlines the proposed treatment along with alternative approaches. The proposal usually does not list all the technical details that are later listed in the treatment report. The treatment proposal should address all the problems identified in the examination report. It should include time/expense estimates. The park curator should review the treatment proposal in consultation with the regional curator. Once satisfied with the treatment proposal, the curator approves it with the concurrence of the park superintendent.

The conservator must discuss and provide in writing, any significant departures from the treatment proposal prior to actually implementing them and receive written approval from the curator and Contracting Officer (CO), if applicable).

4. The conservator prepares a *treatment report*. See Figure 8.5 for a sample treatment report. In this document, the conservator details all the steps of the treatment performed. The conservator discusses the treatment results and should make recommendations about future care, exhibition, and storage

requirements. The conservator also discusses treatment changes and rationale in the final report.

6. *What documentation should park staff generate on its own treatment activities?*

Record two types of activities:

- *Housekeeping*

  You must keep a record of all housekeeping (ongoing, repeated actions or tasks done to preserve collections) performed by staff. Housekeeping tasks may include:

  – cleaning (method and frequency)

  – dusting

  – waxing

  – maintaining proper fluid levels in wet specimens

  Record this information in the ICMS Maintenance module. Instructions for using the module can be found in the *ICMS User Manual*, Chapter 4: Associated Modules. Provide this information to the conservator as part of the historical information about the object.

  For more information about developing a housekeeping plan, including the necessary documentation, see Chapter 13: Museum Housekeeping.

- *Changes in condition*

  Record any observed changes in the condition of objects, whether or not they have or will undergo conservation treatment. Record these changes in as much detail as possible in the Catalog Record portion of ICMS under the condition and condition description fields.

D. Obtaining the Services of a Conservator

When you determine that you need a conservator:

- Take time to locate an experienced, well-qualified conservator who specializes in the type of object(s) you want treated. This is critical to the quality of treatment an object will receive. Consult with your regional curator and local museum professionals.

- Prepare a *scope of work* (SOW) for the project. See Figure 8.2 for a sample scope of work. Contact your regional curator and NPS conservation laboratories to obtain copies of SOWs created for past treatment projects.

- Discuss the entire process and requirements with the conservator and others involved in the project, including thepark manager, park curatorial staff, and regional curator.

- Be sure contract conservators understand NPS conservation treatment policy: *to preserve what remains of an object in as stable a condition as possible*. Provide them with NPS policy and procedural guidelines, including pertinent sections of the *Museum Handbook* and *ICMS User Manual*.

- Make sure that the conservator has a secure storage area, smoke detection system, a fire suppression system and appropriate environmental conditions within the storage and work space..

1. *How do I find a conservator?*

Work with your regional curator to find an NPS conservator or a contract conservator with the appropriate knowledge and experience.

The regional curator can help locate conservators and can also help you obtain funding for the project. The regional curator can also help set priorities and determine a time frame for the project, as well as help prepare procurement documents. Discuss the type of project (such as treatment of a single object or group of objects, identification of methods and materials used to create an object) with the regional curator and determine the:

- nature of the object or collection (type of material and condition)
- present use of the object or collection
- planned use of the object or collection (for example, for research or in an exhibit)

2. *How do I decide if a recommended conservator and treatment are suitable?*

Always ensure that the treatment proposal is in response to, and specifically addresses an existing, documented condition. Evaluate treatment recommendations against the AIC Code of Ethics to inform your judgment. In particular, be aware of the following points in the Code:

- *The conservation professional shall practice within the limits of personal competence and education as well as within the limits of the available facilities.* Ask the conservator these questions:
  - What is your training for this sort of treatment?
  - Have you ever treated objects like this before?
  - Do you have the proper equipment to carry out this treatment?
  - Do your facilities offer the appropriate environmental conditions for housing the objects?
  - What kind of insurance coverage do you have?
  - What kind of security and fire protection does your facility have?
  - Can you give me references from previous clients?
  - What is your schedule for completing the work?
- *The conservation professional must strive to select methods and materials that, to the best of current knowledge, do not adversely affect*

objects or their future examination, scientific investigation, treatment or function. Ask the conservator these questions:

- How will this treatment affect future analysis?

- If you do this treatment, can the object be re-treated in the future? Although no treatment is completely reversible, it is possible to use materials and techniques that allow for re-treatment. For example, you may not be able to remove a consolidant added to give structural strength. However, the choice of consolidant should not rule out the use of a later, alternative treatment, if the original treatment fails.

- *The conservation professional shall document examination, scientific investigation, and treatment by creating permanent records and reports.* Ask the conservator these questions:

  - What documentation will you provide and how will you produce it? Do you have the ability to produce all documentation in compatible electronic format and on acid-free, neutral pH paper using pigment or carbon-based inks?

  - What kind of photo documentation will you do? What equipment will you use to ensure proper lighting, color, etc.? Do you have a digital camera that will produce uncompressed, high-resolution TIFF files and the ability to produce full color, museum quality prints of all digital photos?

- *The conservation professional shall recognize a responsibility for preventive conservation by endeavoring to limit damage or deterioration to objects, provide guidelines for continuing use and care and recommending appropriate environmental conditions for storage and exhibitions, and encourage proper procedures for handling, packing, and transport.* Ask these questions:

  - How would you recommend I handle and store this object in the future?

  - Do you have any recommendations for the future exhibition of this object?

  - Does this object pose health and safety risks to staff or risks to nearby materials?

3. *What do I need to know about contracting for conservation treatment services?*

The following steps are necessary in order to contract for conservation treatment services:

- Create a scope of work (SOW) in consultation with your regional curator and contracting officer. See Figure 8.2, Sample Scope of Work for Requesting Conservation. This document outlines the project and the requirements and expectations for both parties.

  Work with your park or regional contracting officer and regional curator to prepare a legally binding contract both parties will sign. This document should include provisions on insurance, liability, and the assignment of rights, including copyright to the NPS and other clauses tailored to the needs of the contract. See Figure 8.3, Sample Contract Provisions for Insurance and Copyright.

- Work with your regional curator to determine who should serve as the Contracting Officer's Technical Representative (COTR) for the project. You can ask a NPS conservator to serve as (COTR).
  Note: The contracting officer (CO) must appoint the COTR. The COTR is a federal employee who provides advice on the technical aspects of the work being contracted, monitors performance of the contract, and must be FAC-COTR trained and certified in accordance with the requirements of the FAC-COTR program manual [see http://wcp.den.nps.gov/Policy-Program/COR/cor.htm.]

  NPS conservators have the technical knowledge to evaluate a treatment proposal and can assist you and the contracting officer with the resolution of technical problems. Therefore, make sure the COTR has expertise in the type of material that is being treated. A COTR must be formally appointed in writing by the contracting officer and the letter of appointment must be acknowledged and signed by the COTR and returned to the CO. During the treatment process, the COTR may evaluate and recommend necessary changes that might arise. However, the COTR must notify the CO of those suggested changes in the SOW that would result in adjustments of cost or time to the contract so that the CO can process a contract modification. Only the CO can approve changes to a contract. The COTR cannot obligate, in any way, the payment of money or extension of time by the Government.

  If an NPS conservator is not available, a regional curator or knowledgeable park curator can also serve as the COTR for conservation treatments or any other service provided by a contract conservator.

Make sure the contract states that all works and all rights to those works, including copyrights produced as part the contract belong to the National Park Service. (See Museum Handbook, Part III, Ch 2, Legal Issues, Sec. C.7 and Chapter 3, Publications, Fig. 3.4).

4. *Should the treatment be performed on-site or off-site?*

When preparing the conservation treatment SOW, be sure to address any special needs or considerations that might influence where the object(s) can or should be treated.

Some objects, such as building elements (e.g. an ornamental railing) must be treated on-site. Others can be transported or shipped to other locations for treatment.

When deciding whether it is preferable for objects to be treated on-site or off-site, consider the following questions:

- Does transporting the object put it at greater risk for damage? Evaluate the level of risk, given the fragility and/or complexity of the object.

- What does packing and shipping for the object cost, both in money and staff time?

- Is the object of unusually high value or significance? Does treating it off-site raise issues of unacceptable risk regarding theft or disaster and inadequate insurance coverage?

- How far does the conservator have to travel to treat the object on-site? How would this compare to the cost of packing and shipping?

- Will the conservator need access to special equipment, tools, or workspaces that could not reasonably be made available on site?

- How many objects need treatment? Is it more cost effective to have the conservator come to the park to work on the objects?

Consult with an NPS conservator, your regional curator and park superintendent to determine whether the work should be done on-site or off-site.

5. *How do I work with an NPS conservator?*

Several NPS conservation laboratories work on park museum objects. Conservators from these labs can assist with surveys, carry out treatments and provide advice on conservation and conservation contracting. The NPS labs are:

- Museum Conservation Services, Harpers Ferry Center, Harpers Ferry, West Virginia
- Northeast Cultural Resources Center, Lowell, Massachusetts
- Western Archeological and Conservation Center, Tucson, Arizona

Contact the lab directly for guidance on how to initiate the project. Conservation lab staff will develop a work plan, an estimate of costs, a direct charge authorization, project agreement and a mutually agreeable project schedule in consultation with you. You will work with the conservation lab registrar to prepare the loan paper work and arrange suitable transportation.

6. *When I evaluate a treatment proposal, what should I consider?*

Be aware that every active treatment carries inherent risk. Before you allow conservators to carry out treatment on an object, carefully consider the proposed treatment. Make sure that the proposed conservation treatment is sound, meets the best conservation practice standards, and respects the physical, historic, and aesthetic integrity of an object.

Note; It is highly recommended that you consult with the regional curator and a NPS conservator with expertise in the type of object to be treated and have them review treatment proposals **before** work begins. Assess the treatment itself by examining or talking to others about similar objects that received the same type of treatment. You should also confer with other local museum professionals about the proposed treatment. Once you approve the written treatment proposal, work can begin.

During treatment, the curator (and COTR, if applicable) must review and approve any significant deviations from the proposal. Don't simply accept a recommendation; question and evaluate its quality.

7. *What insurance coverage should the conservator have?*

Conservation treatments are delicate, often complex undertakings and can result in the permanent alteration of objects of great cultural, scientific, or monetary value. Although rare, there is always the potential for significant damage to (or total loss of) an object as a result of a conservation treatment. As all conservation treatments come with potential risk to the object, it is important that you:

- take great care in selecting a conservator and to evaluate proposed treatments in detail **before** they are approved

- ensure that a non-NPS conservator obtains liability insurance for objects that are going to be treated

- ensure that the objects are covered during transportation to and from the park, and for the time the objects are in the conservator's custody

Consult with the regional curator and the park contracting officer as to what type(s) or level(s) of insurance the contract conservator will be expected to cover, and/or whether the park friends group can purchase short term insurance coverage for the object(s) undergoing conservation treatment, as well as during transportation.

Understand these general guidelines regarding insurance coverage:

- Discuss insurance coverage with the conservator early on in your negotiations. Determine what type(s) of coverage the contract conservator already has, the limits of his/her policies, and whether there is a need to increase or obtain coverage should the park deem it necessary.

  State the required types of insurance and dollar amounts in the contract pre-solicitation notice or solicitation so that a prospective contractor is aware of what type of insurance coverage is required prior to start of work if awarded the contract. Insurance policy requirements for contracts are covered in the Federal Acquisition Regulation (FAR) at Subpart 28.3 Insurance (see FAR 28.307-2 for dollar amounts required for cost reimbursement contracts) and see DIAR clause 1452.228-70.

- Contractors/conservators are required to comply with applicable Federal and State workers' compensation and occupational disease statutes. Therefore, the insurance requirements should be stated in the contract. As contractors, conservators (or the business they work or/under) are not covered under the compensation program for park employees.

- At a minimum, conservators must have some form of *commercial general liability insurance* in order to sign a contract with the NPS. Some states make this a legal requirement. This type of policy *does not* cover museum objects. It only covers damage to other types of property and personal injury. For example, if a treatment solution is spilled on carpeting and ruins it, or if a conservator leaves a ladder in a gallery and a visitor is injured by tripping over it.

- Conservators should also have *property damage insurance* specifically designed for conservators or art owners/handlers. This covers loss or damage to objects that occurs while the objects are under the conservators' care or control. This type of policy *does not* cover damage to objects caused by the conservation treatment itself, even if the conservator made an error. For example, a painting damaged by a leaky roof in a conservator's studio would be covered. A painting damaged by the conservator applying the wrong cleaning solution would not be covered.

- *Professional errors and omissions* (sometimes called *professional liability*) *insurance* covers liabilities or damage arising from the professional conduct of the conservator due to error, negligence, or omission. This includes damage to the object if it is a result of an error made by the conservator (such as using the incorrect cleaning solution). This type of insurance can be difficult and expensive for a conservator to obtain, especially for high value objects. Efforts are being made to make it more widely available and affordable.

The park should set minimum levels of coverage for the above types of insurance, based on the value of the object(s) undergoing treatment and other factors.

***Include insurance requirements in the contract the conservator signs. Work with your contracting officer/contracting office to add appropriate language regarding insurance to the contract for conservation services. See Figure 8.3, Sample Contract Provisions for Insurance Coverage*.**

8. *What happens after the conservator is selected?*

Once you have selected a conservator, schedule the project. If objects will be transported to the conservator's conservation lab or studio, schedule the shipment dates with the conservator. Discuss packing and shipping methods to ensure the objects are safely transported and not damaged in the course transit. Plan to ship at the beginning or middle of the week rather than on a Friday to avoid unnecessary weekend delays. Consider climate conditions and control measures during shipment.

Review all examination reports and/or treatment proposals. Discuss your questions with the conservator. The person with delegated responsibility (usually the curator) must approve and sign a treatment proposal before work can begin. Get advice from your regional curator or NPS conservators to ensure that the proposal describes an appropriate treatment. File a copy of the signed treatment proposal in the appropriate catalog folder or accession file.

9. *What are my responsibilities once the treatment proposal is approved?*

Routinely monitor the work by visiting the conservation lab or discussing progress with the conservator. Include a requirement in the scope of work for the conservator to provide the park with on-going written updates. After treatment is completed, the conservator will return the objects to the park. Before approving payment, ensure that all conditions of the contract and/or SOW were completed satisfactorily. Review electronic data provided by the conservator and incorporate accepted data into the ICMS Conservation module. Where possible, have a NPS or other conservator review the work. File all documentation (reports, photographs, drawings, etc.) in the proper Catalog Folder or Accession File.

10. *Where can I find information on how to treat objects in an emergency?*

Refer to *Chapter 10: Emergency Planning*, for information on planning for and recovering from an emergency. This chapter also gives you information on basic actions you can take to minimize damage. In particular, review

Figure 10.13, First 48 Hours Emergency Response Checklist.

Also refer to the Emergency Response and Salvage Wheel available from Heritage Preservation <www.heritagepreservation.org>. This tool gives you basic steps to take immediately after a disaster strikes.

Contact a conservator as soon as possible for advice on how to recover from an emergency.

E. Glossary

Accretion – accumulated materials not original to the object that are attached to the surface of an object. For example, calcium deposits may accumulate on buried (archeological) ceramics.

Conservation treatment **–** the deliberate alteration of the chemical and/or physical aspects of objects, aimed primarily at prolonging their existence. Treatment may be categorized as stabilization or restoration.

Inherent vice – the nature of the material itself or the result of manufacturing techniques that cause an object to deteriorate more rapidly than normal, or that make stabilization nearly impossible. For example, some nineteenth and 20th century silk fabrics were sometimes treated with metallic compounds that cannot be removed from the fabric and cause the fabric to split and powder. "The quality of a material or an object to self-destruct or to be unusually difficult to maintain." Examples include nitrocellulose films and wood pulps. Conservation Resources for Art and Antiques, Washington Conservation Guild, 2001

Intervention – taking direct, hands-on action to modify the condition of an object

Minimal intervention – overarching goal of any conservation treatment; reduces the possibility of compromising the object's significance or inadvertently causing increased deterioration in the future

Preservation – encompasses all actions taken to prolong the life of an object

Preventive care – synonym for preventive conservation

Preventive conservation – mitigation of deterioration and damage to objects through non-interventive actions, including maintenance of proper storage conditions, handling and shipping procedures, and emergency preparedness and response

Reproduction – a copy of an item for exhibit, interpretive, educational, sale, research or other purpose, made when use of the original would be inappropriate or would cause undue deterioration or loss

Restoration –conservation treatment that attempts to return objects to a known or assumed state, often by removing additions not considered historically important, replacing missing parts, renewing finishes, and/or concealing damage

Reversibility – the principle of using materials and techniques that can be removed or undone, in so far as possible, should re-treatment of an object become necessary

Spectrum – a graphic or photographic representation of the distribution of energy emitted by a radiant source. For example, spectra might be produced by analytical techniques used to identify the type of varnish on a piece of furniture.

Stabilization – conservation treatment using procedures intended to minimize an object's deterioration while maintaining its integrity.

F. Selected Bibliography

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G. Web Resources

American Institute for Conservation of Historic and Artistic Works (AIC). www.conservation-us.org.
Canadian Conservation Institute (CCI): www.cci-icc.gc.ca.
Conservation OnLine (CoOL): cool.conservation-us.org.

The Getty Conservation Institute: www.getty.edu/conservation.
National Park Service *Conserve O Gram* Technical Leaflet Series:
Northeast Document Conservation Center: www.nedcc.org

H. List of Figures

SCOPE OF WORK (Sample)
Object Conservation Treatment
[Park Name]

I. Background Statement

Provide information on the collections object(s) undergoing treatment and why the treatment is needed (to prepare for exhibition, slow deterioration, etc).

The Park [Park name, address, telephone number, museum curator/contact, email address] requests conservation treatment for the following object(s): [list object(s)].

II. Purpose/Objectives

The purpose of the work is to provide 1) examination of object(s) in need of conservation treatment at **[PARK],** including generation of an Examination Report and a Treatment Proposal, 2) upon written approval of the proposal(s) by **[PARK]**, conservation treatment of the object(s) and subsequent submission of a Treatment Report and other documentation as noted below. This work is to be primarily performed (on site / off-site).

Prior to entering into a contract, the Contractor shall:

A. Agree to fully comply with the *Code of Ethics and Guidelines for Practice* of the American Institute for Conservation of Historic and Artistic Works (AIC) in all work performed.

B. Provide a vitae containing the relevant qualifications and experience of the Contractor and any other the individuals who will be involved in the examination and treatment process, including an estimate of the nature and extent of their anticipated involvement. This will include references to similar work that clearly demonstrates an expertise in the conservation of museum objects and a history of completing work of this scope and character. Include a comprehensive work history that shows specialized training and/or education in the field of conservation.

C. Provide a list of references from museum professionals with first-hand knowledge of work performed and proof of membership in AIC.

D. Provide a sample completed Examination Report (with appropriate redactions to protect privacy as needed).

E. Provide a prior example of a Treatment Report for work completed (with appropriate redactions to protect privacy as needed).

F. Provide proof of insurance for the following types and amounts of insurance coverage: [List of insurance types and coverage amounts required.] See Figure 8.4: Sample Insurance and Copyright Requirements for Inclusion in a Contract. If work is to be performed on-site, provide a copy of liability insurance.

G. If examination and/or treatment of object(s) is to be performed off-site, Contractor shall provide a description of the facility where activities are to be performed, including the applicable portions of a standard AAM facilities report addressing climate control, security and fire detection systems. Off-site work will require transport; the Contractor shall use appropriate museum and fine art shipping practices for packing and transport to and from the Park. A description of the planned transport procedures and insurance coverage must be included.

Prior to entering into a contract, the Park must complete:

Provide copies of any previous surveys or reports that may assist the conservator in understanding the object(s) to be treated, including:

Figure 8.2. Sample Scope of Work for Requesting Conservation Treatment

- Documentation/history of the object(s)
- Collection Condition Survey (CCS), if applicable to the object(s)

If the contractor will be on-site at the park for examination and/or treatment, the Park will provide:

- A suitable work space, separate from collections storage.
- Supervised access to collection storage rooms, vaults, cabinets, shelves, and other locations of museum objects as necessary.
- Opening and closing of storage cabinets, vaults or other containers that may be locked.
- Assistance with moving heavy or unwieldy objects.
- Limited access to museum object accountability (catalog and accession) and conservation (treatment and survey) records when required.
- Answers to questions about existing environmental monitoring and control, preventive care of objects, uses of objects, plans for future exhibition of objects, and the Park's pest management program.
- Other relevant information as needed.

III. Tasks

Independently and not as an agent of the Government, the Contractor shall provide all labor, materials, facilities, and travel necessary to execute conservation treatments on the object(s) listed and described above.

The Contractor will complete the work in two phases:

Phase I: Examination and Treatment Proposal

1. Conduct hands-on examination of the object(s) and produce an individual Examination Report and Treatment Proposal, including full-view obverse and reverse photographs for each object. The treatment proposal shall be sensitive to the cultural, display, and other specified needs of each object.

2. Provide both printed and electronic copies of the Examination Report, Treatment Proposal, and photographs for the object(s).

Phase II: Treatment and Treatment Report

1. Commence treatment of the object(s) upon Park approval of the Treatment Proposal, Examination Report, and photographs for each object.

2. Document and photograph the object(s) in detail during (if appropriate) and after treatment, producing a final Treatment Report and, at minimum, a full-view obverse and a full-view reverse photograph of each object.

Figure 8.2. Sample Scope of Work for Requesting Conservation Treatment (continued)

3. Provide both printed and electronic copies of the Treatment Report, and photographs for the object(s). Treatment Report must include Contractor's recommendations for improvements to object storage and exhibit conditions as well as general suggestions for ongoing preventive care.

4. Upon completion of the treatment and delivery of the Treatment Report and photographs, the Contractor will meet with the Park superintendent and designated curatorial staff to review the results of the treatment. The close-out meeting should cover not only the treatment results, but the Contractor's recommendations for the future storage and exhibition of the treated objects.

IV. DELIVERABLES AND PAYMENT SCHEDULE

Deliverables. The Contractor shall submit deliverables in two phases:

Phase I

1. An Examination Report and Treatment Proposal for each object or group of like objects. Report and Proposal shall be prepared using software approved by the Park, and either be:
    - entered directly into the ICMS Conservation associated module by the Contractor or
    - delivered to the Park in a digital format of the Park's choosing.

The Park shall also be furnished with printed copies of the Report and Proposal in an approved format and on neutral ph, high alpha-cellulose paper (using carbon or pigment-based inks).

2. Full-color examination photographs of each object, delivered to the Park in both printed (using neutral pH, high alpha-cellulose paper and pigment-based inks) and digital form (lossless .TIF files with Dublin Core® schema metadata). Each object examined shall, at minimum, be photographed in full-view obverse and reverse.

All Phase I work shall be completed by **[Date]**.

Phase II

- A draft and final Treatment Report for each object or group of like objects that the Contractor performs treatment on. Report shall be prepared using software approved by the Park, and either be:
    - entered directly into ICMS Conservation associated module by the Contractor or
    - delivered to the Park in a digital format of the Park's choosing.

The Park shall also be furnished with printed copies of the Report in an approved format, printed on neutral pH, high alpha-cellulose paper (using carbon or pigment-based inks).

- Full-color photographs of each object taken during treatment (if appropriate) and after completion of treatment. Photographs should be taken using a digital or film camera, and delivered to the Park in both printed (using neutral ph, high alpha-cellulose paper and pigment-based inks) and digital form (lossless .TIFF files with Dublin Core® metadata).

- A signed statement that all rights to all works produced under this contract, including photographs belong to the National Park Service.

Figure 8.2. Sample Scope of Work for Requesting Conservation Treatment (continued)

- A meeting with the Park superintendant and designated curatorial staff to review the results of the treatment and the Contractor's recommendations for the future storage and exhibition of the object(s).

All Phase II work shall be completed by **[Date]**.

Note:

- All reports, proposals, and photographs shall be created in accordance with the American Institute for Conservation of Historic and Artistic Works (AIC) *Code of Ethics and Guidelines for Practice.*

- All work will be subject to inspection and acceptance by the designated Contracting Officer's Technical Representative (COTR). If submitted deliverables are not to the satisfaction of the COTR, revisions/further drafts must be submitted by the Contractor until the issue(s) are corrected.

Payment Schedule. The Contractor shall be paid in two phases:

Phase I

Following review and approval of the Examination Report, Treatment Proposal, and photographs by the COTR. Contractor shall submit an invoice for no more than [XX]% of the total contract amount.

Phase II

Following: a) Review and approval of the Treatment Report and photographs by the COTR, and (b) a meeting between the Contractor and the Park superintendant and curators to discuss results and recommendations. Contractor shall submit an invoice for the remaining [XX]% of the total contract amount.

If documentation is unable to be delivered in person, send to:

[Name - Address - Telephone number – Contact (museum curator) Email Address]

Figure 8.2. Sample Scope of Work for Requesting Conservation Treatment (continued)

SAMPLE INSURANCE AND COPYRIGHT REQUIREMENTS FOR INCLUSION IN A COTRACT

When contracting for conservation treatment, work with your contracting officer to include the insurance and copyright provisions outlined below:

Insurance

- Coverage shall not be canceled or materially changed without 30 days prior notice, in writing, to the Park. No cancellation provision in any insurance policy shall be construed to negate or void the continuous duty of the Contractor to furnish the required insurance during the term of this Agreement.

The contractor will provide:

- Certificate of insurance or proof of current commercial general liability insurance on an occurrence basis with minimum coverage of $1,000,000 per occurrence and a minimum of $2,000,000 in the annual aggregate, including but not limited to; premises/operations (including off-site operations), blanket contractual liability and broad form property damage. This covers the conservator in the event bodily injury or property (non-collection) damage occurs to others as a result of their work, such as damaged to the building.

- Certificate of insurance or proof of current *property insurance* for conservators or art owners/handlers. This covers the loss or damage of museum objects while they are under the Contractor’s care or control. The minimum amount of coverage should reflect the appraised value of the object(s) undergoing treatment (as determined by an independent appraiser).

- Certificate of insurance or proof of current *errors and omissions (professional liability) insurance,* if deemed necessary by the park.. This covers liabilities and damage arising from the professional conduct of the conservator due to error, negligence, or omission.

Copyright

- The contractor will provide a signed release assigning all rights , including copyrights for works produced for this contract such as written documentation, reports and photographs, to the National Park Service. (See NPS *Museum Handbook* Part III, Fig 3.4: Assignment of Copyright by Contractor).

- The Contractor may keep a copy of each image. The Contractor shall obtain written permission from the park superintendent or curator to use the image in a publication. When the Contractor uses an image, the credit line shall include the following: "Courtesy of the National Park Service," Park Name, Object Name, Catalog Number, Object Date,

Figure 8.3. Sample Insurance and Copyright Requirements for Inclusion in a Contract

SAMPLE OBJECT EXAMINATION REPORT

Owner:	National Park Service	**Park Name:**	Washington Support Office
Object:	Frock coat	**Catalog No:**	WASO1
Conservator:	Lesley Jones	**Date Examined**:	June 13, 2011
Supervisor/COTR:	Bob Smith		

Overall assessment: **[X]** Treatment required to exhibit/loan or stabilize condition
[ ] Suitable for exhibit/loan or stable for long-term storage

DESCRIPTION:

The object is a single-breasted Civil War frock coat of navy blue doeskin (fulled wool) with a standing collar and long cuffed sleeves. The coat has a nine-button center front closure. It is fully lined—the body and skirt with green wool and the sleeves with natural colored twill weave cotton. There is a belt tab on the proper right (PR) side at the waist and an inner breast pocket on the proper left (PL) side of the coat. The 2.4 cm (7/8 inch) diameter brass buttons depict an eagle with a shield. The eagle holds an olive branch in his PL talons and a shaft of arrows in his PR talons; he faces to the right. Two of the same buttons adorn the back vent of the skirt at the waist; each sleeve cuff contains three smaller diameter buttons—1.5 cm (1/2 inch)—with the same eagle and shield design. The buttons have a maker's mark on the back "HORSTMANN & CO / NY & PHI." Shoulder boards of navy blue wool with sheet brass stamped to resemble gold bullion embellish both shoulders.

Dimensions:

Length: 98.9 cm (39 inches) (measured at the center back from the top of the collar to the bottom edge)

Width: 53.4 cm (21 inches) (measured at the widest point across the shoulders)

Structure or Construction:

This coat is a well-made, hand tailored garment constructed of high quality piece goods. The doeskin is fine. This coat does not have bound buttonholes. The collar is lined in black velvet.

The back is constructed in four pieces with a center back seam and two princess seams. Each front section is a single piece with a dart extending up 14.1 cm (5-1/2 inches) from the waist seam. The sleeves are constructed of two pieces with an added cuff that measures 6.5 cm (2-1/2 inches) in width. The skirt is constructed of two main pieces with small additional pieces used to form the vent in the center back. The entire coat is lined—the body and skirt with green wool and the sleeves with natural colored twill weave cotton. The inside front panels are quilted; the quilting extends under the arms to the princess seams.

Figure 8.4. Sample Object Examination Report

CONDITION:

Overall condition: [X] Good [ ] Fair [ ] Poor [ ] Fragmented or disfigured [ ] Other

The coat is in excellent structural and aesthetic condition.

The shoulder guards are very heavy and may not be entirely original. The sheet brass appears to be attached to navy wool, which in turn has been stitched to what may be a modern, black fabric. This final layer is what has been stitched to the shoulders of the coat.

There are several small holes, a result of insect damage, scattered across the surface of the coat; they do not compromise the coat's structural integrity. There is a hole the size of a nickel in the center back along the bottom edge and slightly smaller holes on both sleeves at the elbows. There is a 1.3 cm (½ inch) tear at the PL sleeve seam in the back. The center front edge is unstitched along much of its length on both sides.

The lining is in excellent condition. There is one hole in the lining in the area of the inner breast pocket. The collar lining has come unstitched at the center back.

Physical damage:
[ ] Structurally unstable
[ ] Fragmented
[ ] Distorted/bent/warped
[X] Cracked/split/torn/loose
[ ] Brittle/desiccated
[ ] Wet/damp/mold
[ ] Waterlogged
[ ] Flaking/friable surface
[ ] Scratched/abraded

[ ] Fire or smoke damage
[ ] Accretions
[…] Insect damage/traces
[ ] Other (_____________)

Chemical damage:
[ ] Corrosion (active / inactive)
[ ] Sweating/weeping
[ ] Light damage or fading
[ ] Stains or discoloration
[ ] Crystalline deposits
[ ] Oxidation
[ ] Other (_________________)

Previous treatment and historic evidence:
[X] Previous repairs/restorations
[ ] Historic deposits/soiling

[ ] Other (_________________)

Biological damage:
[X] Insect damage
[ ] Mold/fungi
[ ] Rot
[ ] Other (_______________)

PREVIOUS REPAIRS, TREATMENT, MOUNTING:

Some buttons may have been resewn. Aside from the difference in thread used, it is possible to tell the difference between original and resewn buttons because the original buttons were sewn on before the facing was attached. As a result, the stitching does not extend through all layers and is not seen on the inside. In contrast, the stitching on resewn buttons extends through all layers and can be seen on the inner face of the coat. Components of the shoulder boards may have been replaced.

PHOTOGRAPHIC DOCUMENTATION:

None

Figure 8.4. Sample Object Examination Report (continued)

OBJECT TREATMENT PROPOSAL

Owner:	National Park Service	**Park Name:**	Washington Support Office
Object:	Frock coat	**Catalog No:**	WASO1
Conservator:	Lesley Jones	**Date Proposed**:	July 2, 2011
Supervisor/COTR:	Bob Smith	**Estimated Time:**	75 hours
Estimated Cost:	$7,500 ($100/hr)		

DESCRIPTION AND CONDITION:
See Object Examination Report dated June 13, 2011.

PROPOSED TREATMENT:
1. Vacuum-clean coat using reduced suction.
2. Visually reintegrate areas of loss using compatible weight and color fabric to back holes.
3. Clean buttons and apply protective coating of microcrystalline wax.
4. Re-stitch seams requiring stitching; reinforce with Stabiltex polyester multifilament fabric as needed.
5. Examine shoulder guards. Because of their weight, explore mounting options besides stitching them to shoulder of coat.
6. Prepare custom-built mannequin on which to display coat when on exhibit.

DOCUMENTATION:
Before and after treatment high resolution color TIFF digital files and 2x3 negative film images will be taken of the object.

Figure 8.5. Sample Object Treatment Proposal

RECOMMENDATIONS FOR SUBSEQUENT CARE:

DISPLAY REQUIREMENTS:

- Light levels should not exceed 5 lux (5 foot-candles) using a Visitor Activated lighting system.
- The coat should be inspected annually for signs of pest infestation.
- The coat should be micro vacuumed while on exhibit as required. Vacuuming frequency should be determined by inspecting the textile and noting the accumulation of dust inside the exhibit case.
- The coat should be rotated off display in 2 to 3 years and allowed to remain in storage for at least 5 years before being exhibited again.

POST EXHIBITION CARE:

The coat should remain in storage, in a dark, clean, stable environment for at least 5 years after rotation. See NPS *Museum Handbook* Part I, Appendix K (Curatorial Care of Textile Objects) for preventive conservation, handling and storage procedures.

If you agree with this proposal, please sign it and return it to the conservator. Your approval of this request must be received before work can proceed. The conservator will be happy to discuss this treatment proposal with you and answer any questions. If significant changes to this proposal are anticipated once treatment has begun, the conservator will consult with you.

Prepared by:____________________________________ Date:______________
Title: Conservator

Approved by:____________________________________ Date:______________
Title: Curator

Concurred by:____________________________________ Date:______________
Title: Superintendent

Figure 8.5. Sample Object Treatment Proposal (continued)

OBJECT TREATMENT REPORT

Owner:	National Park Service	**Park Name:**	Washington Support Office
Object:	Frock coat	**Catalog No:**	WASO1
Conservator:	Lesley Jones	**Date Proposed**:	October 24, 2011
Supervisor/COTR:	Bob Smith	**Treatment Time:**	73 hours

DESCRIPTION:
See Object Examination Report dated June 13, 2011.

CONDITION AND TREATMENT PROPOSAL:
See Object Treatment Proposal dated July 2, 2011.

TREATMENT:
Several small holes scattered across the surface of the coat, a result of insect damage, as well as the insect or rodent damage evident along the bottom edge of the coat in the center front, were repaired using patches of a compatible blue wool fabric placed behind the holes and secured with stitching using a thread pulled from Stabiltex, a polyester multifilament fabric. The buttons were cleaned and degreased with Stoddard solvent and a protective coating of microcrystalline wax was applied using cotton swabs. Stitching securing seams of the coat and lining that had failed in numerous areas was replaced using a thread pulled from Stabiltex. A custom mannequin was built on which to display the coat when on exhibit. Once the coat was fit on the mannequin, it was vacuumed using reduced suction.

The shoulder bars were removed from the coat and gently reshaped to better fit the shoulders of the coat. To prevent further damage to the coat, a Velcro hook was sewn to a support fabric and the fabric was sewn to shoulders of the coat with a black cotton thread, 3 S plied Z. A strip of Velcro fabric was sewn to the underside of the shoulder bars. The Velcro hook attaches to Velcro fabric securing the shoulder bars in place.

PHOTOGRAPHS:

Before:	Yes
During:	No
After:	Yes
Type Film:	High resolution TIFF files and 2x3 negative film

SUPPORTING DOCUMENTATION:
Fiber Analysis: No

Figure 8.6. Sample Object Treatment Report

Chapter 8: Conservation Treatment

RECOMMENDATIONS FOR SUBSEQUENT CARE:

DISPLAY REQUIREMENTS:

- Light levels should not exceed 30 lux (3 foot-candles) using a visitor activated lighting system.
- The coat should be inspected annually for signs of pest infestation.
- The coat should be micro vacuumed while on exhibit as required. Vacuuming frequency should be determined by inspecting the textile and noting the accumulation of dust inside the exhibit case.
- The coat should be rotated off display in 2 to 3 years and allowed to remain in storage for at least 5 years before being exhibited again.

POST EXHIBITION CARE:

The coat should remain in storage, in a dark, clean, stable environment for at least 5 years after rotation. See NPS *Museum Handbook* Part I, Appendix K (Curatorial Care of Textile Objects) for preventive conservation, handling and storage procedures.

Notes:

Fulled wool was a British specialty. After the cloth was woven, removed from the loom, and scoured to remove the oils used in the spinning process, fulling occurred to both felt the cloth and shrink it. Fulling was done in a fulling mill using wooden hammers or stocks to raise the nap. The cloth was first scoured with the slow motion of hammers, "leisurely without such violence as heats it much;"[1] fulling was then done with "quick heavy strokes which heat the cloth and shrink the fiber"[2] using an *aena*, a flat wooden implement set with spikes. In some cases the woven cloth was burled before being fulled but after being scoured. Fuller's earth in soft water was used as a detergent in the scouring process; if Fuller's earth was not available, sig (stale urine) or swine's dung was employed instead. The scouring agent needed to be alkaline; sig provided a natural source of ammonia.

The main problem in fulling was ensuring that the textile shrank evenly. "Fine medley broadcloth made in the early eighteenth century shrank less than half its width and one-third its length." Shrinkage was proportional to the texture of the cloth and the length of the fulling process; the thinner the cloth, the less the shrinkage. Well-woven Wiltshire medleys of the eighteenth century could be finished in nine hours; the process was lengthened considerably for badly woven cloth. The degree of fulling varied by location —Gloucestershire cloth tended to be more heavily fulled.

Cloth was easily damaged during the fulling process. After emerging from the fulling mill, the cloth was hung on tenters to dry; the tenters served to stretch the wet fabric. The fulling process sometimes left the sides of the cloth longer than the middle section. Gloucestershire led in the mechanization of scouring; Wiltshire led in the mechanization of fulling. The first patent for a fulling machine was obtained in 1833; by the mid-19th century the fulling process was fully mechanized.

[1] Jenkins, J. Geraint ed. *The Wool Textile Industry in Great Britain*. London: Routledge & Kegan Paul, 1972.
[2] Mann, J. de L. *The Cloth Industry in the West of England from 1640 to 1880*. Oxford: Clarendon Press, 1971.

Figure 8.6. Sample Object Treatment Report (continued)

Chapter 9: Museum Fire Protection

Page

NPS Museum Fire Protection Overview

NPS Museum Fire Protection Overview

NPS Museum Fire Protection Standards
Install automatic fire detection and alarm systems ***and*** automatic fire sprinkler and/or suppression systems in structures housing collections ***or*** consolidate collections in structures protected with automatic fire detection and alarm systems ***and*** automatic fire sprinkler and/or suppression systems ***or*** document the superintendent's decision not to install these systems or consolidate collections in writing in accordance with NPS Museum Fire Protection Standard (1). Develop and implement a Museum Fire Section of the park Structural Fire Management Plan. Conduct regular self-assessments for fire risk and include corrective actions in the Museum Mitigation Action Plan to remove or reduce fire hazards and vulnerabilities. Store collections in a dedicated storage space, implement no smoking and hot work policies, house paper accession (and deaccession) book and folders in locking UL listed 350°F one-hour fire-resistive insulated filing cabinet, safe, or vault when not in use and store cellulose nitrate-based materials in accordance with fire safety guidelines.
Fire Risk Assessment
Complete the NPS Checklist for Preservation and Protection of Museum Collections and update every five years, as well as the Museum Risk Assessment Worksheet. Arrange for a Life Safety and Fire Protection Risk Assessment of structures housing collections, to be conducted by a professional fire protection engineer. Develop and implement a Museum Mitigation Action Plan to remove or reduce fire hazards to collections and structures housing collections in collaboration with the Park Structural Fire Coordinator (PSFC), facility manager, Fire Code Official (FCO) or Regional Structural Fire Marshal (RSFM), and interdisciplinary team. Review the plan annually and update every five years.
Determining Museum Automatic Fire Protection Needs
Determine museum automatic fire protection needs in consultation with the PSFC, FCO or RSFM, regional curator, and interdisciplinary team. Work with the facility manager to develop FMSS work orders, PMIS statements, and funding requests for automatic museum fire protection systems. Identify special fire protection considerations for collections and structures housing collections in consultation with the local fire department.
Fire-Safe Practices and Design
Store museum collections in a dedicated storage space with automatic fire protection systems and appropriate fire-rated assemblies. Containerize collections in well-sealed steel cabinets and mobile compact storage systems. Use fire-resistant materials in structures and in spaces housing collections. Implement fire-safe practices in storage and on exhibit, no smoking and hot work policies, and open flame guidance in structures housing collections. Store the accession book, cellulose nitrate-based materials, and flammable and combustible materials in accordance with fire safety guidelines. Regularly maintain utilities, equipment and appliances.
Fire Protection Systems and Equipment
Work with the FCO or RSFM and interdisciplinary team to identify, design, select, and install automatic fire detection and alarm systems and automatic fire sprinkler and/or suppression systems in structures housing museum collections in accordance with NPS Museum Fire Protection Standard (1) (MHI 9.B.1.1). Inspect, test, and maintain automatic fire detection and alarm systems, automatic fire sprinkler and/or suppression systems, and portable fire extinguishers regularly.
Museum Fire Section of the Park Structural Fire Management Plan
Develop and implement a Museum Fire Section of the park Structural Fire Management Plan (SFMP) in consultation with the PSFC and facility manager. Review annually and update every five years. Restrict distribution of sensitive object information and floor plans in the Museum Fire Section of the park SFMP.
Fire Emergency Response and Salvage
Implement fire Emergency Response Steps. Implement salvage procedures after the fire scene is cleared for entry.
Training, Drills, and Documentation
Conduct regular fire drills and ensure staff complete annual fire extinguisher training. Document all museum fire protection activities.

CHAPTER 9: MUSEUM FIRE PROTECTION

A. Overview

Fire is a major threat to museum collections. It can destroy or irreparably damage irreplaceable collections and structures housing collections within minutes. Effective fire protection includes prevention, detection, and suppression of fire to prevent ignition and fire spread. Implementation of museum fire prevention and protection policies and plans, fire-safe practices and design, and the installation of automatic museum fire protection systems and portable fire extinguishers are critical to life safety and the protection of collections and structures housing collections.

1. What is included in this chapter?

This chapter covers museum fire planning and protection for collections and structures and spaces housing collections. It includes (in order of appearance in the chapter):

- *National Park Service (NPS) Museum Fire Protection Standards*
  Section B: NPS Museum Fire Protection Standards and Policies
- *Risk assessments* to identify fire hazards and vulnerabilities
  Section C: Fire Risk Assessment
- *Museum Mitigation Action Plan* that includes corrective actions implemented to remove or reduce fire hazards and vulnerabilities
  Section C: Fire Risk Assessment
- *Determining museum automatic fire protection needs*
  Section D: Determining Museum Automatic Fire Protection Needs
- *Fire-safe practices and design*
  See Section E: Fire-Safe Practices and Design
- *Overview of automatic fire detection and suppression systems and equipment*, including inspection, testing, and maintenance
  Section F: Fire Protection Systems and Equipment
- *Overview of portable fire extinguishers*
  Section F: Fire Protection Systems and Equipment
- *Sample Museum Fire Section* of the park Structural Fire Management Plan
  Section G: Museum Fire Section of the Park Structural Fire Management Plan and Figure 9.4: Sample Museum Fire Section of a Park Structural Fire Management Plan
- *Fire Emergency Response Steps and salvage procedures*
  Section H: Fire Emergency Response and Salvage and Figure 9.9: Fire Emergency Response Steps
- *Training, drills, and documentation* for museum fire protection
  Section I: Training, Drills, and Documentation
- *Figures and templates* for customization by parks

This chapter does not address fire prevention, protection and suppression in laboratories and exhibit preparation areas. Wildland fires in parks are noted only in relation to structures housing collections. See RM-18: Wildland Fire Management for additional information.

Figure 9.1: Museum Fire Protection Cycle below provides a visual representation of the museum fire planning and protection process, including prevention, detection and suppression, and emergency response and salvage steps.

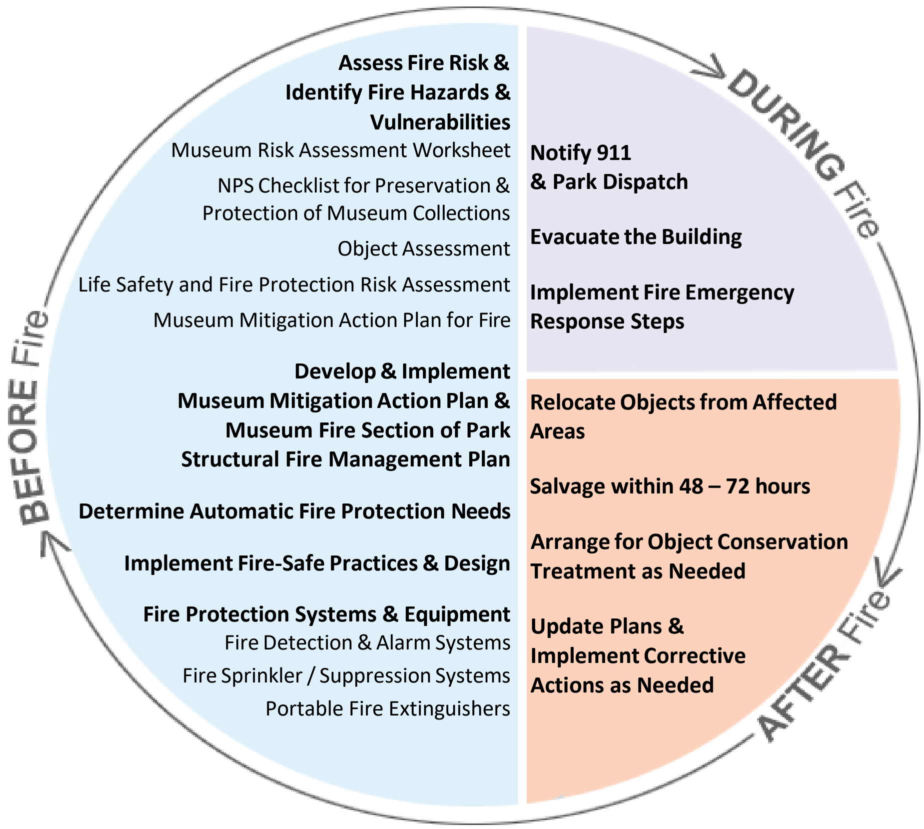

Figure 9.1 Museum Fire Protection Cycle

2. What terms are used in this chapter?

In this chapter:

- *Automatic fire protection system* refers to:

  – *automatic fire detection* (smoke and heat detectors) *and alarm systems*

  and

  – *automatic fire sprinkler systems* (water-based)

  and/or

  – *automatic fire suppression systems* (gaseous or “clean agent” based)

- *Portable fire extinguishers* (“fire extinguishers” or PFEs) refers to manually-operated devices (dry chemical or water-based) that are used to control small fires. They are used *with* automatic fire protection systems; they *are not* a substitute for automatic fire protection systems.

- *Structures housing collections* refers to museums, museum storage facilities, centers, furnished historic structures, spaces within buildings, visitor centers, and administrative offices housing collections.

- *Housing* refers to storing and/or exhibiting collections.

- *Collections* refer to museum objects, specimens, and associated records, archival items, paper and electronic museum records, and digital collection images.

- *Open flame* refers to lit candles, lanterns, fires in open fireplaces and hearths, lit matches, lighters, and smoldering dry materials.

See Section L: Glossary.

3. *Who is responsible for museum fire protection?*

All National Park Service staff are responsible for preventing fire, including permanent and seasonal employees, volunteers, interns, concessionaires, and partner and friends groups.

The *superintendent* or center chief has overall responsibility for preserving and protecting the park’s museum collection, including fire protection. The *curator*, as designated custodial officer, is directly responsible for the physical care of, and has day-to-day on-site responsibility for the museum collection and its fire protection needs. In this chapter, “curator” refers to the museum curator or collateral duty staff designated as responsible for the collection.

As designated by the superintendent, the *Park Structural Fire Coordinator (PSFC)* is responsible for implementing Director’s Order (DO) 58: Structural Fire Management, Reference Manual (RM) 58: Structural Fire Management, and the Park’s Structural Fire Management Plan (SFMP).

The *Fire Code Official (FCO)* is the fire and life safety technical resource responsible for enforcing nationally recognized fire codes. The FCO may also be called the Authority Having Jurisdiction (AHJ). The FCO is usually the *Regional Structural Fire Marshal (RSFM*, formerly Regional Structural Fire Manager*)*, and is referred to as “FCO or RSFM” in this chapter. The FCO or RSFM arranges for the completion of a Life Safety and Fire Protection Risk Assessment that should include collections and structures housing collections at each park.

The park *facility manager* works with the PSFC, FCO or RSFM, and curator to implement the Museum Mitigation Action Plan, work on funding requests, and arrange for the installation, maintenance and inventory of automatic fire protection systems for structures housing collections.

The *interdisciplinary team* for museum fire protection includes the curator, FCO or RSFM, PSFC, park facility manager, park wildland Fire Management Officer, chief of cultural resources, park Physical Security Coordinator, and the regional curator, historical architect advisor, cultural landscape specialist, conservator, and other specialists as needed. The interdisciplinary team should meet regularly to discuss upcoming and ongoing projects, compliance, and related issues to ensure collaboration on fire protection activities.

4. What are the curator's responsibilities for museum fire protection?

The curator is responsible for working with the interdisciplinary team to:

- Develop and implement the following for fire protection:
  - Museum Risk Assessment Worksheet
    Figure 10.2
  - NPS Checklist for Preservation and Protection of Museum Collections
    Appendix F, Figure F.2, Section F: Fire
  - Museum Mitigation Action Plan
    Figure 10.3
  - First Priority Criteria for Object Relocation and Salvage
    Figure 10.20
  - Object Assessment
    Figure 9.3
  - Museum Fire Section of the park SFMP
    Figure 9.4
  - Fire Emergency Response Steps
    Figure 9.9
- Work with the PSFC and FCO or RSFM to:
  - include structures housing collections in the Life Safety and Fire Protection Risk Assessment conducted by a professional fire protection engineer
  - select, install, and maintain automatic fire detection and alarm systems and automatic fire sprinkler and/or suppression systems in structures housing collections in accordance with NPS Museum Fire Protection Standard (1) (*Museum Handbook* I, Chapter 9.B.1.1 [MHI 9.B.1.1]), in collaboration with the park facility manager
  - select appropriate portable fire extinguishers

Note: Collateral duty staff responsible for museum collections must work with the regional curator when selecting and installing automatic fire protection systems for collections.

5. *Can I work with other parks to develop a museum fire protection strategy?*

Yes. Parks with collateral duty staff responsible for museum collections or that are understaffed should work collaboratively with center and/or neighboring park staff with appropriate expertise and the regional office to develop and implement a museum fire protection strategy for the park. This includes fire risk assessment, planning, prevention, mitigation, response, and salvage.

6. *What are potential fire hazards to museum collections?*

Most structure fires are caused by human activity or carelessness. They can occur due to failure to correct one or more of the deficiencies and hazards listed below in Figure 9.2: Fire Hazards to Museum Collections.

Category	Specific Fire Hazard
Civil Disturbances and Crime	− Arson − Terrorist attack − Vandalism
Construction and/or Maintenance	− Poorly installed and/or maintained automatic fire detection and alarm, automatic fire sprinkler and/or suppression, HVAC, and electrical systems − Inappropriately modified fire detection and alarm systems and sprinkler and/or suppression systems − Use of High Density Polyethylene (HDPE) building materials − Careless hot work − Faulty or deteriorated electrical and mechanical systems, lighting, and installation − Improperly disposed chemicals − Deferred maintenance
Museum and Park Operations (Procedural)	− Absence of fire-safe practices and design − Smoking − Open flames in or near structures housing collections − Appliances left on, improperly used, or in poor condition − Inappropriately housed flammable liquids and hazardous collections
Emergency Incidents	− Earthquake − Hazardous materials spill, exposure, and explosion − Power outage − Severe weather, including lightning strike − Volcanic eruption − Wildland fire

Figure 9.2 Fire Hazards to Museum Collections

7. *What do I need to know about fire protection systems in furnished historic structures?*

Many historic structures are extremely vulnerable to fire due to their design, building materials and components. Without automatic fire protection, furnished historic structures and their contents are at serious risk of damage or total destruction from fire. Many furnished historic structures and the collections on exhibit in these structures are mission-critical. To protect collections *and* the historic structure, install and maintain an automatic fire detection and alarm system *and* an automatic fire sprinkler and/or suppression system in accordance with NPS Museum Fire Protection Standard (1.a) (MHI 9.B.1.1.a).

The curator should work with the regional curator, historical architect advisor, and FCO or RSFM to ensure that the selection and installation of minimally invasive automatic museum fire protection systems respects the character defining features of the structure. Installation of these systems in furnished historic structures must be in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties, Section 106 of the National Historic Preservation Act of 1966, and the Programmatic Agreement with the National Council of State Historic Preservation Officers (NCSHPO).

8. What sources of assistance are available?

Consult the PSFC, FCO or RSFM, and regional curator for assistance and information on fire risk assessment, planning, prevention, mitigation, automatic fire detection, suppression, and safety self-inspections. Other contacts include:

- NPS Structural Fire Program, National Interagency Fire Center (NIFC), Boise, ID.
- NPS, Department of the Interior (DOI), and contract structural fire protection professionals.
- Regional, county, and state fire marshal's offices and fire prevention bureaus.
- Museum fire specialists.

See NPS Structural Fire subject page.

B. NPS Museum Fire Protection Standards and Policies

National Park Service standards and policies included below form the basis of the park's museum fire protection program and apply to collections housed in NPS and non-NPS structures and repositories.

1. NPS Museum Fire Protection Standards

Implement the following NPS Museum Fire Protection Standards in structures housing collections.

1. (a) Install automatic fire detection and alarm systems *and* automatic fire sprinkler and/or suppression systems in all purpose-built and adapted structures and spaces housing or exhibiting museum collections as approved by the FCO or RSFM in consultation with the park or regional museum curator and interdisciplinary team. In furnished historic structures, select and install automatic fire detection and alarm systems *and* automatic fire sprinkler and/or suppression systems as approved by the FCO or RSFM in consultation with park and regional facilities management staff, the historical architect advisor, and the park or regional museum curator.
   or
   (b) Consolidate collections in structures protected with

automatic fire detection and alarm systems *and* automatic fire sprinkler and/or suppression systems.
or
(c) The decision not to use these systems must be made by the superintendent or delegate in consultation with the FCO or RSFM, park curator, regional curator, and historical architect advisor as appropriate, using information from Figure 9.3: Object Assessment, and the Museum Collections Assessment Matrix and Historic Structure Fire Protection System Assessment Matrix in RM- 58 Appendix B.

This decision must be documented in writing using Figure 9.3a: Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collections. Copies of the documents noted in NPS Museum Fire Protection Standard (1.c) must be distributed to the FCO or RSFM, regional director, regional curator, the park central and museum files, and the historical architect advisor if appropriate.

2. Develop and implement a Museum Fire Section as part of the park Structural Fire Management Plan (SFMP) with procedures to prevent, detect, and suppress fires. Review annually and update the Museum Fire Section every five years and after a structure fire incident, addition of a new or renovated structure to house collections, new exhibit installation, or change in curator.

3. Conduct regular self-assessments for fire risk, including the NPS Checklist for Preservation and Protection of Museum Collections, and have a professional fire protection engineer complete a Life Safety and Fire Protection Risk Assessment for structures housing museum collections.

4. Include and implement corrective actions to remove, reduce, and/or mitigate fire hazards and vulnerabilities in the Museum Mitigation Action Plan.

5. House museum collections in a dedicated storage space separated from the curatorial office, research and work areas, and supply storage areas.

   House collections in spaces separated (compartmented) by appropriate fire-rated assemblies in purpose-built and adapted structures and spaces, and separate functions to the extent possible in furnished historic structures.

6. Prohibit smoking in or within 25 feet of structures and spaces housing collections.

7. House the paper accession (and deaccession) book and folders in a locking UL listed 350°F one-hour fire-resistive insulated filing cabinet, safe, or vault when not in use. House

electronic museum records, backups, and other media files in a UL listed 125°F one-hour fire resistive media safe or box.

8. Store cellulose nitrate-based materials in accordance with fire safety guidelines and Director's Order 24.4.3.23: Cellulose Nitrate and Cellulose Ester Film.

9. Require a Hot Work Permit (HW-1) for hot work in spaces housing collections. Protect collections or move to a secure location during hot work.

2. DOI Museum Property Directive #4: Required Standards for Managing and Preserving Museum Property

1.8 Fire Protection Standards. "Equipment and/or systems must be installed to detect and suppress fire in storage and exhibit spaces that house museum collections. General requirements are to:
A. Address in a fire plan the needs of museum collections, including objects and archives, when fire is being prevented, detected, and/or suppressed.
B. Select systems appropriate to the nature of the museum collections in the space and for the structure in which the objects are housed.
C. Make spaces that house museum collections fire-resistant to the extent possible.
D. Store museum records, including records in electronic format, in appropriate fire resistant containers, vaults, or secure off-site facilities, and keep the containers secured when not in use.
E. Prohibit flammable liquids in any area that houses museum collections, except where flammable liquid is a component of the museum object such as natural history specimens stored in jars containing alcohol."

3. NPS Management Policies

5.3.1.2 Fire Detection, Suppression, and Post-fire Rehabilitation and Protection: "…Smoking will not be permitted in spaces housing museum or library collections or in historic structures…"

9.1.8 Structural Fire Protection and Suppression: "Fire prevention, protection, and suppression will be primary considerations in the design, construction, rehabilitation, maintenance, and operation of all facilities. Structural fires will be suppressed to prevent the loss of human life and minimize damage to property and resources…
Each superintendent will complete a structural fire assessment and develop a structural fire plan to meet park needs…Prevention priorities will focus on occupied structures and cultural resources, …code compliance, early warning detection, suppression systems, and employee training…
Fire prevention through code-compliant new construction, upgrading of existing structures, ...scheduled fire inspections, and properly installed and maintained detection and suppression systems will be the primary means of addressing…deficiencies…"

9.4.2 Museum Collections Management Facilities: "...Curatorial facilities will meet each collection's special requirements for security, fire suppression, and environmental controls…"

4. *NPS Director's Orders (DO)*

DO 24: NPS Museum Collections Management:
4.3.10: Emergency Operation: "Approve, keep current, and implement a Museum Collections Emergency Operations Plan, as part of the park's Emergency Operations Plan… identifying museum collection vulnerabilities to events (such as fire…) and responses that will protect resources without endangering human health and safety…"

DO 50D: Smoking Policy:
4.1.1: "[S]moking is prohibited…[w]ithin 25 feet of any entrance or exit …where smoking would result in smoke traveling through doorways, windows, air ducts or other openings."

DO 58: Structural Fire Management:
5.C: Procedures
"5. Each superintendent will ensure the completion of a comprehensive Life Safety and Fire Protection Risk Assessment on park buildings in accordance with the requirements of RM-58…

6.A: Fire Prevention
"3. All fire protection systems will have inspection, testing, and maintenance (ITM) performed at least once a year, as required by RM-58, ensuring they are fully operational. More frequent ITM is required for some occupancies and systems."

6.B: Planning
"1. Each superintendent will complete a Structural Fire Management Plan (SFMP) in accordance with guidelines and procedures outlined in RM-58…"

6.E: Natural and Cultural Resources
"2. Automatic detection and suppression systems, based on codes, standards, Director's Order #24: NPS Museum Collections Management, and the NPS Museum Handbook, Part I, Chapter 9: Museum Fire Protection, will be installed, inspected, and maintained in buildings storing or exhibiting collections. Exceptions must be documented by the superintendent in writing and only after consultation with the FCO and regional museum curator…"

5. *NPS-28: Cultural Resource Management Guideline*

NPS-28: Cultural Resource Management Guideline
Chapter 4.D.1: Structural Fire: "A structural fire plan treating prevention, detection, and suppression, including special procedures for fighting fire in historic structures and structures housing museum property, is required for each park…"

Chapter 9.B.3.b: Cataloging: "All paper museum records (e.g., accession book, accession file, catalog records) are kept in a locking, insulated file. Magnetic media (e.g., disks, tapes) that back up (ICMS) data files and other collection data files are stored in an appropriately rated container (e.g., media safe, media file, mixed media file, media box)."

6. *NPS Reference Manual 58: Structural Fire*

NPS Reference Manual 58: Structural Fire (RM-58) provides guidance on implementing structural fire management policy for the National Park Service, including performance-based design solutions for historic structures and spaces housing collections.

See RM 58 Chapter 2: Community Risk Reduction and Code Compliance, Chapter 2.22: Fire Protection for Historic Structures & Buildings Storing/Exhibiting Museum Collections, and Appendix B: Historic Structure Fire Protection System Assessment Matrix.

7. *National Fire Protection Association (NFPA) and nationally recognized fire codes*

Fire and life safety inspections, building construction, inspection, testing, and maintenance of fire protection systems, and other fire code compliance issues are based on applicable codes. These include NFPA 909: *Code for the Protection of Cultural Resource Properties – Museums, Libraries, and Places of Worship* and NFPA 914: *Code for Fire Protection of Historic Structures*, and the International Fire Code, as described in DO 58 and RM-58.

See Section J: Selected Bibliography for a list of specific nationally recognized fire codes for protecting structures and life safety.

C. Fire Risk Assessment

1. *What is risk assessment?*

Risk assessment identifies possible ways losses can occur by analyzing the severity of an event, its probability of occurrence, and exposure to hazards and vulnerabilities. Risk assessment for fire involves:

- Identifying fire hazards and vulnerabilities, including which structures and objects are most likely to be lost or damaged by fire.

- Evaluating the likelihood of fire damage due to the:

  - composition and condition of the collection (such as wet or fluid-preserved specimens or high fuel load items)
  - nature and/or condition of structures housing the collections (such as wood or plaster)
  - condition of mechanical and electrical systems
  - presence or absence and condition of functioning automatic fire detection and alarm systems
  - presence or absence and condition of functioning automatic fire sprinkler and/or suppression systems
  - location within the wildland-urban interface
  - availability of water supply and ability of the fire department to quickly arrive at and control the fire

See Question E.22: Wildland fire protection and Chapter 10.B.1: What is risk assessment?

2. *Which fire risk assessment tools do I use to identify fire hazards and vulnerabilities?*

The curator should conduct self-assessments to identify deficiencies, hazards, and vulnerabilities in the collection and structures housing collections, in consultation with a structural fire protection professional and the facility manager. These include:

- ***Museum Risk Assessment Worksheet*** with a focus on the threats from fire (Chapter 10: Emergency Planning, Figure 10.2) should be completed by the curator every five years, or after a significant fire event, construction or renovation, large new acquisition(s), installation of a new exhibit, or change in the curator. It should be reviewed annually. This is a fillable worksheet.

- ***NPS Checklist for Preservation and Protection of Museum Collections*** (Appendix F, Figure F.2), reviewed and submitted to the National Catalog annually in accordance with DO 24.5.2: Checklist and updated every five years in accordance with DOI Museum Property Directive 14.1.5.B: *Facility Checklist for Spaces Housing DOI Museum Property*.

- ***Object Assessment*** (Figure 9.3) should be completed to support the decision to install automatic museum fire protection systems or relocate "first priority" objects (see Figure 10.20: First Priority Criteria for Object Relocation and Salvage) to a safe separate space where these systems are installed. This is a fillable form. The Object Assessment is used together with the Museum Collections Assessment Matrix and Historic Structure Fire Protection System Assessment Matrix in RM-58 Appendix B.

3. *What is the Life Safety and Fire Protection Risk Assessment?*

The ***Life Safety and Fire Protection Risk Assessment*** (formerly Fire Protection Condition Assessment or FPCA) is a risk-based inspection of fire and life safety systems and processes for buildings, including structures housing collections. It is conducted by a professional fire protection engineer to document code compliance of buildings (structures) and risks to life safety, buildings, and contents, including collections. The superintendent is responsible for ensuring the Life Safety and Fire Protection Risk assessment is completed. Work with the FCO or RSFM to request a new or updated assessment if conditions have changed.

4. *What is included in the Statement of Work for a Life Safety and Fire Protection Risk Assessment?*

Work with the FCO or RSFM to develop a Statement of Work (SOW) to obtain a Life Safety and Fire Protection Risk Assessment for structures housing collections. The SOW should specifically address risks to collections and meet or include the following requirements:

- The assessment must be conducted by a registered professional fire protection engineer.

- Work must address the needs of the collections and structures housing collections.

- Complete Figure 9.6a: Attachment to the Life Safety and Fire Protection Risk Assessment Statement of Work: Questions Related to Museum Spaces.

- The professional fire protection engineer must work with the curator to incorporate Section B of the Object Assessment (Figure 9.3) in the final assessment report.

See Figure 9.6: Sample Statement of Work for a Life Safety and Fire Protection Risk Assessment.

5. What fire protection corrective actions should the Museum Mitigation Action Plan include?

The curator generates corrective actions for fire protection from deficiencies identified in the Checklist, Museum Risk Assessment Worksheet, and Life Safety and Fire Protection Risk Assessment for inclusion in the Museum Mitigation Action Plan. These corrective actions cover storage, exhibit, and work spaces in structures housing collections. The Museum Mitigation Action Plan is implemented in collaboration with the facility manager, PSFC, FCO or RSFM, Physical Security Coordinator, and regional curator. Work with the historical architect advisor when implementing fire prevention strategies, including performance-based design alternatives, in furnished historic structures.

Keep the Museum Mitigation Action Plan current, review annually, and update every five years and after a significant structure fire incident, addition of a new or renovated structure to house collections, new exhibit, or change in the curator. Group corrective actions by mitigation area. Prioritize as immediate, intermediate, or long-term. *Remember*: the museum fire protection plan is only effective when implemented.

See Question 10.C.1: What is the Museum Mitigation Action Plan?, Figure 10.3: Sample Museum Mitigation Action Plan, and RM-58.2.22: Fire and Life Safety Code Compliance for Historic Structures and Structures with Museum Collections.

D. Determining Museum Automatic Fire Protection Needs

1. How do I determine which structures housing collections should have automatic fire protection systems?

In consultation with the PSFC and FCO or RSFM, the curator evaluates information from Figure 9.3: Object Assessment and RM-58.2.22: Fire and Life Safety Code Compliance for Historic Structures and Structures with Museum Collections to:

- Determine in which structure(s) to install an automatic fire detection and alarm system and an automatic fire sprinkler and/or suppression system.

- Determine which automatic fire protection systems are appropriate to the nature of the collection and structures housing collections and the level of fire protection to be provided, including where recommendations may exceed code requirements.

- Design and install these automatic systems in structures housing collections.

The decision *not* to use these systems must be made by the superintendent or delegate in consultation with the FCO or RSFM, park curator, regional curator, and historical architect advisor as appropriate, using information from the Object Assessment. And the Museum Collections Assessment Matrix and Historic Structure Fire Protection System Assessment Matrix in RM-58 Appendix B. This decision must be documented in writing using the Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collections (Figure 9.3a). Distribute a copy of these documents to the FCO or RSFM, regional director, regional curator, the park central and museum files, and the historical architect advisor if appropriate.

2. What information is needed to determine automatic fire protection system needs and who generates this information?

The curator, PSFC or specialist, and the facility manager, in consultation with the interdisciplinary team, are responsible for generating information and completing the documents noted below to determine automatic fire protection system needs for collections and structures housing collections.

The *curator* completes the Museum Risk Assessment Worksheet (Figure 10.2), NPS Checklist for Preservation and Protection of Museum Collections, Section F: Fire Protection (Appendix F, Figure F.2), and Object Assessment (Figure 9.3).

The *professional fire protection engineer* completes the Life Safety and Fire Protection Risk Assessment.

The *PSFC or specialist*:

- Provides fire protection system condition information from the Life Safety and Fire Protection Risk Assessment and recommendations for fire protection in structures housing collections.

- Completes the following in RM-58 Appendix B when alternative performance-based design solutions for furnished historic structures are needed:

  - Museum Collections Assessment Matrix
  - Historic Structure Fire Protection System Assessment Matrix, where appropriate

The *facility manager*:

- Generates information on:

  - availability of sufficient physical resources such as power and water
  - availability of back-up generators
  - existing systems and controls in structures housing collections, including HVAC systems
  - facility operations and maintenance funding, including life-cycle costs

- Develops FMSS work orders and PMIS statements to install, upgrade, maintain, and/or replace automatic fire protection system equipment to protect collections and structures housing collections.

3. How is museum fire protection mitigation funded?

Work with the facility manager, PSFC, the Contracting Officer's Representative (COR), regional curator, and regional fee and business office to obtain funding for museum fire protection mitigation projects. Sources of funding include cyclic maintenance, equipment replacement, repair and rehabilitation (RERE), the recreation fee program, and other sources.

Information obtained from all risk assessments, and the Museum Mitigation Action Plan is used to generate a *work order* for installation of automatic fire protection systems using the *Facility Management Software System (FMSS)*. Work with the facility manager and PSFC to ensure that all *location information* in FMSS for structures housing collections is up-to-date and accurate.

FMSS work orders are entered into the *Project Management Information System (PMIS)* to request and obtain funding for the installation of automatic fire protection systems.

4. What special considerations should be addressed with the local fire department?

The local fire department is generally best equipped to respond to fires that impact collections. The curator should collaborate with the PSFC to establish a relationship with the local fire department or equivalent organization to inform them of the special needs of collections, structures housing collections, and furnished historic structures when fighting fires.

Work with the PSFC to ensure the local fire department has the expertise, equipment, and/or staffing to meet museum fire protection needs and take the actions noted below.

- Establish a formal or informal agreement for mutual cooperation with the primary local fire department to provide fire protection for each structure housing collections. Formal agreements include Memoranda of Agreement (MOA) and Memoranda of Understanding (MOU) that include language from Figure 9.5: Sample Museum Fire Protection Language for Inclusion in a Memorandum of Understanding between a Park and a Fire Company.

- The local fire department should develop a pre-fire plan outlining the department's fire response procedures for each structure housing collections that includes:

  - minimum response time
  - minimum staffing level
  - level of coverage (day, night, weekend)
  - rapid entry alternatives
  - utility shutoff locations
  - equipment and training needed to fight fires involving collections and structures housing collections, including furnished historic structures
  - procedures for contacting the next-closest provider if unavailable

- Tour fire department members through collections storage, work, and exhibit areas, including furnished historic structures, and:

  - discuss the use of fire hoses and other suppression activities to prevent damage to collections
  - identify access points to avoid damaging character defining features of historic structures housing collections
  - indicate which collections need to be protected in place
  - conduct annual orientation training
  - identify potentially hazardous or flammable collections and non-collection materials

- Provide the fire department with pertinent sections of the Museum Fire Section and floor plans of structures housing collections, including locations of:

  - access routes
  - utility shut offs, including sprinkler shut-off valves and alarm system annunciator panels
  - utility risers
  - sensitive or hazardous objects or areas such as wet specimen storage and/or hazardous non-collection materials

- The local fire department is responsible for requesting additional assistance as needed.

E. Fire-Safe Practices and Design

Fire-safe practices and design in storage, work, and exhibit spaces are critical to preventing ignition and the spread of fire. Work with the PSFC, FCO or RSFM, facility manager, interdisciplinary team, regional curator, and a fire specialist, to implement fire safe practices, design, and operational procedures to remove, reduce, or mitigate fire hazards and vulnerabilities.

1. *Fire-safe collections care in storage*

Best practices in collection storage and workspaces minimize fire risk. They are essential to life safety and collections protection. Implement best practices described in this *Handbook* and:

- House collections in dedicated storage spaces with automatic fire protection systems.

- Perform collections processing and preparation separately from collections storage areas.

- Store collections in:

  - well-sealed locking steel cabinets that are closed and secured after use and at the end of each day
  - cabinets and shelving no closer than 18 inches from sprinkler head deflectors
  - cabinets and shelving raised 4 – 6 inches off the floor
  - appropriate containers for works on paper and archival items

- Store oversized objects off the floor.

- Practice good housekeeping and:

  - keep storage areas housing collections free of clutter
  - maintain clean and organized storage and work spaces
  - empty trash receptacles daily
  - keep equipment vents, electrical outlets and wiring, and pipes unobstructed
  - keep portable fire extinguishers unobstructed
  - keep doors and windows closed

- Store collections away from vents or flammable and combustible chemicals.

- Close and store containers of chemicals such as alcohol or Paraloid™ B-72 used in collections preparation after use.

- House non-collections storage materials such as boxes, paper, and packing materials separately from collections.

2. *Mobile compact storage system fire safety*

Mobile compact storage systems (compactors) eliminate fixed aisles and expand a room's storage capacity by as much as 40%. These systems may be manually (mechanically) or electronically operated. The high density of objects stored in compactor carriages increases the fuel load and requires specialized fire protection design considerations. Be aware that wiring in electronically operated systems may pose an increased risk of ignition from sparking.

Provide openings between carriages when the system is closed and not in use to increase the capability to detect and suppress fire. Be aware that these spaces increase exposure to agents of deterioration and reduce the space savings these systems provide. Consult with a qualified structural fire protection engineer experienced with collections and the regional curator when designing and installing automatic fire protection systems in spaces with compactors.

Take the following fire safety precautions when designing and installing a mobile compact storage system:

- Fully enclose carriages, including solid steel tops, backs, and longitudinal and transverse dividers to slow fire spread.

- Provide openings of a minimum of four inches between carriages to allow for penetration by sprinkler or suppression systems when the compactor is not in use and:

    - design openings in the footprint for new systems
    - use bumpers to provide openings for existing and new systems

- Base automatic fire protection system capacity to effectively detect and suppress fire on:

    - composition of objects (paper, wood, baskets, wet specimens, etc.)
    - density of objects stored in the system
    - carriage height
    - system type (manually or electronically operated)

- Include the following automatic fire protection systems:

    - Very Early Warning Smoke Detection Apparatus (VESDA) detection system
    - quick response wet pipe or single-interlock pre-action sprinkler system

- Space sprinkler heads with sufficient density and set to open at an appropriate temperature as designed by a fire protection professional with concurrence from the FCO or RSFM.

- Ensure carriage tops are not closer than 18 inches from sprinkler head deflectors.

- Do not store anything on top of the carriages. Post a sign in the space stating "No storage on the top of the unit" in accordance with nationally recognized fire codes.

3. No smoking policy

In accordance with NPS Management Policies (2006) 5.3.1.2, "Smoking will not be permitted in spaces housing museum or library collections…"

- Prohibit smoking:

  - within structures housing collections
  - within 25 feet of the entrance to the building
  - in front of or near air intake ducts
  - in exterior spaces adjacent to structures housing collections

- Post "No Smoking" signs at entrances to structures housing collections.

- Provide appropriate receptacles for the disposal of discarded tobacco materials at all approved smoking areas.

See 310 DM 11: Smoking in Public Buildings, DO 50D: Smoking Policy, and Executive Order 13058: Protecting Federal Employees and the Public from Exposure to Tobacco Smoke in the Federal Workplace.

4. Open flame guidance

Open flames include lit candles, lanterns, fires in open fireplaces and hearths, and lit matches, lighters, and smoldering of dry materials. Open flames used in and immediately adjacent to structures or spaces housing collections pose an extreme fire risk.

DO NOT use open flames in structures housing collections to avoid the risk of fire.

- Conduct all activities using open flames outside structures housing collections and:

  - have park staff monitor open flames at all times
  - arrange for a portable fire extinguisher at the site of any open flame activity adjacent to structures and spaces housing collections

- ***Do not*** use open flames in historic structures housing collections, including fireplaces.

- Perform demonstrations such as cooking or blacksmithing well away from structures housing collections.

- Use fire-safe alternatives such as battery-operated flameless

LED candles and lanterns for events that take place in structures housing collections.

Select fire-safe alternates in consultation with the curator, facility manager, FCO or RSFM, and interpretation and education staff. Be aware that certain flameless fireplace logs emit heat and are potential fire risks.

The lighting or burning of smoldering plant materials in activities such as smudging presents a major fire risk to collections and structures housing collections. Conduct all smudging activities in a designated space outside of and away from structures housing collections to avoid the risk of fire. Discuss smudging requests and fire-safe alternatives with tribal representatives, in consultation with the PSFC and regional curator.

See Question E.16: Hot work procedures.

5. Consolidating collections

If collections are to be consolidated in accordance with NPS Museum Fire Standard (1.b) (MHI 9.B.1.1.b), *then* an automatic fire detection and alarm system and automatic fire sprinkler and/or suppression system must be installed in the designated structure. This structure or facility may be housed elsewhere in the park or at a nearby park, center, or repository, and must meet fire protection and life safety standards.

6. Housing flammable and combustible materials

Flammable and combustible materials are found in a variety of sources including wet (fluid-preserved) specimens, specimen preparation, including casting and modeling materials, and housekeeping and building maintenance materials. Flammable liquids such as ethanol and isopropyl alcohol have a flash point below 100°F. Combustible liquids, such as formalin, have a flash point at or above 100°F. Ventilation is needed to prevent the accumulation and ignition of fumes from these materials.

Work closely with the FCO or RSFM, PSFC, fire specialist, facility manager, and regional curator to:

- Install and maintain an automatic fire detection and alarm system, automatic fire sprinkler and/or suppression system, and portable fire extinguishers appropriate for suppressing a flammable liquids fire (Class B fire) in structures housing flammable and combustible materials.

- Determine appropriate fire rated assemblies, ventilation, run-off control procedures, and other requirements for structures housing flammable and combustible liquids in accordance with nationally recognized fire codes adopted by DO 58 and RM-58.

- Store bulk chemicals used in specimen preparation separately from collections in accordance with nationally recognized fire codes and:

  - house in flammable liquid storage cabinets of appropriate size and rating
  - label cabinets housing flammable and combustible liquids
  - do not exceed the capacities for individual chemical storage drums and other containers
  - regularly dispose of hazardous waste

- House small arms ammunition in accordance with Appendix G: Museum Firearms, Small Arms Ammunition, Munitions, and Artillery.

- Maintain an inventory of flammable, combustible, and hazardous materials and their safety data sheets (SDS).

7. Housing wet (fluid-preserved) specimens

When housing wet or fluid-preserved specimens, follow guidance in Question 6: Housing flammable and combustible materials, and work closely with a fire specialist, the FCO or RSFM, PSFC, and regional curator to:

- House wet specimens separated from other collections in:

  - well-sealed steel cabinets for a small volume of wet specimens
  - containers or jars with seals that are sufficiently tight to prevent the escape of flammable or combustible liquids and/or vapors
  - for a large volume of wet specimens, store separately in a space with a separate ventilation system

- Label rooms and spaces housing wet specimens.

- Identify wet specimen storage areas in the Museum Fire Section of the SFMP, including floor plans.

Note: NFPA 30 (2015).9.5.4: Flammable Liquids Storage Cabinets states: "Storage cabinets shall not be required by this code to be ventilated for fire protection purposes" and NFPA 30 (2015).9.5.4.1 states: "If a storage cabinet is not ventilated, the vent openings shall be sealed with the bungs supplied with the cabinet or with bungs specified by the cabinet manufacturer."

See Appendix Q.D.15: What problems may occur with fluid-preserved specimens?, Appendix T.IV.D.3: Are there any special considerations for storing wet specimens? And T.IV.E.3: How are fluids lost or compromised?, and *COG*s 2/18: Safe Storage And Handling Of Natural History Specimens Preserved In Fluid and 11/3: Storage Concerns For Fluid-Preserved Collections.

8. Cellulose nitrate-based materials

Cellulose nitrate-based materials are an explosion threat to collections and deteriorated cellulose nitrate-based materials are highly flammable. See Appendix M: Management of Cellulose

Nitrate and Ester Film and DO 24.4.3.23: Cellulose Nitrate and Cellulose Ester Film for information on how to handle and/or dispose of cellulose nitrate-based materials.

If there is cellulose nitrate remaining in the collection:

- Copy and inspect nitrate-based materials, and do not store in parks for longer than it takes to copy. Store in a facility with appropriate flammable materials storage freezer capability until copies are made.

- Isolate cellulose nitrate- based materials from the rest of the collection to prevent damage from off-gassing, preferably in off-site cold storage.

- If nitrate-based materials are to be stored in the park, place flammable materials storage freezers in properly vented spaces with appropriate warning labels and:

  - establish a temperature threshold for environmental alarms and have freezers monitored 24/7 by a monitoring station
  - ensure that the weight of nitrate negatives (minus packaging) in the freezer is below mandatory limits
  - ensure back-up power is available

- Work with a structural fire protection engineer and the FCO or RSFM to ensure that automatic fire protection systems and construction, including appropriate fire-rated walls, are adequate for the amount of cellulose nitrate-based materials housed in accordance with RM-58.2 and NFPA 40: *Standard for the Storage and Handling of Cellulose Nitrate Film*.

See *COG*s 2/20: Handling and Shipping of Cellulose Nitrate Film and 14/8: Caring for Cellulose Nitrate Film.

9. Housing the accession (and deaccession) book and folders

House the accession book and folders and the optional deaccession book and folders in a secure room in an insulated UL listed fire-resistive filing cabinet or vault that is locked when not in use, in accordance with NPS Museum Fire Protection Standard (7) (MHI 9.B.1.7).

- For *paper records*, use an insulated filing cabinet, safe, or vault with a UL listing of (350°F 1-hour).

- For *electronic museum records, backups, and other media files*, house in an insulated media safe or box with a UL listing of (125°F 1-hour).

- Make museum quality photocopies and digital scans of the accession (and deaccession) book and documents and store in a different location from the original and off-site. Deposit the photocopies and electronic copies with the regional curator.

- Maintain up-to-date electronic museum records and other media files, and create regular electronic backups. Maintain a current copy of the backup in a secure off-site location.

See NPS-28: Cultural Resource Management Guideline 9.B.3.b: Cataloging and *Museum Handbook* Part II Chapter 2.U.3: Should I store the accession book in a special place?

10. Fire prevention for objects on exhibit

Minimize the risk of fire in exhibit areas, including visitor centers, museums, and furnished historic structures by implementing best practices described in this *Handbook* and:

- Ensure exhibit cases are not closer than 18 inches from sprinkler head deflectors.

- Work with facilities management to ensure that the HVAC intake for exhibit spaces is separated from intakes for other spaces in the structure to minimize spread of fire and/or smoke.

- Use fire-resistant and/or noncombustible materials for:

  - exhibit cases and platforms
  - interior finishes and flooring
  - seating areas
  - exhibit props and components, including artificial foliage and reconstructions of environments

- Use indirect LED lighting for objects enclosed in exhibit cases in accordance with *Museum Handbook* Part III.7.I.4: How do I balance exhibit lighting needs with preservation requirements?

See *Museum Handbook* Part III, Chapter 7: Using Museum Collections in Exhibits.

11. Fire prevention for objects on exhibit in furnished historic structures

Objects on exhibit in furnished historic structures pose special concerns. They are likely to be on open display and more susceptible to fire damage than objects in enclosed cabinets. To prevent fires in furnished historic structures, implement best practices as described in this *Handbook*, and:

- Keep exits and paths through furnished rooms clear and unobstructed.

- Display objects away from:

  - lighting that can cause heat buildup and ignition
  - drapes, windows, and other furnishings than can spread fire

- Work with facilities management to ensure that:

- electrical wiring is in good condition and well-maintained
- filters, exhaust ducts, and HVAC system components are well-maintained and cleaned frequently

- Use fire-resistant decorative materials such as banners, bunting, streamers, fabric, paper, cotton batting, and artificial vegetation.

- Use flame-retardant impregnated or treated fabrics and other materials in curtains, draperies, tarps, floor treatments such as ceramic tiles and carpets, and window treatments as appropriate.

- Keep doors to non-public areas of the structure closed to maintain compartmentation and prevent flame spread.

See *Museum Handbook* Part III, Chapter 8: Using Museum Collections in Historic Furnished Structures.

12. Seasonal, remote, and high risk location considerations

Evaluate objects housed in seasonally-open or remote locations on a case-by-case basis. The curator should assess fire risk and whether objects should be relocated in consultation with the PSFC and regional curator. Be aware that repeated packing, handling, and relocation is likely to damage objects. However, if the object is determined to be high value based on the Object Assessment (Figure 9.3), it should be considered for relocation. If it is determined that the objects will remain *in situ*, the structure needs to be secure and free of fire risk. Electrical wiring needs to be in good condition, and electrical appliances removed.

If collections are housed in an area of high risk of wildland fire, follow precautions outlined in RM-18: Wildland Fire Management or consider relocating the collection to a safer location.

13. Regular inspection and ongoing maintenance

Regular inspection and ongoing maintenance are essential to fire protection. The curator should work with facilities management to ensure that the building envelope, structural elements such as walls and doors, utilities such as boilers and HVAC units, and electrical components such as wiring and fuses are in good working order.

14. Electrical and mechanical equipment and appliances

Work with facilities management to take the following precautions when using electrical and mechanical equipment and appliances:

- Ensure that all equipment and appliances are in good working order.

- Correct, repair, or replace defective or improperly installed components and overloaded circuits.

- In designated areas, use only:

  - electrical appliances with automatic shutoffs that are

thermostatically controlled and UL approved, including coffee makers
  - appliances set on a noncombustible surface such as ceramic tile
  - UL listed personal heaters without open heating coils and with a tip-over switch
  - microwave ovens for warming and cooking food

- Switch off and/or disconnect heating and cooking appliances after use.

- Keep combustible items such as paper, cloth, or trash cans away from portable heaters.

- ***Do not***:

  - use hot plates, stovetops or ovens for cooking, and fuel-fired (kerosene) open-coil portable heaters within structures housing collections
  - use extension cords of any size with high wattage electrical appliances (coffee makers, microwaves, freezers, electric heaters, etc.), or as a substitute for permanent fixed wiring
  - overload surge-protected strip cords

- Designate break spaces well away from spaces housing collections.

- Arrange for periodic inspection of electrical appliances.

- Ensure electrical wiring is installed, inspected, and maintained by a professional electrician in accordance with NFPA 70: *National Electric Code*.

15. Construction and renovation project precautions

Many fires occur during construction and renovation projects. Work with the PSFC, facility manager, regional curator, and FCO or RSFM to review plans, provide guidance, and minimize fire risk in accordance with RM-58.2.3: Construction, Planning, and Design Review.

Keep automatic fire protection systems operational and exercise extreme caution during construction and renovation.

Work with the PSFC to include the precautions listed below in the SOW for construction and renovation.

- Relocate collections to another secure space or building in the park, nearby park, local museum, or regional repository or center with automatic fire protection systems during construction.

- Seal off work areas from collections in storage and on exhibit.

- Keep entrance and exit points clear and maintain a clean and uncluttered work environment.

- Ensure portable fire extinguishers of the proper type and size are available, visible, and unobstructed at the construction and adjacent areas.

- Do not impede or block fire detectors, sprinklers, or emergency strobes.

- Protect fire detectors from construction dust, debris, or impact.

- Dispose of cloths and paper products used for painting, polishing, or cleaning properly to avoid spontaneous ignition.

- *If* the PSFC has authorized the automatic fire detection and alarm system or the automatic fire sprinkler and/or suppression system to be turned off, *then* implement fire watch procedures and reactivate the system(s) immediately when work is completed.

See RM-58 Chapter 2.7: Fire Safety During Construction.

16. Hot work procedures

Hot work includes welding, cutting, brazing, use of heat guns and blow torches, soldering, grinding, burning, or similar activities capable of initiating fires or explosions. A Hot Work Permit (Form HW-1) is required for all hot work in buildings housing collections. See RM-58.2.18.8: Hot Work for guidance on how to safely conduct hot work.

The curator should move objects to a safe location with automatic fire protection systems when hot work is being performed, including another structure in the park, another park, center, or local museum in accordance with NPS Museum Fire Protection Standard (9) (MHI 9.B.1.9). Include the precautions listed below in the SOW for hot work in buildings housing collections.

- Work must be contained within a designated or permit-required area with proper ventilation, automatic fire detection and suppression, and fully charged and visible fire extinguisher(s) and:

  - work areas within 35 feet must be cleared of combustibles
  - combustible waste is properly disposed
  - combustibles that cannot be cleared from the work area during the project are covered with fire-retardant tarps
  - flammable gas containers are sealed properly
  - fire watch must remain on site for 30 minutes after hot work has been terminated

- “Collections management plans and historical building plans may designate areas or buildings where hot work is to be restricted" in accordance with RM-58.2.18.8.

17. Fire-safe design for new or renovated structures housing collections

Ensure that the design and construction of structures housing collections removes or reduces fire hazards and vulnerabilities. Design new structures or spaces housing collections or renovate existing spaces using the guidance provided below:

- Use inert noncombustible or fire-resistant material for all new construction, modifications, and renovations and:
  - ***do not*** use plasticized lumber and/or High Density Polyethylene (HDPE) building materials in new construction of structures housing collections
  - park facilities management staff should conduct visual inspection activities to identify HDPE in or adjacent to structures housing collections and take corrective actions
  - remove or relocate HDPE materials in accordance with Memorandum: Flight 93 Memorial: High-Density Response
- Provide adequate exits and exit signage in accordance with nationally recognized fire codes.
- Install:
  - automatic fire detection and alarm systems, including smoke detectors, and automatic fire sprinkler and/or suppression systems
  - a VESDA detection system in areas of high fuel load and concentrated collections
  - appropriate fire-rated assemblies to limit fire spread
  - doors, door hardware, and door frames with a fire rating consistent with their surrounding walls
  - emergency exit doors that are sufficiently wide and swing freely without restriction or blockage
- Equip doors to spaces protected with fire-rated walls with magnetic hold-opens or closers connected to the fire alarm system that will automatically close when the alarm is activated.
- Ensure there is an adequate water supply or access to water to fight a fire.

18. Fire-safe design inside spaces housing collections

Implement fire-safe design inside spaces housing collections using the guidance provided in this chapter and below:

- House collections in a dedicated storage space and separate:

  - work and break rooms from collections areas
  - spaces to accommodate flammable liquids, wet specimens, and freezers as appropriate
  - supply storage areas

- Replace fluorescent light bulb ballasts with LED lighting, particularly those in lamps older than 15 years.

- Use fire-resistant:

  - interior and exterior finishes and surfaces, including wall coverings, insulation, and wood paneling such as flame-resistant medium-density fiberboard (MDF-FR) that will lower flame spread and smoke generation during a fire
  - furniture, equipment, and fixtures (such as UL listed appliances) with the lowest possible flame spread ratings

- Do not use carpeting, highly combustible materials, and materials that produce toxic fumes when burned in storage and research spaces.

Be aware the materials such as plastic will melt during a fire.

See the Smithsonian Institution's *Fire Protection & Life Safety Design Manual* for more detailed information on fire-resistant materials.

19. Removing obstructions and keeping doors closed to prevent fire spread

Well-fitting doors and windows that are kept closed when not in use can help prevent the spread of fire and smoke; all it takes to compromise them is a single open door or window.

- Keep fire exits and routes, aisles, and walkways clear and unobstructed to facilitate firefighting and evacuation.

- Keep fire-rated doors closed at all times.

- Do not alter, block, or wedge open doors and windows.

- Do not obstruct:

  - air flow around smoke detectors
  - fire suppression system discharge heads
  - fire protection components such as emergency strobes
  - visibility of exit signs

- Work with facilities management to keep brush, vegetation, and trash away from structures housing collections as appropriate.

20. Compartmentation

Compartmentation involves dividing a structure into separate compartments to limit the spread of fire. It is essential to fire protection and includes the installation of fire-rated walls, floors, ceilings, doors, hardware, windows, barriers, and other structural design elements.

21. Fire-rated interior barriers, walls, doors, and assemblies

Work with the FCO or RSFM, PSFC, regional curator, and facility manager to include fire-rated assemblies when renovating or designing new structures housing collections, including shared spaces such as workshops or other high fire-risk activities.

Fire-rated assemblies include the following:

- *Fire barriers* are continuous membranes designed to restrict the movement of fire.
- *Fire walls and doors* separate or subdivide structures and spaces and are designed to prevent the spread of fire.
- *Fire windows* have glass that resists shattering from heat, rapid temperature changes, and pressure of fire hoses.
- *Fire/smoke dampers* are devices installed in HVAC ducts, fire barriers, and fire doors to limit fire spread and smoke infiltration.
- *Smoke barriers* are installed in spaces between walls and floors to limit smoke infiltration.
- *Roofs* with an appropriate fire rating, such as Class A roofs and roof tiles.

Ensure fire-rated assemblies are regularly maintained and kept in good working order.

See RM-58 Chapter 2.3: Construction, Planning, and Design Review for additional information.

22. Wildland fire protection

Wildland fires can cause the catastrophic and total destruction of park collections and structures housing collections in a very short period of time. Timber and grass can fuel wildland fires. Periods of drought, high winds, lightning strikes, tree disease, careless use of matches, lighters, and camp fires, and years of low fire activity increase wildland fire risk. Wildland fires that do not threaten buildings can impact collections, staff, and visitors. The thick smoke caused by wildland fires can also damage collections and impair breathing, especially for individuals with respiratory problems.

Locate structures storing collections outside of susceptible areas of the Wildland-Urban Interface and implement appropriate fire protection and codes to protect collections stored in these structures, in collaboration with the park Fire Management Officer and cultural landscape specialist. If your park is in the wildland-urban interface, consult with the park Fire Management Officer to:

- Meet applicable federal and state wildland fire and building codes.

- Create and maintain firebreaks around structures housing collections.

- Use fire-resistive building and roofing materials such as fiber cement siding products to clad exterior walls for new construction as required by the International Wildland-Urban Interface Code.

- Determine wildland fire protection system needs, including the installation of deluge sprinkler systems on the roofs of structures housing collections in accordance with the International Wildland-Urban Interface Code (IWUIC).

See DO 18: Wildland Fire Management and RM-18: Wildland Fire Management for further guidance. See also the California Building Code Chapter 7A: Materials and Construction Methods for Exterior Wildfire Exposure.

23. Wildland fire design considerations for structures housing collections

Ensure that the location, design, and construction of structures housing collections removes or reduces the threat of wildland fires to the extent possible. The International Wildland-Urban Interface Code (IWUIC) includes construction guidelines that provide additional protection based on the fire hazard severity of building sites.

Work with the park Fire Management Officer, facility manager, FCO or RSFM, and the regional curator to include ignition-resistant construction materials and features in purpose-built and adapted structures housing collections, including (in alphabetical order):

- Eaves and soffits.
- Exterior walls, doors, and windows.
- Gutters and downspouts.
- Roof coverings.
- Underfloor areas.
- Ventilation openings and accessory structures.

Consult with the Fire Management Officer, historical architect advisor, and cultural landscape specialist to determine wildland fire protection strategies for historic structures.

See IWUIC Chapter 5: Special Building Construction Regulations for further information.

F. Fire Protection Systems and Equipment

Automatic sprinkler systems are one of the most effective fire safety tools. According to NPS Fire Prevention 52, "…[Y]our chance of dying in a fire is reduced by 80% in a building with a sprinkler system and property damage can be reduced as much as

71%.” Structures *without* an automatic fire detection and alarm system and an automatic fire sprinkler and/or suppression system are at risk of catastrophic fire. Objects and structures housing collections exposed to fire may be irreparably damaged or lost forever.

A fire protection system is effective only if detection is immediately followed by automatic suppression.

Work closely with the PSFC, FCO or RSFM, facility manager, and regional curator to design, select, and install code-compliant automatic fire protection systems. These systems should provide appropriate protection 24/7 for life safety, the collection, and structures housing collections. Work with the PSFC to train museum staff annually in the use of portable fire extinguishers.

1. Essential fire protection systems and equipment

Essential fire protection systems and equipment include:

- *Automatic fire detection and alarm systems*. These operate 24/7 and should be combined with automatic fire sprinkler and/or suppression systems.
  And
- *Automatic fire sprinkler and/or suppression systems* include water-based sprinkler systems and/or gaseous or “clean agent” suppression systems. Both systems control and extinguish fires 24/7 without human intervention. They should be combined with automatic fire detection and alarm systems.
  And
- *Portable fire extinguishers* (PFEs) are used to manually extinguish fires. They require human intervention. They *are not* a substitute for automatic fire sprinklers and/or suppression systems.

Keep automatic fire detection and alarm systems and automatic fire sprinkler and/or suppression systems operational at all times.

See RM-58.2.11.3: Fire Protection Systems Design, and RM-58 Appendix B for a fire protection system comparison.

2. Designing a museum automatic fire protection system

A fire protection engineer should design the automatic museum fire protection system in collaboration with the curator and interdisciplinary team. The curator and regional curator should review all system plans and designs and confirm that they are appropriate for structures housing collections. The FCO or RSFM must approve the design and location of the automatic fire detection and alarm system and the automatic fire sprinkler and/or suppression system, including control valves, tanks, and pipe runs.

For furnished historic structures, design and install automatic fire protection systems with minimum impact to historic fabric and character in consultation with the historical architect advisor and interdisciplinary team.

When designing a museum fire protection system:

- Design the automatic fire protection systems as per RM-58.2.11.4: Fire Protection Systems Installation for ease of installation, testing, and maintenance and identifying the source of alarms and system problems.
- Ensure that fire alarm communications accurately signal the presence and location of a fire to a UL listed and/or regionally-approved receiving and monitoring station or central station that is monitored 24/7.
- Ensure emergency strobes are visible throughout the structure and register at the designated fire response center.
- Ensure backup power is available.
- Ensure availability of water and necessary water pressure.

3. Selecting automatic fire protection equipment

Select automatic fire protection systems best suited to the needs of the collection and structure in accordance with RM-58 Appendix B, Figure 9.3: Object Assessment, and the considerations noted below. Make this selection in consultation with a fire specialist experienced with museum fire protection systems, the regional curator, and the interdisciplinary team.

Take the following considerations into account when selecting fire protection equipment:

- Object composition (paper, paintings, wet specimens, cellulose nitrate-based materials, etc.).
- Potential impact of suppression agent on the collection.
- Collections housing (closed steel cabinets, mobile compact storage systems, open shelving, on exhibit in closed cases, or on open display).
- Function of the museum space (exhibit, storage, or processing).
- Characteristics of the structure, including:
  - purpose built, adapted, or historic structure
  - level of compartmentation
  - fabric of the structure
  - proximity to and adequacy of water supply
- Number of occupants in the structure.

- Whether the structure is shared with workshops or other programs that pose a high fire risk.

- Capacity of utilities and other physical resources to support automatic fire protection systems.

- Frequency and regularity of inspection, testing, and maintenance.

- Local climate (below vs. above freezing temperatures).

- Fire department response time and capabilities.

4. Automatic fire detection and alarm systems

Automatic fire detection and alarm systems automatically alert occupants inside a structure and designated fire response personnel such as the local fire department or park emergency response personnel of a fire 24/7.

An automatic fire detection and alarm system can include the following (in alphabetical order):

- Alarm notification appliance (horns, bells, strobes, etc.).
- Control unit.
- Detectors (smoke, heat, flame, etc.) appropriate to collection material(s) and location.
- Fire alarm pull boxes (manual pull stations).
- Initiating device (manual or automatic smoke detectors, heat detectors, pull devices, water flow switches, etc.).
- Power supply with battery back-up.

The automatic fire detection and alarm system should monitor the status of all detectors and alarm pull stations and provide notification when components are damaged or require maintenance. Ensure that the system monitors and reports communication failures 24/7 and is compatible with existing monitoring equipment.

Be aware that automatic fire detection and alarm systems *only* provide information. They *do not* suppress fire. These systems *must* be interconnected with the automatic fire sprinkler and/or suppression system to ensure prompt fire suppression and control.

Systems that are not monitored or that do not notify responders, such as local alarm systems, can result in catastrophic loss or significant delay in suppressing a fire.

See RM-58 Appendix B for a comparison of various automatic fire detection systems.

5. Fire detector types

Fire detectors are used to quickly detect the smoke, heat, or radiant energy produced by the flames of a fire and alert occupants and response personnel.

Types of fire detectors used in NPS structures housing collections described in RM-58 Appendix B include but are not limited to (in alphabetical order):

- Flame or radiant energy detectors.
- Heat detectors (line or spot type).
- Incipient sampling detectors (Air Aspiration, Air Sampling, or VESDA).
- Ionization smoke detectors.
- Laser detectors.
- Photoelectric smoke detectors.
- Projected beam detectors.

Each detector type has advantages and disadvantages as described in the Glossary, RM-58 Appendix B, and NFPA 914 Appendix D, Table D.2(c): Classification of Fire Detection and Alarm Systems by Type of Control. Consult with the PSFC, FCO or RSFM, and a structural fire protection professional to select the appropriate type(s) and number of fire detectors needed to provide adequate coverage for the collection.

The types of fire detectors listed above may be installed either in conventional or addressable systems:

- *Conventional detectors* alert occupants and responders that a fire has occurred somewhere in the system, but do not provide a specific location. They are best suited for systems covering a small area.

- *Addressable detectors* alert and provide occupants and responders with the specific room or location of the detector(s) where fire was indicated. They provide a higher level of flexibility in system operation than conventional detectors. Addressable detectors may be combined with intrusion detection security systems.

6. Fire alarms and alarm system monitoring

Fire alarms provide visual and auditory notification of a fire. They may be automatic or manual.

Automatic alarms and alarm communications need to accurately signal the presence and location of a fire to a UL listed and/or regionally-approved receiving and monitoring station or central station that is monitored 24/7. These include the park dispatch office, another park's dispatch office, local fire department, a contractor, or a Federal Protective Service MegaCenter. Ensure that all monitoring software is approved for NPS use.

Manual fire alarm pull boxes may be part of the fire alarm system. Once activated, the pull box alerts occupants and notifies the alarm receiving station.

See RM-58.2.11.3: Fire Protection Systems Design and 2.11.4: Fire Protection Systems Installation, as well as Question D.5: What special considerations should be addressed with the local fire department?

7. Automatic fire sprinkler systems and fire suppression systems used in structures housing collections

Automatic suppression is the process of extinguishing a fire through the use of automatic fire sprinkler systems and/or fire suppression systems.

Sprinkler systems use liquid water to extinguish and control fire.

Suppression systems use substances other than liquid water such as gas to extinguish and control fire.

Sprinkler systems widely used in NPS museums include:

- Wet pipe systems.
- Dry pipe systems.
- Pre-action systems.

Suppression systems used in NPS museums include:

- Clean agent (gaseous) systems (may require separate evacuation procedures).
- High-pressure water mist systems.

When there is a fire in a sprinklered structure, only the sprinkler head(s) exposed to heat (usually between 165°–225°F) should open and discharge water individually to suppress or control the fire. In certain circumstances, a fire suppression system may be installed alongside a fire sprinkler system.

See Figure 9.7: Comparison of Selected Fire Suppression Systems for Museum Objects and RM-58 Appendix B for advantages and disadvantages of each suppression system type.

8. Suppression systems not recommended for use in spaces housing collections

Antifreeze, deluge, and high expansion foam suppression systems are not recommended for use in spaces housing NPS museum collections due to difficulty of maintenance, life safety risk, damaging effect on collections, and/or high cost. See RM-58, Appendix B for further information.

NPS no longer installs Halon systems, as they contribute to environmental (ozone) degradation. Consult with the FCO or RSFM about occupant-use standpipe hoses.

9. Automatic fire sprinkler system installation

Sprinklers are usually connected to the domestic water supply through an underground connection on the exterior of the building. In instances where a municipal water supply does not exist or is inadequate, a tank or cistern may be provided with a pump to supply the sprinkler system as approved by the FCO or RSFM.

Install sprinkler heads as approved by a fire protection engineer or NICET III equivalent to protect the collections and structure:

- Design sprinkler piping to run through aisle areas, not over the top of cabinets where possible, and:
  - protect sprinkler heads with wire cages as appropriate
  - mark and label exposed sprinkler piping
- Work closely with the FCO or RSFM and a design professional when installing fire sprinklers and selecting non-corrosive piping materials, fittings for piping connections, sealants, and other components.
- Ensure that sprinkler systems are designed to allow facilities management and first responders to have access to control valves at all times in one area of a building without having to shut off the entire system.
- ***Do not*** install wet pipe systems in areas or spaces subject to freezing.

10. Commissioning automatic fire protection systems

Commissioning tests whether a fire protection system is correctly installed and meets NPS and NFPA requirements, manufacturers' specifications, and functions as described in the contracting documents.

Generally, the commissioning period lasts a year after the installation of a new system. Ensure that a one year commissioning period is incorporated into the contract for automatic fire protection system installation. Complete commissioning and final system acceptance according to the schedule outlined in the contract and in accordance with RM-58.2.11.5: Acceptance of Installed Fire Protection Systems.

Fire protection systems must be commissioned prior to acceptance by the Contracting Officer's Representative.

Note: Commissioning is required in addition to the warranty period when the system should not be worked on by anyone except the original installers so as not to void the warranty.

See RM-58.2.3: Construction, Planning, and Design Review.

11. Inspection, testing, and maintenance for automatic fire protection systems

Regular inspection, testing, and maintenance are essential to the proper functioning of automatic fire protection systems. Inappropriate modifications and/or lack of maintenance can result in system failure.

Work with the PSFC and facility manager to ensure inspection, testing, and maintenance of automatic fire protection systems is conducted:

- By the manufacturers' representative and/or NICET II equivalent structural fire protection professional.

- At minimum annually in accordance with:

  - RM-58.2.11.6: Fire Protection Systems Inspection Testing and Maintenance (ITM)
  - NPS inspection, testing, and maintenance schedules
  - nationally recognized fire codes
  - manufacturer's specifications

On occasion, fire protection systems may be faulty and subject to a manufacturer recall. Check the U.S. Consumer Product Safety Commission website to determine if installed systems have any pending recalls.

See also RM-58. 2.11.6.1: ITM Qualified Personnel.

12. Avoiding unintentional alarms, accidental sprinkler discharge, and system failure

Unintentional activation of fire alarms and sprinkler discharge can occur due to improper design, improper or lack of maintenance, and/or human error.

Move or cover affected objects as soon as the discharge is observed to prevent further damage. Immediately contact facilities management ***and*** the fire department to identify the source of the unintentional activation to halt the discharge.

Do not shut down a suppression or sprinkler system that has activated until the fire department has arrived and determined there to be no fire, or the cause of the activation is obvious and not due to fire.

To avoid unintentional sprinkler discharge and system activation:

- Ensure automatic fire protection systems are installed, commissioned by the FCO or designee, and used in accordance with nationally recognized fire codes and the manufacturers' specifications.

- Keep detectors clean and free of dust, as dirty smoke detectors and spider webs are the most frequent cause of unwanted alarms.

- Maintain a regular, ongoing inspection, testing, and maintenance schedule to prevent alarm, sprinkler, and other system component failure and ensure alarms operate 24/7 and are audible.

- Provide backup power sources to ensure the control panel does not fail or operate erratically, particularly in areas prone to unreliable electric power.

- Replace backup batteries every five years at minimum in accordance with nationally recognized fire codes.

- Consult with the system manufacturer if special equipment finishes are needed.

- ***Do not***:

  - modify automatic fire protection systems outside manufacturers' specifications
  - paint over or use fire protection system components for any function other than their intended use
  - hang equipment, decorations, or clothes hangers from fire protection system components such as sprinkler heads and pipes
  - create steam, dust, or other types of concentrated fog that can be interpreted as smoke by fire detectors

See Question H.5: Water damage from fire sprinklers.

13. Portable fire extinguisher types

Manually operated portable fire extinguishers (PFEs or "fire extinguishers") are often the first line of defense when a fire breaks out in a building. PFEs *supplement* automatic fire protection. Annual training to operate a PFE is required for all staff. When installed in a building, properly maintained, and in the hands of trained staff, PFEs may stop a fire before it gets out of control. Fire extinguishers must comply with NFPA 10: *Standard for Portable Fire Extinguishers*.

There are many different types of fire extinguishers available, including (in alphabetical order):

- *ABC multipurpose dry chemical extinguishers* use a fine chemical powder.

- *Carbon Dioxide (CO_2) extinguishers* used pressurized CO_2 gas.

- *Clean agent extinguishers* use a pressurized gas or liquid.

- *Water extinguishers* use a stream of water.

- *Water mist extinguishers* use a spray of water of smaller particle size than a water extinguisher.

Note: Purple K and Monnex™ dry chemical extinguishers can cause severe damage to objects, and *should not* be used in structures housing collections.

14. Portable fire extinguisher selection for structures housing collections

Each type of PFE has advantages and disadvantages as described in Figure 9.8: Comparison of Selected Portable Fire Extinguishers for Museum Objects. A combination of different PFE types may be necessary. Consult with the PSFC, FCO or RSFM, regional curator, and a conservator to determine the type(s) of PFE best suited to each structure housing collections.
Consider the following variables when selecting fire extinguishers:

- *Type of materials in the collection*: Some materials, such as metals and composites, may be more susceptible to damage from certain fire extinguishers than others.

- *Containerization of objects:* Objects in sealed steel cabinets or mobile carriages in storage and on exhibit in cases or vitrines are more protected than those in open storage or display.

- *Impact of extinguishing agent on objects:* The chemical composition of non-water PFEs may damage objects, as can the high pressure of non-mist water PFEs.

Installation and placement of fire extinguishers depends on various factors, including type of occupancy, hazards present in the building, square footage, and building layout. Ensure extinguishers are properly spaced in a building and installed along regular routes and exits so employees can access them when needed.

Note: Many museums use water mist extinguishers in collections areas, unless there are specific hazards such as flammable liquids that require other types of extinguishers.

15. Portable fire extinguisher inspection, testing, and maintenance

Portable fire extinguishers should be inspected monthly by building occupants for signs of damage such as denting or detached parts and confirmation that the pressure gauge is in the green. Improper maintenance can compromise efficacy during a fire. They must be annually inspected and maintained by an organization or individual acceptable to the FCO or RSFM in accordance with the manufacturers' instructions, RM-58.2.21.1: Inspection Testing and Maintenance of Portable Fire Extinguishers, and NFPA 10.

G. Museum Fire Section of the Park Structural Fire Management Plan

1. What is the park Structural Fire Management Plan (SFMP)?

The park Structural Fire Management Plan (SFMP) addresses fire protection guidance on life safety and protection of park resources, including museum collections.

2. What is the Museum Fire Section of the SFMP?

The Museum Fire Section of the SFMP addresses the needs of collections and structures housing collections. It must be appended to the park SFMP. It covers museum fire protection, fire-safe practices, automatic fire protection systems, portable fire extinguishers, fire control and Emergency Response Steps, floor plans, and evacuation routes. See Figure 9.4: Sample Museum Fire Section of Park Structural Fire Management Plan, which can be customized as needed. Salvage procedures, emergency contacts, and an emergency supply list can be found in Figures 10.21 – 10.24.

The curator is responsible for developing and updating the Museum Fire Section in collaboration with the PSFC and/or FCO or RSFM and the facility manager, and ensuring that it is appended to the park SFMP in accordance with NPS Museum Fire Protection Standard (2) (MHI 9.B.1.2).

The regional curator and RSFM review and concur with the Museum Fire Section of the park SFMP. A copy must be provided to the regional curator on approval by the superintendent. The Museum Fire Section should be reviewed and updated on the same schedule as the park SFMP.

3. How do I restrict sensitive information in the Museum Fire Section?

To ensure collections security, restrict the distribution of floor plans indicating object locations to the curator, superintendent, and regional curator. ***Do not*** include these sensitive floor plans in copies of the Museum Fire Section distributed to the FCO or RSFM or local fire department. Ensure that all copies of the Museum Fire Section containing floor plans of "first priority" object locations are filed in a locked cabinet.

4. When does the Museum Fire Section need to be reviewed and updated?

The Museum Fire Section is reviewed annually and updated every five years on the same schedule as the park SFMP and/or after a significant structure fire incident, addition of a new or renovated structure to house collections, new exhibit installation, or change in the curator. When a new superintendent and/or PSFC is appointed, ensure they have a copy of the current version of the Museum Fire Section.

H. Fire Emergency Response and Salvage

If a fire breaks out in an area where collections are housed, in addition to the possibility of catastrophic loss, the resulting damage may include soot, smoke, and/or water and physical damage from fire sprinkler or suppression systems, hoses, and fire extinguisher discharge.

1. *Implementing fire Emergency Response Steps*

Implement Fire Emergency Response Steps (Figure 9.9) as soon as a fire is discovered.

Do not shut off the fire alarms or the sprinkler and/or suppression system. If this is to be done, it should ***only*** be done by emergency responders.

The fire department and/or Incident Commander will take over operational control of the site until the area is declared safe to re-enter. After the fire scene is cleared, a structural fire protection professional should ensure that the automatic fire protection systems are fully functional. Work with facilities management staff and fire professionals to review system procedures annually or after a fire incident.

See Chapter 10.A.8: What is the Incident Command System (ICS)?

2. *Planning for rapid entry to structures housing collections during a fire*

In the event of a fire, first responders will need access to secured structures and spaces housing collections. Consult with the local fire department or first responders to establish a means for rapid entry to structures housing collections during a fire emergency, such as an emergency access key box.

Many fire departments use emergency access key box systems (such as Knox-Box® or SupraSafe™) that use a master key for all key boxes in their jurisdiction. The curator ***must*** ensure that the local fire department's key control procedures are sufficient to maintain museum security and prevent theft or accidental loss. The emergency access key box should have electronic tamper switches that are connected to the intrusion detection system and monitored 24/7 by closed-circuit television. The park museum intrusion detection system should detect and notify the curator of unauthorized attempts to enter spaces housing collections.

The rapid entry system is implemented ***in addition to*** museum security procedures. The curator ***must*** maintain key control with a log of all keys and key cards issued to museum staff for structures and spaces housing collections, including storage cabinets and exhibit cases. Museum keys are restricted to designated museum staff responsible for the collection. Keys ***must*** be signed in and out in the key log ***only*** by those authorized in writing to use them.

See Chapter 14: Museum Security.

3. *Posting information for fire emergency response*

For ease of access before, during, and after a fire, post copies of fire Emergency Response Steps, the emergency contact list, and evacuation routes and floor plans in accessible locations in storage, exhibit areas such as the visitor center front desk, and work areas.

4. *Salvage procedures after a fire*

After the fire scene has been cleared for entry, quickly and safely remove collections from affected areas. Implement appropriate salvage procedures immediately after a fire to help stabilize damaged or affected objects. ***Do not*** perform any interventive treatments on objects damaged by fire; this should be done by a conservator. Contact the MCEOP team leader, regional curator, and/or contractors for assistance.

For detailed salvage procedures, see Figure 10.24: Salvage Procedures.

See Chapter 10.G: Relocating Museum Collections and *COG* 2/13: An Introduction to Respirator Use in Collections Management.

5. Water damage from fire sprinklers

Sprinklers and/or fire hoses extinguish the fire, but may cause significant damage to collections. The water pressure and velocity of fire hoses, typically 120 – 150 gallons per minute, and exposed sprinkler heads that may discharge water until manually turned off can damage objects and result in water saturation.

To minimize water damage from fire sprinklers:

- Implement:
    - regular inspection, testing, and maintenance of the automatic fire sprinkler system by qualified personnel
    - frequent visual inspection by trained park staff
- House objects in closed cabinets and:
    - raise cabinets 4 – 6 inches off the floor
    - house oversized objects off the floor
- Follow the steps in Figure 10.24: Salvage Procedures for water-damaged collections to prevent mold growth and air dry or freeze objects.

See NPS Fire Protection Systems Installation and ITM Guidance.

6. Soot and smoke damage

Soot and smoke are byproducts of fire that can cause significant damage. Smoke can penetrate walls and objects and leaves a distinct, residual odor. It can spread to other parts of the structure through air ducts, open doors, or small wall and ceiling penetrations and settling on objects.

Duct fire/smoke dampers can limit the spread of smoke, and smoke barriers can provide additional protection. Once the fire is out and the structure is stabilized for access, work with an abatement team to confirm that the space is free of contaminants so that salvage can proceed. Work with a conservator to treat soot and smoke-damaged objects as quickly as possible to prevent permanent adhesion or damage.

I. Training, Drills, and Documentation

1. Training for portable fire extinguishers

All staff, including able-bodied employees, volunteers, and partners, must receive PFE training at least once annually in accordance with RM-58.5.6.2.1: Required Experience and Certification. The park safety officer, in cooperation with the PSFC, conducts training and reviews fire prevention measures.

See the NPS Structural Fire Training website.

2. Fire drills

Fire drills reduce the possibility of panic in a real situation. They should be held periodically to ensure that all personnel, including museum staff, know how to calmly react in an emergency. Follow instructions in the park SFMP when a fire drill occurs.

3. Documentation

Document all museum fire protection activities and maintain copies for museum management and reference purposes. Include:

- *Planning and mitigation*
  - risk assessment documents
  - Museum Mitigation Action Plan (Figure 10.3)
  - Museum Fire Section of the SFMP
  - museum fire protection system installation documents
- *Documenting the decision not to install automatic fire protection systems or consolidate objects* (as per NPS Museum Fire Protection Standard (1) [MHI 9.B.1.1]): In collaboration with the FCO or RSFM, complete and submit:
  - Object Assessment (Figure 9.3)
  - Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collections (Figure 9.3a)
  - provide copies to the regional director, regional curator, and historical architect advisor as appropriate
- *Hazardous materials:*
  - inventory of hazardous objects, non-collection materials, and cleaning chemicals
  - binder of SDS for these materials
- *Relocation:* Tracking and object relocation information.
- *Salvage:* Written reports and logs describing the type(s) of object damage sustained, salvage activities (freezing, drying, etc.) and who authorized them, and other related information.
- *Photographs:* Images of affected objects and spaces.

- *Distribution:* File these documents in the curatorial office together with the MCEOP. File sensitive documents in a locking filing cabinet and limit distribution. Distribute copies to the FCO or RSFM, regional director, regional curator, the park central and museum files, and the historical architect advisor if appropriate.

J. Selected Bibliography

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NFPA 1: *Fire Code*
NFPA 10: *Standard for Portable Fire Extinguishers*
NFPA 13: *Standard for the Installation of Sprinkler Systems*
NFPA 25: *Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems*
NFPA 30: *Flammable and Combustible Liquids Code*
NFPA 40: *Standard for the Storage and Handling of Cellulose Nitrate Film*
NFPA 45: *Standard on Fire Protection for Laboratories Using Chemicals*
NFPA 55: *Compressed Gases and Cryogenic Fluids Code*
NFPA 70: *National Electric Code*
NFPA 72: *National Fire Alarm and Signaling Code*
NFPA 92: *Standard for Smoke Control Systems*
NFPA 101: *Life Safety Code*
NFPA 105: *Standard for Smoke Door Assemblies and Other Opening Protectives*
NFPA 232: *Standard for the Protection of Records*
NFPA 257: *Standard on Fire Test for Windows and Glass Block Assemblies*
NFPA 701: *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*
NFPA 750: *Standard on Water Mist Fire Protection Systems*
NFPA 909: *Code for the Protection of Cultural Resource Properties- Museums, Libraries, and Places of Worship*
NFPA 914: *Code for Fire Protection of Historic Structures*
NFPA 2001: *Standard on Clean Agent Fire Extinguishing Systems*

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K. List of Figures

Object Assessment

Use the information generated from this assessment to support the decision to install automatic fire protection systems *or* relocate individual "first priority" objects to a safe space where these systems are installed.

Complete this assessment in collaboration with the Collections Advisory Committee and interdisciplinary team for museum fire protection. Use this assessment together with the RM-58 Chapter Appendix B Museum Collections Assessment Matrix.

Complete this assessment for each space or structure storing or exhibiting collections.

Park/Unit Name: ______________________________

Indicate if the space or structure is: (Check all that apply)

☐ Storage ☐ Work Room ☐ Preparation Area ☐ Research Room
☐ Exhibit ☐ Furnished Historic Structure ☐ Visitor Center

Space/Structure Name: ______________________ FMSS Number: ______________

Number of Floors: ______________________ Floor Area (Sq. Ft.): ______________

Completed By: ______________________ Date: ______________
(Print Name, Title)

A. Evaluation of Objects in this Space
One or more "Yes" responses to the questions in this section indicates the need to install an automatic fire protection system *or* relocate "first priority" objects to a safe space where these systems are installed.

1. Are there objects, specimens, and/or archival items in this space/structure that are/have: (indicate all that apply)								
Associated with an eminent individual(s) or event?	YES ☐	NO ☐	Essential for resource management?	YES ☐	NO ☐	High interpretive and/or educational value?	YES ☐	NO ☐
High monetary value?	YES ☐	NO ☐	High research and scientific value?	YES ☐	NO ☐	Irreplaceable?	YES ☐	NO ☐
Mission-critical?	YES ☐	NO ☐	Rare?	YES ☐	NO ☐	Type specimens?	YES ☐	NO ☐
						Voucher specimens?	YES ☐	NO ☐
Comment:								

2. How many museum objects are stored or exhibited in the space/structure?	
Total number of objects in this space: Comment:	Number of objects meeting criteria in A.1: Comment:

3. Would the loss of the object(s) housed in this space/structure negatively impact the park research, exhibition and visitor interpretation, and/or education program?
YES ☐ NO ☐
Comment:

4. Are the accession (and deaccession) book and folders housed in this space/structure?
YES ☐ NO ☐
Comment:

5. Are any of the objects in this space/structure on loan to the park or center?	
YES ☐ NO ☐	Number:
If "Yes," is fire protection a requirement of the loan(s)? YES ☐ NO ☐	
Comment:	

Figure 9.3 Object Assessment

B. Evaluation of Fuel Load in the Space/Structure Housing Collections
A preponderance of "Yes" responses to questions in this section indicates the need to install automatic fire protection systems *or* relocate "first priority" objects to a safe space where these systems are installed.

1. Do objects in this space/structure add to the structure's fuel load? (Indicate numbers* for all that apply)				
Archival items	YES ☐	NO ☐	Linear Feet:	Comment:
Basketry	YES ☐	NO ☐	Number:	Comment:
Cellulose nitrate-based materials	YES ☐	NO ☐	Number:	Comment:
Firearms and ordnance	YES ☐	NO ☐	Number:	Comment:
Magnetic media	YES ☐	NO ☐	Number:	Comment:
Negatives, polyester	YES ☐	NO ☐	Number:	Comment:
Paintings	YES ☐	NO ☐	Number:	Comment:
Photographic prints	YES ☐	NO ☐	Number:	Comment:
Textiles	YES ☐	NO ☐	Number:	Comment:
Wet specimens	YES ☐	NO ☐	Number:	Comment:
Wood	YES ☐	NO ☐	Number:	Comment:
Works on paper	YES ☐	NO ☐	Number:	Comment:
Other (describe)				
Total number*:				

2. What percentage* of objects, specimens, and/or archival items in this space/structure are housed in: (Indicate all that apply)					
Storage	Closed steel cabinets	%:	Open shelving	%:
	Mobile compact storage (manual)	%:	Mobile compact storage (electronic)	%:
Exhibit	Exhibit cases	%:	Open display	%:
Other:				
Comment:				

3. Are flammable or combustible non-collection materials housed in this space/structure?
YES ☐ NO ☐
Describe:

4. Does this space/structure include a workshop, preparation room, laboratory, breakroom with cooking appliances, or other activities such as living history activities?
YES ☐ NO ☐
Describe:

** Use ( ) to indicate estimate.*

Figure 9.3 Object Assessment (continued)

Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collections

The Superintendent completes this Record in accordance with NPS Museum Fire Protection Standard (1.c) (*MH* I 9.B.1.1.c) together with the Object Assessment (Figure 9.3), and provides a copy of these two documents to the FCO or RSFM, Regional Director, and Regional Curator.

Park/Unit Name: ______________________________

Superintendent: ______________________ ______________________
(Print Name) (Signature)

Submitted by: ______________________ Date: ____________
(Print Name, Title)

Building/Structure Name	FMSS Number
Number of Floors	Floor Area (Sq. Ft.)

Indicate if the building or structure is (Check all that apply):			
☐ Storage	☐ Work Room	☐ Preparation Area	☐ Research Room
☐ Exhibit Gallery	☐ Furnished Historic Structure		☐ Visitor Center
☐ Other (describe):			

Type of construction (concrete, wood, steel, masonry, etc.) for the following:	
Walls	
Floors	
Ceilings	
Roof	
Supporting Members	

Existing automatic fire protection systems (Check all that apply):			
☐ Sprinkler system	☐ Suppression system	☐ Fire detection / alarm system	☐ Smoke detection/ alarm system
☐ None			
☐ Other (describe:)			
Comment:			

Availability of utility resources (Check all that apply):	
☐ Water (city/well)	☐ Electricity (commercial/generator)
☐ Other (describe:)	
Comment:	

Describe the rationale for ***not*** installing an automatic fire protection system in this building/structure, ***or*** for ***not*** consolidating individual "first priority" objects to a safe space where these systems are installed, in accordance with NPS Museum Fire Protection Standard (1):

Figure 9.3a Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collections

[*Beautiful Home National Historic Site (BEHO)*]

Sample Museum Fire Section of Park Structural Fire Management Plan (SFMP)

Prepared by Curator	Name (Print)	Signature	Date
Concurred by Chief, Cultural Resources	Name (Print)	Signature	Date
Concurred by Park Structural Fire Coordinator	Name (Print)	Signature	Date
Concurred by Regional Structural Fire Marshal	Name (Print)	Signature	Date
Concurred by Regional Curator	Name (Print)	Signature	Date
Approved by Superintendent	Name (Print)	Signature	Date

Review and Update Record

Annual Review Date	Name (Print)	Signature	Date
Update (every 5 years)	Name (Print)	Signature	Date

Past Reviews

Date	Reviewed by, Title	Signature
3/20/2018	Marianne Kuratur, curator	*Marianne Kuratur*
4/12/2019	Marianne Kuratur, curator	*Marianne Kuratur*
2/24/2020	Marianne Kuratur, curator	*Marianne Kuratur*

Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan

Table of Contents

Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan (continued)

I. Overview

This Museum Fire Section provides guidance on the preservation and protection of collections and structures and spaces housing collections as part of the [*Beautiful Home National Historic Site (BEHO)*] Structural Fire Management Plan (SFMP). It covers museum fire protection, risk assessment, pending corrective actions, fire-safe practices, and automatic museum fire protection systems designed to remove or reduce fire hazards and vulnerabilities for [*BEHO*] collections and structures housing collections. It includes fire Emergency Response Steps (Figure 9.9) and salvage procedures. The park SFMP provides life safety guidance.

The [***BEHO***] **collection** numbers [*over 16,000 objects.*] It includes [*artwork, archeology, history, period decorative arts and furniture, historic photographs, and archival items.*] The collections and museum records are housed in the park [*Curatorial Facility*], with [*550 objects*] on exhibit in [*Hilltop House.*]

[***Hilltop House***] (FMSS ID# [*77777*]), built in [*1898*], is a [*two*] story structure with a [*stone*] foundation and a [*slate shingle*] roof. [*A steel frame supports the brick walls.*] There are [*two*] exterior doors on the [*ground floor*], and each of the [*two*] floors has [*four single pane sash*] windows. The floors are [*original hard wood, and are not carpeted.*] [*Hilltop House is on the National Register of Historic Places (#99999999)*.] It is located [*two miles from the town center.*]

The [***Curatorial Facility***] (FMSS ID# [*77776*]), located [*a quarter mile to the north of Hilltop House*], is a [*one*]-story, [*purpose-built concrete block structure*] built in [*1993.*] The structure has [*two*] exterior doors: [*one entrance on the west side for staff and visitors, and the emergency exit on the south side.*] It includes [*two workspaces and a research room.*]

The Superintendent's office and park administration offices are located [*in the town center and house a backup of ICMS and digital images of the collection.*] Security includes [*emergency access key boxes mounted in front of Hilltop House*] and the [*Curatorial Facility.*] The key log is located in [*the curatorial office.*]

II. Museum Fire Protection Standards and Related Policies

NPS Museum Fire Protection Standards (*Museum Handbook* Part I Chapter 9.B.1)

1. (a) Install automatic fire detection and alarm systems ***and*** automatic fire sprinkler and/or suppression systems in all purpose-built and adapted structures and spaces housing or exhibiting museum collections as approved by the FCO or RSFM in consultation with the park or regional museum curator and interdisciplinary team. In furnished historic structures, select and install automatic fire detection and alarm systems and automatic fire sprinkler and/or suppression systems as approved by the FCO or RSFM in consultation with park and regional facilities management staff, the historical architect advisor, and the park or regional museum curator.
   or
   (b) Consolidate collections in structures protected with automatic fire detection and alarm systems and automatic fire sprinkler and/or suppression systems.
   or
   (c) The decision not to use these systems must be made by the superintendent or delegate in consultation with the FCO or RSFM, park curator, regional curator, and historical architect advisor as appropriate, using information from Figure 9.3: Object Assessment, and the Museum Collections Assessment Matrix and Historic Structure Fire Protection System Assessment Matrix in RM-58 Appendix B.

   This decision must be documented in writing using Figure 9.3a: Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collections. Copies of the documents noted in NPS Museum Fire Protection Standard (1.c) must be distributed to the AHJ or RSFM, regional director, regional curator, the park central and museum files, and historical architect advisor if appropriate.

1

Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan (continued)

2. Develop and implement a Museum Fire Section as part of the park Structural Fire Management Plan (SFMP) with procedures to prevent, detect, and suppress fires. Review annually and update the Museum Fire Section every five years and after a structure fire incident, addition of a new or renovated structure to house collections, new exhibit installation, or change in curator.
3. Conduct regular self-assessments for fire risk, including the NPS Checklist for Preservation and Protection of Museum Collections, and have a professional fire protection engineer complete a Life Safety and Fire Protection Risk Assessment for structures housing museum collections.
4. Include and implement corrective actions to remove, reduce, and/or mitigate fire hazards and vulnerabilities in the Museum Mitigation Action Plan.
5. House museum collections in a dedicated storage space separated from the curatorial office, research and work areas, and supply storage areas.

   House collections in spaces separated (compartmented) by appropriate fire-rated assemblies in purpose-built and adapted structures and spaces, and separate functions to the extent possible in furnished historic structures.
6. Prohibit smoking in or within 25 feet of structures and spaces housing collections.
7. House the paper accession (and deaccession) book and folders in a locking UL listed 350°F one-hour fire-resistive insulated filing cabinet, safe, or vault when not in use. House electronic museum records, backups, and other media files in a UL listed 125°F one-hour fire resistive media safe or box.
8. Store cellulose nitrate-based materials in accordance with fire safety guidelines and Director's Order 24.4.3.23: Cellulose Nitrate and Cellulose Ester Film.
9. Require a Hot Work Permit (HW-1) for hot work in spaces housing collections. Protect collections or move to a secure location during hot work.

Fire Protection Policies and Code References

NPS policies and nationally recognized fire codes relating to museum fire protection include:

- NPS Management Policies (2006) 9.4.2: Museum Collections Management Facilities
- NPS-28: Cultural Resource Management Guideline
  - Chapter 4.D: Fire Management 1: Structural Fire
  - Chapter 9.B.3.b: Cataloging
- NPS Director's Order 50D: Smoking Policy
- NPS Director's Order 24: NPS Museum Collections Management, 4.3.10: Emergency Operation
- NPS Reference Manual 58: Structural Fire
  - Chapter 2.22: Fire Protection for Historic Structures & Buildings Storing/Exhibiting Museum Collections
- NFPA 909: *Code for the Protection of Cultural Resource Properties- Museums, Libraries, and Places of Worship*
- NFPA 914: *Code for Fire Protection of Historic Structures*

III. Designated Responsibilities

The park ***curator*** or collateral duty staff designated as responsible for the museum collection is directly responsible for the physical care of, and has day-to-day on-site responsibility for the museum collection. The curator will work with the Park Structural Fire Coordinator (PSFC) and interdisciplinary team for museum fire protection to append this Museum Fire Section to the park Structural Fire Management Plan.

2

Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan (continued)

The curator is responsible for developing, implementing, and updating the following, in coordination with the PSFC and facility manager:

- Museum Fire Section of the park Structural Fire Management Plan.
- Museum Risk Assessment Worksheet (Figure 10.2).
- NPS Checklist for Preservation and Protection of Museum Collections (Appendix F, Section F: Fire).
- Museum Mitigation Action Plan (Figure 10.3).
- First Priority Criteria for Object Relocation and Salvage (Figure 10.20).
- Object Assessment (Figure 9.3).

Updates to fire detection and suppression systems in [*Hilltop House and/or the Curatorial Facility*] will be made in consultation with the Regional Structural Fire Marshal (RSFM) or Fire Code Official (FCO) and the regional curator.

Completed Risk Assessment Documents

The following documents are filed in the curator's office in the [*Curatorial Facility*]:

- Museum Risk Assessment Worksheet.
- NPS Checklist for Preservation and Protection of Museum Collections.
- Life Safety and Fire Protection Risk Assessment.

Museum Fire Protection Mitigation to be Completed

See Museum Mitigation Action Plan (Figure 10.3) dated [*February 13, 2020*] for pending corrective actions.

IV. Fire-Safe Practices in Collections and Structures Housing Collections

Implement the following fire-safe practices in accordance with Chapter 9.E: Fire-Safe Practices and Design.

- Museum collections are housed in dedicated storage spaces separated from the curatorial office and research and work areas.
- Cabinets are raised 4 – 6 inches off the floor.
- Collections in the [*Curatorial Facility*] are stored in well-constructed, sealed steel cabinets that are closed and secured after use and at the end of each day.
- Cabinets, exhibit cases, and furniture are not closer than 18 inches from sprinkler head deflectors.
- Furniture in [*Hilltop House*] does not obstruct fire detectors.
- The accession book and folders are housed in an insulated filing cabinet with a UL listing of (350°F 1-hour) that is locked when not in use. Electronic media, including backups, are housed in a media safe or box with a UL listing of (125°F 1-hour). An electronic backup of the accession book and documents is filed off-site and with the regional curator.
- Non-collection items (packing materials, paper products, cleaning supplies, shipping boxes, etc.) are housed outside collection storage rooms and away from electrical outlets, pipes, vents and other utilities.
- Regular housekeeping in exhibits, storage and workspaces, includes:
  - maintaining clean and organized storage and work spaces
  - keeping storage areas housing collections free of clutter
  - emptying trash receptacles daily
- The following are prohibited in or adjacent to [*Hilltop House*] and the [*Curatorial Facility*]:
  - smoking in or within 25 feet of the structure, with "No Smoking" signs posted at entrances
  - open flames (including candles, fireplaces, or stoves) in or near the structure
  - lighting matches or lighters in or near the structure
  - open coil heaters or hot plates

3

Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan (continued)

- Hot work permit HW-1 is required for all hot work.
- Containers of chemicals such as alcohol or Paraloid™ B-72 used in collections preparation are closed and stored after each use.
- All doors and windows are kept closed and locked when the structure is not in use or unoccupied.
- Fire-rated doors are kept closed at all times.
- Fire protection system components such as detectors or sprinkler heads are not painted over, used to support decorations or hang clothing, or used for any function other than their intended use.
- Fire-resistant interior and exterior finishes and surfaces are used in structures housing collections.

V. Museum Automatic Fire Detection and Alarm Systems and Automatic Fire Sprinkler Systems

[*Hilltop House*] and the [*Curatorial Facility*] have [*automatic fire detection and alarm systems*] and [*automatic fire sprinkler systems.*] The museum fire protection system is monitored 24/7 by a [*UL receiving and monitoring station staffed by the local fire department.*]

- [*Photoelectric intelligent addressable*] smoke detectors are installed in all structures housing collections. An incipient air sampling system is installed in [*Hilltop House*] and the [*Curatorial Facility.*]
- Fire alarm pull boxes are located near all exits in [*Hilltop House*] and the [*Curatorial Facility.*] See Figure 9.4a for floor plan.
- A wet pipe automatic fire sprinkler system was installed throughout [*Hilltop House*] in [*2017.*]
- The wet pipe sprinkler system in the [*Curatorial Facility*] was installed in [*1993.*] [*Automatic fire sprinkler system is hard-wired to a fire alarm control panel that reports to 24/7 monitoring station*.]
- The smoke detectors, monitoring system, and automatic sprinkler systems in both structures are inspected, tested, and maintained by the certified fire contractor, [*Fire Service Company*], in accordance with RM-58.2.11.6: Fire Protection Systems Inspection Testing and Maintenance (ITM), nationally recognized fire codes, and the manufacturers' specifications. The PSFC manages and schedules park-wide fire protection inspection, testing, and maintenance.
- Manually-operated water mist portable fire extinguishers are located in the [*Curatorial Facility*] and [*furnished rooms in Hilltop House.*] ABC dry chemical extinguishers are located in non-collections areas. Facilities management conducts monthly inspections. See Figure 9.4a for floor plan and Figure [*X*] in the park SFMP for a floor plan of sprinkler shutoff valves.

The museum fire protection system is linked to the park intrusion detection system. The intrusion detection system is monitored 24/7 by a [*UL receiving and monitoring station.*]

VI. Fire Emergency Response

The [*Town of Hilltop Fire Department*] responds to structure fires at [*BEHO.*] The fire department is familiarized annually with the fire protection needs of [*Hilltop House*] and the [*Curatorial Facility*], including the special needs of the museum collection. [*Station No. 1*] is located within [*three*] miles of [*Hilltop House*] and the [*Curatorial Facility.*] The nearest fire hydrant is [*¼ mile*] from [*Hilltop House.*] The average response time between the station and the location of a fire in the park is [*15*] minutes.

The following Museum Collection Emergency Operation Plan and other park documents are attached:

Floor Plan: Portable Fire Extinguisher and Fire Alarm Pull Box Locations (Figure 9.4a)
Floor Plan: Evacuation Routes (Figure 9.4b)
Fire Emergency Response Steps (Figure 9.9)

VII. Emergency Contacts, Vendors and Sources of Assistance

The following documents from the Museum Collection Emergency Operation Plan are attached:

Emergency Contact List (Figure 10.21)
Emergency Vendor and Sources of Assistance List (Figure 10.22)

4

Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan (continued)

VIII. Emergency Supplies and Equipment

The list of Emergency Supplies and Equipment (Figure 10.23) from the Museum Collection Emergency Operation Plan are attached here.

IX. Salvage

Once the affected structure is cleared for re-entry, salvage can begin. Contact the regional curator and conservator before beginning salvage activities. Save as much as possible. Do the minimum amount of work per object. Ensure that actions taken to salvage collections do not damage the collections further. Interventive treatment should only be done by a conservator.

The Salvage Procedures (Figure 10.24) from the Museum Collection Emergency Operation Plan are attached here.

X. Documentation

Maintain a copy of the following documents in the curatorial office in the [*Curatorial Facility*]:

- *Planning and mitigation:* Risk assessment documents, current copies of this Museum Fire Section of the SFMP, Museum Mitigation Action Plan, museum fire protection system installation documents, and related memoranda and worksheets.
- *Relocation:* Tracking and object relocation information.
- *Salvage:* Written reports and logs describing the type(s) of object damage sustained, salvage activities (freezing, drying, etc.) and who authorized them, and other related information.
- *Photographs:* Images of affected objects and spaces.
- *Distribution:* Copies of these documents are distributed to the FCO or RSFM, regional director, regional curator, the park central and museum files, and the historical architect advisor if appropriate.

XI. Review Cycle

Review the Museum Fire Section of the SFMP annually and update every five years and after a significant structure fire incident, addition of a new or renovated structure to house collections, new exhibit installation, or change in the designated curator.

XII. Training and Drills

- The curator works with the PSFC and/or park safety officer to ensure the coordination and delivery of fire prevention training. All training is documented and maintained on file. Training includes how to report fires, portable fire extinguisher operating procedures, and evacuation procedures and routes.
- The PSFC conducts fire drills once a year at minimum.

List of Figures

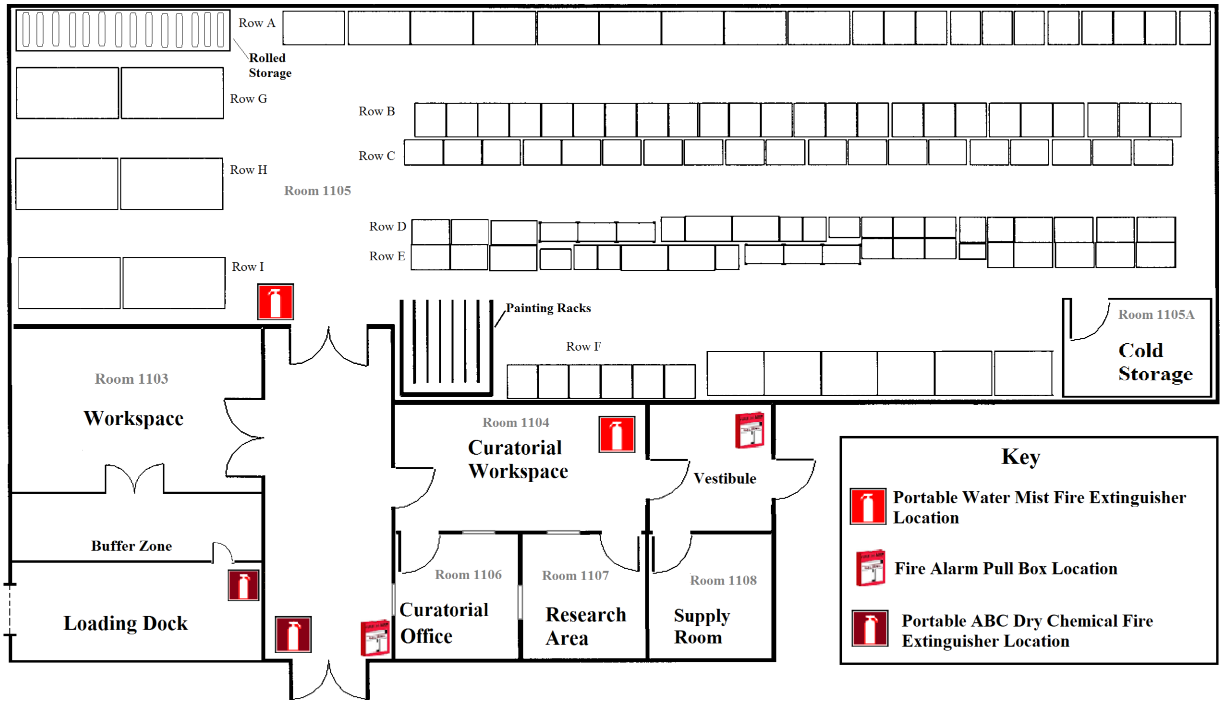
The following figures are attached to this plan:

Note: The First Priority Object List for Relocation and Salvage and the First Priority Floor Plans for Relocation and Salvage are filed with restricted access in the [*curatorial office*] in the [*Curatorial Facility.*]

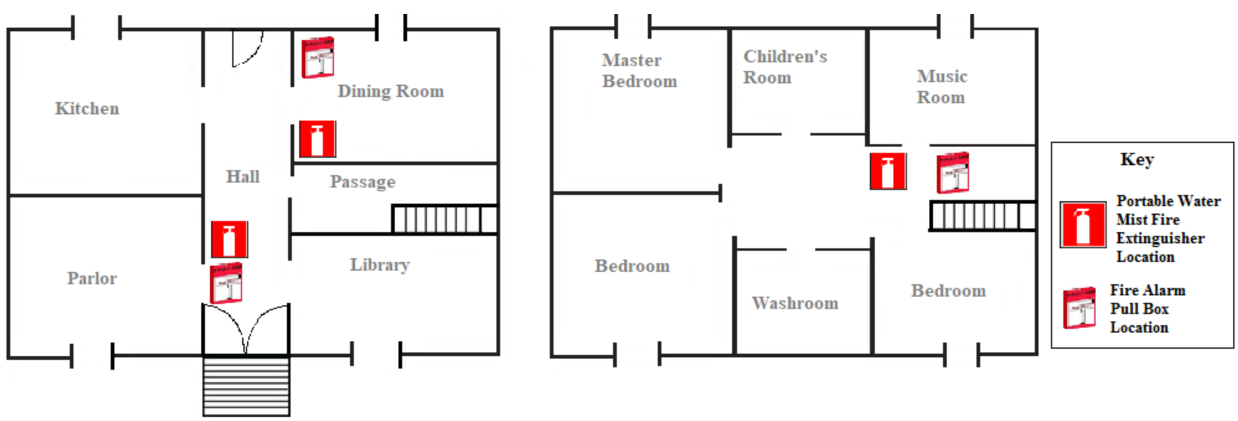
5

Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan (continued)

Floor Plan: Portable Fire Extinguisher and Fire Alarm Pull Box Locations



Portable Fire Extinguisher and Fire Alarm Pull Box Location Floor Plan: Curatorial Facility



First Floor **Second Floor**

Portable Fire Extinguisher and Fire Alarm Pull Box Location Floor Plan: Hilltop House

See Figure [*X*] in park SFMP for floor plans of sprinkler shutoff valves.

Figure 9.4a Floor Plan: Portable Fire Extinguisher and Fire Alarm Pull Box Locations

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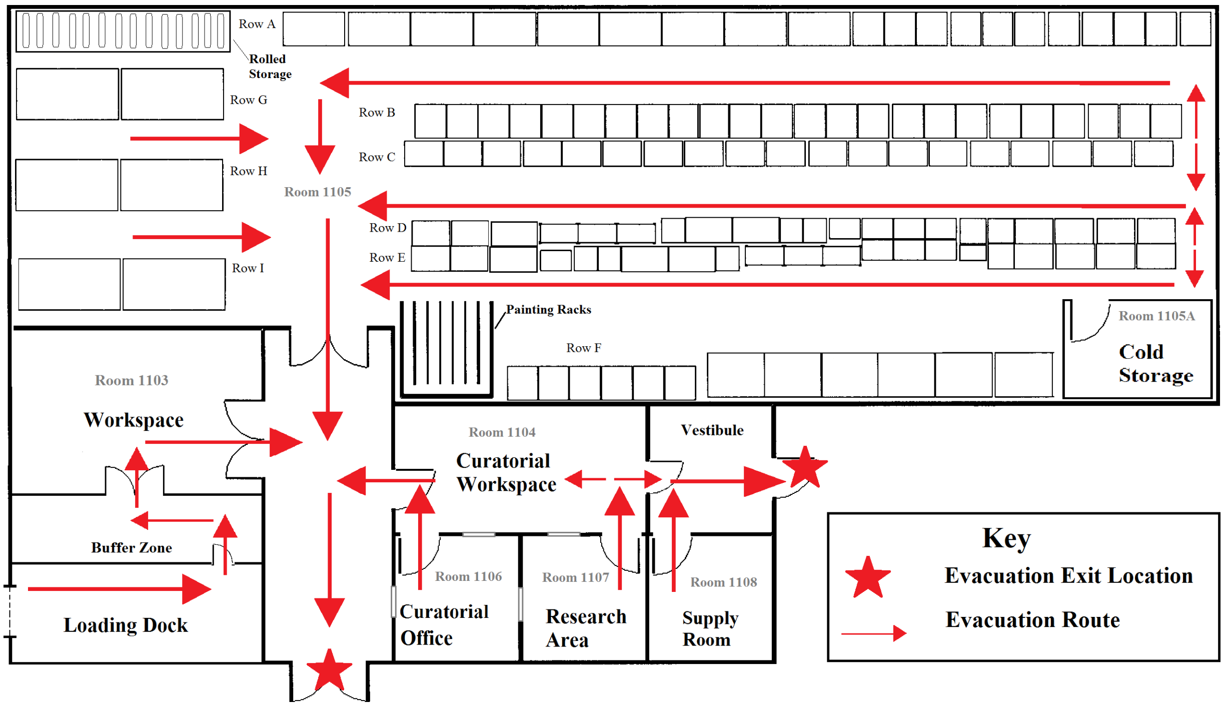
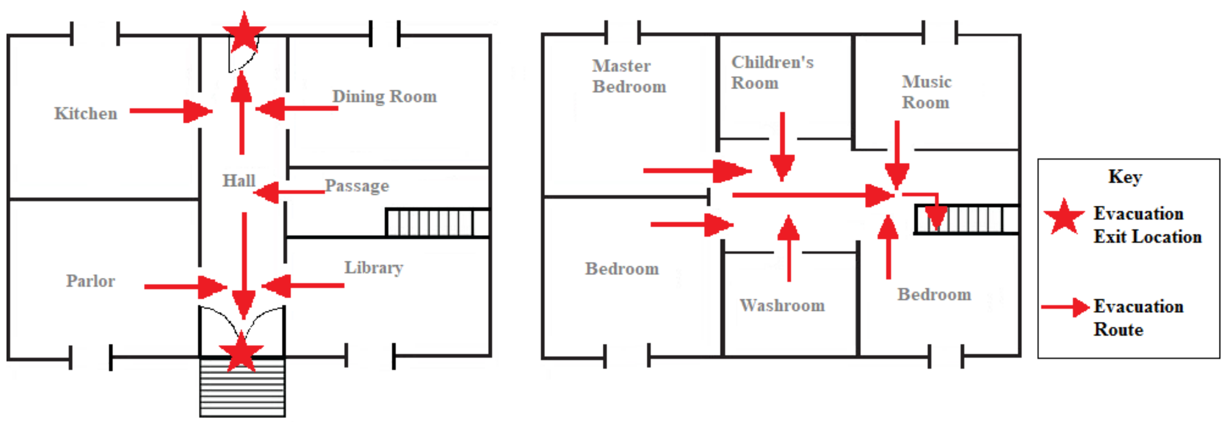
Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan (continued)

Floor Plan: Evacuation Routes



Evacuation Route Floor Plan: Curatorial Facility



Evacuation Route Floor Plan: Hilltop House

★ Meet at the designated assembly point at the [*South Parking Lot*.]

Figure 9.4b Floor Plan: Evacuation Routes

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Figure 9.4 Sample Museum Fire Section of a Park Structural Fire Management Plan (continued)

Sample Language for Museum Fire Protection to be Included in a Memorandum of Understanding Between a Park and a Fire Company

Special firefighting procedures may be necessary to safeguard museum collections and structures housing museum collections, including storage facilities, buildings, furnished historic structures, visitor centers, museums, and administrative offices. Park museum staff will provide the Town Fire Department an annual familiarization tour of the Park's museum storage facilities, buildings, work spaces, furnished historic structures, and exhibit spaces. Access points, selected museum objects in need of special attention, and hazardous non-collection materials storage will be noted on the tour.

Park staff will develop, in consultation with the Town Fire Department, appropriate arrangements for rapid entry to structures housing collections during a fire emergency.

Figure 9.5 Sample Language for Museum Fire Protection to be Included in a Sample Memorandum of Understanding Between a Park and a Fire Company

Sample Statement of Work for a Life Safety and Fire Protection Risk Assessment*

*This sample Statement of Work was provided by the NPS Structural Fire Program.

Part A – General Information

Description of Work:

The Life Safety and Fire Protection Risk Assessment is a physical survey and a report which provides a complete evaluation of each Park structure's construction, function, operational support systems and occupancy as they impact fire protection and life safety. The report shall identify risks to life, property, or Park mission from the effects of potential fire incidents. The report shall serve as a reference document to NPS management for planning and prioritizing projects for short term work in order to maintain satisfactory facility safety, and to plan for long range decisions regarding renovation, reinvestment and preservation.

Qualifications & Experience:

All services under this task order shall be performed in accordance with applicable codes and NPS policy as identified in the task order and accepted industry standards. All work is to be accomplished by a registered professional fire protection engineer in the United States. Firms bidding on task orders associated with this line item will be required to appoint a senior fire protection engineer as the project manager who will be responsible for review of all submissions prior to submitting them to the NPS. Experience with condition and risk assessment procedures and work in museums and historic structures is desired and contractors may be asked to submit documentation showing experience with each.

Part B – Scope of Services

Often several parks will be listed on a single task orders. This will require the contractor to coordinate with each park and negotiate inspection dates and times in order to accomplish several park inspections in a single trip. The Contractor shall:

- Provide all management, supervision, personnel, support services, supplies, materials and equipment necessary for the performance of the Life Safety and Fire Protection Risk Assessment survey.
- Perform a thorough survey of the entire structure to determine how the building's features function together as a system. The building, its occupancies and operations, including structures housing museum collections, shall be considered as part of the "total system" relative to overall safety. All positive and negative aspects shall be taken into consideration.
- Review all available inspection, testing & maintenance records, as-built drawings, and operational manuals for all life safety and fire protection systems.
- Identify and analyze all of the building's major fire protection and life safety systems. Provide substantive description and profile information regarding the building's systems and features as they impact the Structural Fire program. All positive and negative aspects of the building's systems/features shall be evaluated and analyzed for their impact/contribution to the level of risk inherent in the building.
- Identify conditions within the building which must be corrected or reduced to provide the building with an acceptable level of risk. Identifying risk incorporates the evaluation of the condition and potential impact to the occupants, property and the mission of the Park. The analysis shall include justification statements that thoroughly address the hazard and the need for improvement/replacement based upon risk, life cycle cost analysis, obsolescence, excessive maintenance costs, etc.
- Determine the severity of each risk condition. The severity of each risk condition shall be based on the contractor's professional judgment and the guidance in Appendix A.
- Provide recommendations which may reflect a variety of alternatives for correcting the identified risk condition or reducing the identified risk condition to an acceptable level. Provide an estimated

Figure 9.6 Sample Statement of Work for a Life Safety and Fire Protection Risk Assessment

construction cost for each recommendation. Recommended actions shall meet the criteria or the "intent" of NPS Reference Manual 58 and NFPA Codes/ Standards.

- Provide a detailed report of the survey using the format in Attachment 1.

Pre-Site Preparation:

- The contractor shall initiate a pre-survey conference with the Park Facility Manager at least 15 calendar days before surveying begins, either by phone or in person, to discuss necessary topics and information including but not limited to:
  - The schedule and plans for conducting the survey
  - Provision of floor plans for each structure
  - Secured areas in the each structure
  - Need to perform any tasks after normal working hours
  - Types of fire protection, safety, and environmental systems in each structure
  - Scheduling of necessary personnel
  - Safety issues
- When museum collections are housed on site, the contractor shall initiate a pre-survey conference with the park museum curator or regional curator at least 15 calendar days before surveying begins, either by phone or in person, to discuss the needs of the museum collection, including but not limited to:
  - Hazardous or vulnerable objects in the museum collection
  - Location of museum fire protection, safety, and environmental system piping and components
  - Fire risk to museum collections under current conditions

On-Site Procedures:

- The Park Facility Manager (or representative) shall arrange for escort or access to all spaces the contractor needs to view.
- The park curator or regional curator shall escort the contractor through all spaces housing collections the contractor needs to view.
- The contractor shall conduct a complete and thorough walk-through of the structures and record all conditions affecting risk, both positive and negative, as deemed necessary.

Assessment Report:

Format and content, at a minimum, shall comply with Appendix A.

- The report shall describe building conditions, with explanations, which may have a significant impact, both positive and negative, on life safety, fire risk in each structure, and contents of each structure, including museum collections. The report shall analyze how conditions identified during the survey could affect the occupants, the cultural heritage or value of the property, including current fire risk to museum collections, and the mission of the Park.
- The report shall incorporate Section B of the Object Assessment (Figure 9.3), completed by the museum curator, for structures housing museum collections.
- Appropriate corrective actions for risk control shall be recommended to reduce the probability, severity or a combination of both. The contractor shall develop corrective actions with estimated costs for each risk condition noted. The recommended corrective actions shall ensure the risks have been eliminated or controlled to an acceptable level for museum collections and structures housing museum collections.
- Photographs shall be used to illustrate any adverse conditions noted as well as general facility conditions. At least one photograph shall be taken for each visible finding. Additional photographs will be provided to show each means of egress and any special or unusual conditions.
- All code, policy and other references shall be cited in the report.

Figure 9.6 Sample Statement of Work for a Life Safety and Fire Protection Risk Assessment (continued)

Attachment to the Life Safety and Fire Protection Risk Assessment Statement of Work Questions Related to Museum Spaces*

*This Attachment was provided by the NPS Structural Fire Program. It should be completed by a registered professional fire protection engineer during the Life Safety and Fire Protection Risk Assessment.

Park Alpha Code: ______________________________
Facility/Location Name: ______________________________
Location FMSS ID: ______________________________
Completed by: ______________________________
Date: ______________________________

Fire Detection and Fire Suppression Systems:

Does the space/building have a fire alarm system? Y N

Does the space / building have a fire sprinkler system? Y N

Does the space / building have a fire suppression system? Y N

Installed: Identify and confirm what systems are actually installed and whether the installation meets NFPA and manufacturers' requirements (residential systems vs commercial).
Comments:

Maintained: Confirm maintenance records exist and indicate maintenance was performed in the proper frequency by qualified personnel. Confirm inspection records exist with the proper frequency and are conducted by qualified individuals.
Comments:

Operational: Is each system operational? Y N

Does the system have any visible deficiencies or code violations? Y N

Is each system appropriate for the space? Would it be better to replace the system? If so, with what type of system (dry, double interlock, clean agent (what type clean agent))?
Comments:

Monitoring Station Notification: Is it working, reliable, and monitored 24/7 (with code required communication methods and lines)? Concern about reliability of phone lines and other notification strategies. If not working/ reliable, recommendations for replacement? Y N
Comments:

If a sprinkler system is not installed, is it possible to install one? If not, why not? *(nearest available water supply that can support an automatic sprinkler system)*
Comments:

Would a different type of automatic suppression (extinguishing) system work rather than an automatic sprinkler system?
Comments:

Figure 9.6a Attachment to the Life Safety and Fire Protection Risk Assessment Statement of Work: Questions Related to Museum Spaces

Spaces Housing Collections and Risk:

Are installed detection systems and suppression systems reliable? Y N
For example, is water available and sufficient? Y N
Comments:

Are 1- and/or 2-hour fire walls with appropriate fire-rated doors and windows installed for collection storage spaces? If not, are spaces separated by function? Y N
Are penetrations appropriately sealed? Y N
Rating of fire wall:
If not, is retrofit possible? Y N
Comments:

Are 1- and/or 2-hour fire walls with appropriate fire-rated doors and windows installed for exhibit areas in visitor centers, galleries, and furnished historic structures? Y N
Are penetrations appropriately sealed? Y N
Rating of fire wall:
If not, is retrofit possible? Y N
Comments:

Do the collections spaces (storage buildings, furnished historic structures, exhibits) have drop ceilings? If so, what areas? Y N
Are detectors attached to them? Y N
Are sprinklers attached to them? Y N
Comments:

If only parts of the building have sprinkler protection, which areas are protected with sprinklers?
Collections storage Y N
Exhibit galleries Y N
Visitor center Y N
Furnished historic structure Y N

Are the collections stored in a basement or attic environment? Y N
Comments:

Is the installed sprinkler system appropriate for the space and collections, considering location, maintenance, training, and contents of the collection?
Collections storage Y N
Exhibit galleries Y N
Visitor center Y N
Furnished historic structure Y N

Is the type of portable fire extinguisher (i.e. ABC, clean agent) in the space appropriate for the collection? Should a different type of extinguisher (i.e. water mist) be added?
Collections storage Y N
Exhibit galleries Y N
Visitor center Y N
Furnished historic structure Y N
Comments:

Figure 9.6a Attachment to the Life Safety and Fire Protection Risk Assessment Statement of Work: Questions Related to Museum Spaces (continued)

Is the location of fire extinguishers appropriate and accessible? Y N
Is the staff trained on their use? Y N
Comments:

What are the structural fire risks to the spaces housing the collections?
Comments:

Containers and Enclosures:

Are the accession (and deaccession) book and folders stored in a UL listed locking fire-resistive insulated filing cabinet that will maintain under 350 degrees (F) for an hour for a fire of 1700 degrees (F)?
Visually confirm.
Comments:

Are the electronic museum records, including Interior Collection Management System (ICMS) backup tapes housed in a media safe that will maintain under 125 degrees (F) for an hour in a fire of 1700 degrees (F)?
Visually confirm.
Comments:

Are containers storing flammable liquids appropriate and located away from collection storage?
Comments:

Figure 9.6a Attachment to the Life Safety and Fire Protection Risk Assessment Statement of Work: Questions Related to Museum Spaces (continued)

Comparison of Selected Automatic Fire Sprinkler Systems and Suppression Systems for Museum Objects*

System Type	Description	Advantages	Disadvantages
Wet pipe sprinkler system	Sprinkler pipes are constantly filled with water Installed in climate-controlled structures or in climates above 40°F Typically used in environments that are not susceptible to freezing	– Extremely reliable – Faster response than dry pipe systems – Pipes less susceptible to corrosion than in dry pipe systems – Relatively easy and economical to install and maintain	– Not for use in environments susceptible to freezing – Accidental discharge can result in water and mold damage – Objects not stored in closed cabinets are susceptible to water damage
Dry pipe sprinkler system	Pipes are filled with pressurized air or nitrogen rather than water Used in climates below 40°F and in non-climate-controlled and unheated structures When sprinkler head is activated, compressed air is released so water can flow out of the pipes *Pre-action systems* are a type of dry pipe system that have closed heads with no water in the piping; the fire detection system opens a valve that charges pipes with water	– Can be used in environments susceptible to freezing, typically in northern climates – Minimal water leakage and accidental discharge of water – Less likely to cause water and mold damage to collections	– Delay in initial response (code allows up to 60 seconds) – Requires more maintenance than a wet pipe system – Pipes susceptible to inline corrosion if not constantly filled with compressed air or nitrogen – Requires reliable power to maintain inline pressure – After operation, pipes can corrode if not thoroughly drained and dried – Objects not stored in closed cabinets are susceptible to water damage
Gaseous (Clean agent) suppression system	Discharges a fire extinguishing gas instead of water for total flooding of the structure Must comply with NFPA 2001: *Standard on Clean Agent Fire Extinguishing Systems*	– Can be used in cold storage rooms and other areas subject to temperatures below 40°F and in sensitive areas – Eliminates the possibility of water damage to collections from fire suppression	– If not properly maintained and pressurized the system will not discharge – Gas requires tightly sealed compartments for effective operation – Suppression agent levels must be maintained for several minutes after discharge to prevent re-ignition – Objects not stored in closed cabinets can sustain physical damage from gas pressure and potential chemical alterations
High-pressure water mist suppression system	A higher pressure, low water system that discharges extremely small water particles	– Reduces potential for water damage to collections and historic fabric – Uses less water used than a typical wet or dry pipe system – Can be used to protect structures lacking water and reliable utility service – Can be serviced with a water storage tank or cistern	– Cost is higher than wet or dry pipe systems – Requires specialized design and installation expertise – Requires specialized inspection, testing, and maintenance expertise

*This table incorporates information from RM-58 Appendix B.

Figure 9.7 Comparison of Selected Automatic Fire Sprinkler Systems and Suppression Systems for Museum Objects

Comparison of Selected Portable Fire Extinguishers for Museum Objects*
(In alphabetical order)

Extinguisher Type	Description	Advantages	Disadvantages
ABC	Multi-purpose dry chemical extinguisher Extinguishing agent is a fine powder Used on Class† A, B, and C fires	– Easy to use – More effective at preventing soot damage than other PFEs	– Can cause chemical damage to metals and composite objects – Deposits of powder can cause permanent damage if not cleaned immediately – Spray covers a wider area than other PFEs – Chemical extinguishing agent may irritate skin and eyes or pose respiratory problems
Carbon Dioxide (CO_2)	Uses pressurized CO_2 gas to displace oxygen from a fire Used on Class B and C fires Widely used in electrical rooms and computer rooms	– Easy to use – Does not leave a residue	– Cannot be used on Class A fires, so has limited museum applicability – Can pose health issue if used in a contained space without respiratory protection
Clean Agent	Pressurized liquid or gas extinguisher Used on Class A, B, and C fires	– Easy to use – More contained spray than ABC PFEs	– Can cause significant physical/toppling damage to freestanding objects – Can drive soot into organic objects – Can cause adhesives to swell and ink to bleed – Can pose a health issue if used in a very small contained space
Water	Uses a stream of water (tap, deionized, or distilled) to extinguish fire Used on Class A fires	– Easy to use – Does not cause chemical damage to objects – Extinguishers using distilled or deionized water aid in salvaging collections wetted during a fire	– Can cause significant physical/toppling damage to freestanding objects – Can cause water damage to freestanding collections and structures housing collections – Can drive soot into organic objects – Can cause adhesives to swell and ink to bleed – Cannot be used on Class B and C fires
Water Mist	Uses a fine mist of water (deionized or distilled) to extinguish fire Pressurized using nitrogen Used on Class A and C fires Widely used in museum exhibit and storage areas and archives	– Easy to use – Does not cause chemical damage to objects – Lowest risk of physical/toppling damage to freestanding objects – Extinguishers using distilled or deionized water aid in salvaging collections wetted during a fire – More contained spray than ABC PFEs	– Can cause water damage to freestanding collections and structures housing collections – Can drive soot into organic objects – Can cause adhesives to swell and ink to bleed – Heavier than chemical extinguishers – Cannot be used on Class B fires

*This table incorporates information from NFPA 10 and OSHA, "Portable Fire Extinguishers: Types of Fire Extinguishers."

†Fire Class Definitions from NFPA 10: *Standard for Portable Fire Extinguishers*:
Class A fires involve ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.
Class B fires involve flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.
Class C fires involve energized electrical equipment.

Figure 9.8 Comparison of Selected Portable Fire Extinguishers for Museum Objects

FIRE EMERGENCY RESPONSE STEPS

- Activate the fire alarm.
- Call 911 and park dispatch.
- Evacuate the area immediately.
- Never jeopardize your personal safety.
- Use a fire extinguisher to put out a ***small fire only*** if you have been properly trained.
- Do not attempt to put out a nitrate or plastics fire.
- If smoke is present, keep close to the ground. Use a wet cloth on your face as needed.
- Use stairs. Do not use elevators.
- Close doors as you evacuate to confine the fire.
- Do not open windows.
- If your clothing catches fire, **Stop — Drop — Roll**.
- Assemble at the designated meeting point.

Figure 9.9 Fire Emergency Response Steps

L. Glossary

Air Sampling Smoke Detector: A device that draws air through small diameter (generally less than 1/8") tubing into a detector unit that uses the ionization, photoelectric, or cloud chamber principle to analyze the quantity of smoke or combustion products in the sample. (Also called an Early Warning, Incipient, Very Early Warning Detection System, Very Early Warning Smoke Detection Apparatus, or VESDA.)

Fire Code Official (FCO): See Fire Code Official (FCO).

Automatic Fire Detection and Alarm System: The combination of fire detectors and alarm designed to automatically detect and notify occupants and first responders of fire.

Automatic Fire Protection System: The combination of an automatic fire detection and alarm system and an automatic fire sprinkler and/or suppression system designed and installed to detect, control, or extinguish a fire and alert occupants, the fire department, or both, that a fire has occurred.

Automatic Fire Sprinkler System: A network of overhead pipes with spaced outlets (sprinkler heads) that open at a predetermined temperature to discharge liquid water onto a fire.

Automatic Fire Suppression System: A network of fire extinguishing agents, including gaseous ("clean") agents or water mist, installed in a structure that automatically activate to control and extinguish a fire.

Class A Fire: A fire in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

Class B Fire: A fire in flammable or combustible liquids, petroleum greases, tars, oils, solvents, lacquers, alcohols, and flammable gases.

Class C Fire: A fire that involves energized electrical equipment.

Combustible Liquid: A liquid, such as formalin, with a flash point of 100°F or greater.

Compartmentation: The practice of dividing a space into separate compartments to slow the spread of fire. Compartmentation is established through building materials, such as fire-rated assemblies, and is maintained through practices such as ensuring that doors are closed and fire walls are left unpierced by unnecessary piping. *See* Passive Fire Protection and Fire Prevention.

Domestic Water Supply: The water supply for a building's drinking and sanitary needs that may also serve as the water source for a sprinkler system.

Dry Pipe Sprinkler System: A sprinkler system used in areas where temperatures below 40° F are expected. Pipes are filled with air or nitrogen under pressure. When fire opens a sprinkler head, air pressure in the system drops, releasing a valve, letting water flow into pipes and discharge from the open sprinkler(s).

Fire Code Official: The fire and life safety technical resource responsible for enforcing nationally recognized fire codes and standards. Usually the Regional Structural Fire Marshal, the FCO may also be called the Authority Having Jurisdiction (AHJ).

Fire Damper: A fire protection element typically installed in HVAC ducts to prevent the spread of fire. Fire/smoke dampers prevent the spread of both fire and smoke.

Fire Detection System: See Automatic Fire Detection and Alarm System.

Fire Prevention: Daily fire-safe practices, such as compartmentation and good housekeeping, that reduce the risk of fire and help to slow fire spread.

Fire Protection: Fire-rated assemblies and automatic systems in structures that slow the spread of fire, alert occupants and responders of a fire's presence, and control and extinguish the fire.

Fire Protection System: See Automatic Fire Protection System.

Fire-Rated Assembly: Any combination of fire-rated walls, doors, door frames, windows, window frames, fire barriers, and similar construction designed to prevent fire spread.

Fire-Resistive Material: Any construction or building material, including metal, stone, or concrete, that inherently resists fire or has been chemically treated to resist fire. Also known as "fire-resistant" material. *See* Flame-Retardant Fabric.

Fire-Safe Practices: Practices that prevent or limit ignition, fire spread, and the risk of fire reaching objects, including a no smoking policy, no open flame guidance, and good housekeeping.

Fire Wall/Fire Door: A structural component separating or subdividing structures and spaces to prevent fire spread.

Flame Detector: A fire detector that detects the radiant energy generated by flames. Also called a radiant energy detector.

Flame-Retardant Fabric: A fabric that has been impregnated, treated, or immersed in a chemical that resists burning. *See* Fire-Resistive Material.

Flammable Liquid: A liquid, such as ethanol, with a flash point under 100°F.

Fuel Load: The total mass of combustible materials in a space or structure.

Hazard: A natural or locational factor or human-based event (such as a volcanic eruption, arson, or wildfire) that can negatively impact life safety, collections, and structures housing collections. *See* Risk and Threat.

Heat Detectors: Heat-responsive devices either of the spot or line type, designed to respond when the operating element reaches a predetermined temperature (Fixed Temperature), when the temperature rises at a rate exceeding 15°F per minute (Rate-of-Rise), or when the temperature of the air surrounding the device reaches a predetermined level, regardless of the rate of temperature rise (Rate Compensation). Some have both fixed temperature and rate-of-rise features.

Ionization Smoke Detector: Spot type wired smoke detectors that use ionization technology to detect incipient smoke in the early stages of a fire event. They are more responsive to invisible particles produced by most flaming fires, and are less responsive to larger particles typical of most smoldering fires.

Laser Detectors: Spot type wired heat detectors that use lasers to provide very early warning of incipient fire conditions.

Life Safety and Fire Protection Risk Assessment: A risk-based assessment of the code compliance of fire protection and personnel training programs, structural and procedural fire hazards, maintenance of protective systems, and overall effectiveness of the fire protection program conducted by a registered professional fire protection engineer.

Local Alarm System: A fire or intrusion detection system that causes an audible or visual alarm at the protected site, but which is not monitored off-site. Note: This type of system should not be installed in structures housing collections because it does not notify fire responders of a fire.

Mitigation: Reducing the severity of damage caused by fire or other emergencies by minimizing or eliminating risk factors.

Museum Fire Section: The section of the park Structural Fire Management Plan (SFMP) that specifically addresses the needs of museum collections. It covers mitigation, control and response, and collections salvage strategies to reduce the likelihood and severity of fire damage to collections housed in storage, work and exhibition spaces, and furnished historic structures. It includes floor plans.

Museum Mitigation Action Plan: A plan with specific action items to reduce deficiencies in storage, exhibit, and work spaces that could cause or increase the risk of fire or other emergencies.

Ordinary Combustibles: Substances such as wood or paper that can be ignited in a Class A Fire.

Performance-Based Design: A flexible design process that determines code-compliant fire protection systems and/or building modifications based on the specific characteristics of each structure in consultation with the FCO, rather than requiring all structures to conform to a single set of specifications in a fire code.

Photoelectric Smoke Detector: Spot type wired smoke detectors that use photoelectric technology to detect incipient smoke in the early stages of a fire event. They are more responsive to larger particles typical of smoldering fires.

Portable Fire Extinguisher (PFE): A portable device, operated by hand, containing an extinguishing agent that can be expelled under pressure for the purpose of suppressing or extinguishing fire.

Pre-Action Sprinkler System: A type of dry pipe sprinkler system with the water supply controlled by a fire detection system (either smoke or heat detection) wired so an alarm opens a valve to let water flow into the system piping. After the supply valve opens, the system operates like a wet pipe system.

Projected Beam Detector: A type of photoelectric light obscuration smoke detector consisting of a transmitter and receiver connected to a fire alarm circuit that generate a beam spanning the protected area. They are typically used in open spaces such as open atriums and large halls.

Risk: The combination of hazards (or threats) and vulnerabilities faced by collections as the result of a fire or other emergency event.

Risk Assessment: Analyzing hazards (or threats) and vulnerabilities and their probability of occurrence, identifying possible ways losses can occur and developing corrective action steps to prevent or reduce losses and damage to collections, structures housing collections, and life safety from emergency events.

Severity: The level of damage sustained by collections and structures housing collections as a result of a fire or other emergency.

Sprinkler System: *See* Automatic Fire Sprinkler System.

Standpipe System: A piping system in a building to which hoses are connected for emergency use by building occupants or by the fire department. Standpipe systems intended for occupant use are not permissible in NPS structures.

Structural Fire Management Plan (SFMP): A park document that describes operational policies and procedures necessary to establish and implement the park's structural fire prevention and protection program. It should include a Museum Fire Section detailing specific steps to protect museum collections and structures housing collections from fire damage.

Suppression System: *See* Automatic Fire Suppression System.

Threat: A natural or locational factor or human-based event that can cause harm to life safety, collections, and structures housing collections. *See* Hazard and Risk.

UL Listed Cabinet: A storage cabinet tested and confirmed to meet Underwriters Laboratories' safety regulations. Fire-resistive museum storage cabinets carry a UL listing class of 350 1-hour, indicating that the cabinet's internal temperature will not exceed 350°F when exposed to external temperatures over 1700°F for at least one hour.

UL Listed Media Safe: A storage cabinet designed to house digital records, magnetic media, and/or photographic negatives and slides that has been tested and confirmed to meet Underwriters Laboratories' safety regulations. Fire-resistive media safes carry a UL listing class of 125 1-hour, indicating that the internal temperature of the safe will not exceed 125°F when exposed to external temperatures over 1700°F for at least one hour.

Vulnerability: The likelihood that a collection will sustain damage, based on its composition, ease of object removal before or during a fire or other emergency event, and the features of the structure(s) housing collections. *See* Risk.

Wet Pipe Sprinkler System: A sprinkler system in which the piping permanently contains water. It cannot be used in environments below 40°F, as these environments can cause the pipes to freeze.

Definitions in this Glossary adapted from:

NFPA 10: *Standard for Portable Fire Extinguishers*
NFPA 557: *Standard for Determination of Fire Loads for Use in Structural Fire Protection Design*
NFPA 701: *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*.
NFPA 703*: Standard for Fire Retardant—Treated Wood and Fire–Retardant Coatings for Building Materials.*

M. Abbreviations Used in this Chapter

AHJ	Authority Having Jurisdiction
COR	Contracting Officer's Representative
DO	Director's Order (NPS)
DOI	Department of the Interior
FCO	Fire Code Official
FMSS	Facility Management Software System
HDPE	High Density Polyethylene
HVAC	Heating, Ventilation, and Air Conditioning
ICC	International Code Council
ICMS	Interior Collection Management System
IBC	International Building Code
IFC	International Fire Code
IWUIC	International Wildland-Urban Interface Code
MCEOP	Museum Collection Emergency Operations Plan
MDF-FR	Flame-Resistant Medium-Density Fiberboard
MHI 9.B.1	*Museum Handbook* I Chapter 9.B.1: NPS Museum Fire Protection Standards
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NCSHPO	National Council of State Historic Preservation Officers
NFPA	National Fire Protection Association
NICET	National Institute for Certification in Engineering Technologies
NIFC	National Interagency Fire Center
NPS	National Park Service
OSHA	Occupational Safety and Health Administration
PFE	Portable Fire Extinguisher
PMIS	Project Management Information System
PSFC	Park Structural Fire Coordinator
RAC	Risk Assessment Code
RERE	Repair and Rehabilitation
RSFM	Regional Structural Fire Marshal
RM	Reference Manual (NPS)
SDS	Safety Data Sheet
SFMP	Structural Fire Management Plan
SOW	Statement of Work
UL	Underwriters Laboratory
VESDA	Very Early Warning Smoke Detection Apparatus

N. Index

Chapter 10: Emergency Planning

NPS Museum Emergency Planning Overview

NPS Museum Emergency Planning and Preparedness Standards

Develop, approve, keep current, and implement a Museum Collections Emergency Operations Plan (MCEOP) as part of the park Emergency Operations Plan in accordance with Director's Order (DO) 24.4.3.10: Emergency Operation, that addresses museum collection requirements for emergency protection, response, relocation, and salvage. Review the MCEOP annually and update every five years.

Develop Emergency Response Steps for different emergency incidents in the MCEOP.

Implement the NPS Checklist for Preservation and Protection of Museum Collections to identify and document hazards to and vulnerabilities of museum collections and structures and spaces housing collections in accordance with DO 24.4.3.21: Checklist. Review and submit to the National Catalog annually in accordance with DO 24.5.2: Checklist.

Develop a Museum Mitigation Action Plan that includes corrective actions to be implemented to remove or reduce hazards and vulnerabilities identified in risk assessments. Review annually and update every five years.

Mitigate hazards and vulnerabilities identified in the Museum Mitigation Action Plan ***or*** relocate objects at risk to a designated secure and stable location.

Risk Assessment

Complete the NPS Checklist for Preservation and Protection of Museum Collections annually. Complete the Object Assessment, Risk Assessment Worksheet, and other risk assessments.

Museum Mitigation Action Plan

Develop a Museum Mitigation Action Plan that includes corrective actions to be implemented to remove or reduce hazards and vulnerabilities in structures and spaces housing collections. Review annually and update every five years.

Mitigating Hazards and Vulnerabilities

Implement corrective actions identified in the Museum Mitigation Action Plan to remove or reduce identified hazards and vulnerabilities in collaboration with the facility manager, emergency operations coordinator, and interdisciplinary team.

Museum Collections Emergency Operations Plan

Develop and implement a Museum Collections Emergency Operations Plan (MCEOP) as part of the park Emergency Operations Plan. Review the MCEOP annually and update every five years.

The MCEOP includes sections on: Museum Emergency Planning Standards and Policies; Incident Command System (ICS); Collections and Structures Housing Collections Overview; Risk Assessment; MCEOP Team Responsibilities; First Priorities for Relocation and Salvage; Emergency Response, including Emergency Response Steps; Security; Emergency Contact Information; Emergency Equipment, Services, and Supplies; Salvage Procedures; Post-Emergency Critique; MCEOP Update and Review; and Figures and Floor Plans.

Museum Emergency Response Steps

Implement Emergency Response Steps for different types of emergency incidents, including:

Active Shooter; Disruptive Individual; Earthquake; Explosion; Fire; Hazardous Materials Spill, Odor, and Gas Leak; Medical Emergency; Mold Outbreak; Power Outage; Severe Weather; Suspicious Package or Item; Suspicious Person and Vandalism; Threat (Threatening Call or Bomb Threat); Volcanic Eruption; and Water Leak and Flood.

Follow Incident Command System (ICS) procedures when activated.

Relocation and Salvage

Identify First Priorities for Relocation and Salvage before an emergency incident using the First Priority Criteria for Object Relocation and Salvage (Figure 10.20) and Object Assessment (Figure 9.3).

Implement relocation and salvage procedures within the first 48 – 72 hours after an emergency incident.

Training and Documentation

Conduct annual emergency training and response exercises for museum staff, including ICS training, in collaboration with the emergency operations coordinator.

Document all museum emergency planning and preparedness activities.

Complete a Post-Emergency Critique (Figure 10.26) within a month of the emergency incident.

CHAPTER 10: EMERGENCY PLANNING

A. Overview

Emergencies pose a threat to life safety, museum collections, and structures housing collections. They may be large- or small-scale and occur due to natural or human causes. Emergencies may occur as a single incident or as a complex of two or more, with or without warning.

Emergency planning includes risk assessment, removal or reduction of hazards and vulnerabilities, and implementation of emergency operations plans, Emergency Response Steps, and salvage procedures. When planning and preparing for museum emergencies, consider what impact the loss of or damage to the collection and structures housing collections would have on the park mission and programs.

Take corrective actions to mitigate identified hazards and vulnerabilities ***before*** an emergency incident occurs. Pre-incident actions ensure response and salvage activities taken ***during*** and ***after*** an emergency incident are implemented without confusion, delay, and unnecessary loss or damage.

A.1. What is included in this chapter?

This chapter covers museum emergency planning and preparedness for collections and structures housing collections. It includes (in order of appearance in the chapter):

- *National Park Service (NPS) Museum Emergency Planning and Preparedness Standards*
  Section B: DOI and NPS Emergency Planning Policies and Standards
- *Risk assessments* to identify hazards and vulnerabilities
  Section C: Risk Assessment, Appendix F Figure F.2: NPS Checklist for Preservation and Protection of Museum Collections, and Figure 10.2: Risk Assessment Worksheet
- *Museum Mitigation Action Plan* including corrective actions to remove or reduce identified hazards and vulnerabilities
  Section D: Museum Mitigation Action Plan and Figure 10.3: Museum Mitigation Action Plan (Sample)
- *Mitigation of hazards and vulnerabilities* through implementation of the Museum Mitigation Action Plan
  Section E: Mitigating Hazards and Vulnerabilities
- *Museum Collections Emergency Operations Plan* (MCEOP) appended to the park Emergency Operations Plan (EOP)
  Section F: Museum Collections Emergency Operations Plan and Figure 10.4: Museum Collections Emergency Operations Plan (Sample)
- *Emergency Response Steps* for different emergency incidents
  Section G: Museum Emergency Response and Figures 10.5 – 10.19: Emergency Response Steps
- *Determination of object relocation and salvage priorities* using the *First Priority Criteria for Object Relocation and Salvage*
  Section H: Relocating Museum Objects, Figure 10.20: First Priority Criteria for Object Relocation and Salvage, and Figure 9.3: Object Assessment

- *Salvage procedures* for affected objects
  Section I: Salvaging Museum Objects and Figure 10.24: Salvage Procedures
- *Training and documentation* for museum emergency planning and preparedness
  Section J: Training and Documentation
- *Figures and templates* for customization by parks, including MCEOP, Emergency Response Steps, and emergency contact and supply and equipment lists
  Figure 10.21: Emergency Contact List (Sample), Figure 10.22: Emergency Vendor and Sources of Assistance List (Sample), and Figure 10.23: Emergency Supplies and Equipment (Sample)

The Museum Emergency Planning Cycle (Figure 10.1) provides a visual representation of the ongoing museum emergency planning and preparedness process.

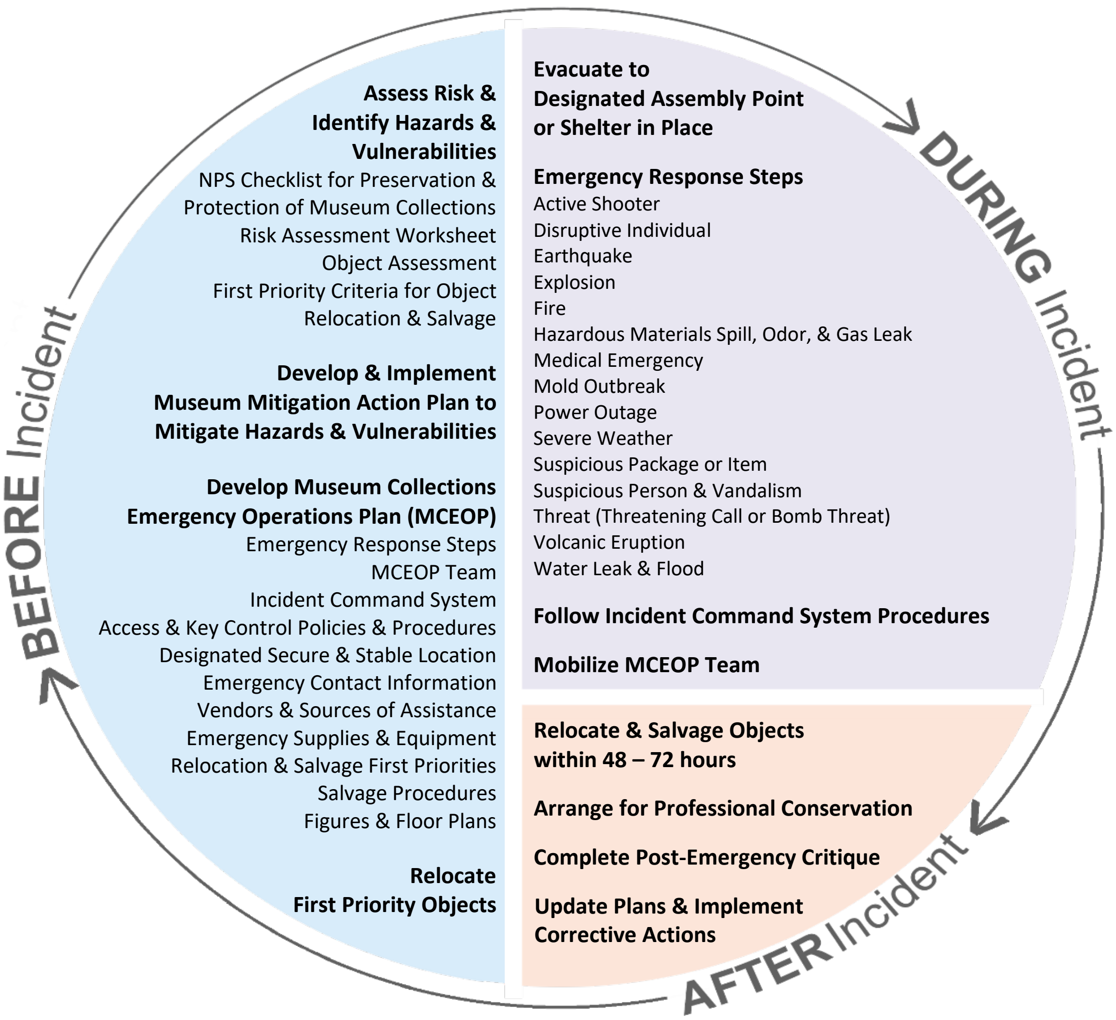

Figure 10.1. Museum Emergency Planning Cycle

This chapter does not address emergency planning and preparedness for laboratories or wildland fires.

A.2. What kinds of emergency incidents are addressed in this chapter?

Emergency incidents that impact collections, structures housing collections, and/or life safety include (in alphabetical order):

- Active shooter
- Disruptive individual
- Earthquake
- Explosion
- Fire
- Hazardous materials spill, odor, and gas leak
- Medical emergency
- Mold outbreak
- Power outage
- Severe weather
- Suspicious package or item
- Suspicious person and vandalism
- Threat (threatening call or bomb threat)
- Volcanic eruption
- Water leak and flood

See Section E: Mitigating Hazards and Vulnerabilities and Figures 10.5 – 10.19: Emergency Response Steps. See also Chapter 5: Biological Infestations, Chapter 9: Museum Fire Protection, Chapter 11: Curatorial Health and Safety, and Chapter 14: Museum Security.

A.3. Who is responsible for museum emergency planning?

The ***superintendent*** has overall responsibility for preserving and protecting the park's museum collection. The ***curator****,* as designated custodial officer, is responsible for preserving and protecting the museum collection, including museum emergency planning and preparedness. In this chapter, "curator" refers to the park curator or collateral duty staff designated as responsible for the collection.

The curator is responsible for developing and completing:

- Risk assessments including:
  - NPS Checklist for Preservation and Protection of Museum Collections (Appendix F, Figure F.2)
  - Risk Assessment Worksheet (Figure 10.2)
- Museum Mitigation Action Plan (Figure 10.3).
- Museum Collections Emergency Operations Plan (MCEOP) (Figure 10.4), in collaboration with the emergency operations coordinator and facility manager.
- Prioritization of objects for relocation and salvage using the First

Priority Criteria for Object Relocation and Salvage (Figure 10.20).

- Object Assessment (Figure 9.3).

The curator collaborates with the:

- Emergency operations coordinator to coordinate museum emergency response and salvage activities and training.

- Facility manager to develop and implement the Museum Mitigation Action Plan.

A.4. What are the emergency operations coordinator's responsibilities for emergency planning?

The superintendent is responsible for park-wide emergency planning and preparedness. The superintendent may delegate responsibilities for emergency operations coordination to the chief ranger, park safety officer, facility manager, or other staff as appropriate. This delegation is made in writing and filed in the park central files and/or Superintendent's Orders.

The ***emergency operations coordinator*** will:

- Develop and maintain park emergency planning documents, including the park Emergency Operations Plan (EOP), and coordinate park-wide emergency planning and response.

- Append the MCEOP to the park EOP, in collaboration with the curator.

- Develop and implement emergency response and situational awareness training for park employees.

- Arrange for a Physical Security Assessment for each structure housing collections, in collaboration with park security and the curator.

A.5. What are the facility manager's responsibilities for museum emergency planning?

The ***facility manager*** works with the curator and emergency operations coordinator to:

- Ensure regular inspection, testing, and maintenance of the structure and building envelope, utilities, equipment, and systems in structures and spaces housing collections in accordance with nationally-recognized codes, manufacturer's specifications, and NPS policies and guidance.

- Complete a comprehensive condition assessment of the building envelope, utilities, equipment, and systems for structures housing collections.

- Generate information on:

  – availability of physical resources such as power and water
  – existing utilities and mechanical systems and controls in spaces housing collections
  – funding needed to install, upgrade, and replace equipment and systems

- Implement corrective actions in the Museum Mitigation Action Plan in collaboration with the curator and other specialists.

- Recommend and install equipment, utilities, and structural components in structures housing collections, including water, HVAC systems, power, and lighting.

- Develop work orders using the Facility Management Software System (FMSS), Project Management Information System (PMIS) statements, and Scopes of Work for structures and spaces housing collections, in collaboration with the curator.

- Coordinate new construction and renovation of structures and spaces housing collections.

- Coordinate landscaping adjacent to structures housing collections.

See Section D.3: Mitigation funding. See also the NPS Denver Service Center Design and Construction Division website.

A.6. What is the interdisciplinary team's role in museum emergency planning?

The ***interdisciplinary team***, coordinated by the curator, participates in planning and preparedness for museum emergencies. The team should include the emergency operations coordinator, facility manager, safety officer, Park Structural Fire Coordinator (PSFC), Regional Structural Fire Manager (RSFM) or Authority Having Jurisdiction (AHJ), chief ranger, chief of cultural and/or natural resources, and regional curator. Include the historical architect advisor, cultural landscape specialist, conservator, and other specialists as needed. The team should meet regularly to discuss emergency planning and mitigation projects.

A.7. What is the Incident Command System (ICS)?

The ***Incident Command System*** (ICS) is a uniform, scalable command structure that can be activated to address park-wide emergency incidents. It is also used for planned events.

NPS emergency operations are conducted using ICS as part of the National Incident Management System (NIMS). The Unified Command System is used when other agencies are involved. Under ICS, the Incident Commander (IC) has overall responsibility for managing the emergency incident. Once ICS is activated, park emergency response actions, including actions for the museum program, fall under the IC's authority.

The curator should:

- Ensure that collections and structures housing collections are addressed in park ICS planning documents, including the Continuity of Operations Plan (COOP).

- Liaise with the ICS Operations Section Chief and participate in planning meetings to represent collections needs and coordinate actions that impact collections and structures housing collections.

- Arrange for ICS training for all museum staff.

In the event that wildland fire impacts collections and structures housing collections, work with the IC and/or park Fire Management Officer to implement the steps outlined in the MCEOP.

See Section J.1: What training is needed? See also DO 55: Incident Management Program: 5.3: Incident and Event Management, Reference Manual 55: Incident Management Program: 4.1: National Program Management: Department of the Interior and 4.5: Chain of Command, *Management Policies (2006)* 8.2.5.2: Emergency Preparedness and Emergency Operations, and the Federal Emergency Management Agency (FEMA) National Incident Management System (NIMS) website.

A.8. What terms are used in this chapter?

In this chapter:

- *Collections* refer to museum objects, specimens, archival items, paper and associated electronic museum records, and collection images.
- *Designated secure and stable location* refers to a structure or space designated in advance with physical security, including access and key control policies and procedures, appropriate stable relative humidity (RH) and temperature, and exclusion of ultraviolet radiation (UV).
- *Emergency planning* includes planning, preparedness, mitigation, response, and salvage before, during, and after emergency incidents.
- *First Priority Criteria for Relocation and Salvage* are used to determine "First Priority" objects to be relocated and/or salvaged due to emergency incidents.
- *Hazards* or *Threats* are natural or human-caused occurrences or variables that can negatively impact life safety, collections, and structures housing collections.
- *Housing* refers to storing and/or exhibiting collections.
- *Incidents* are unplanned, and *Events* are planned activities. Incidents may also be referred to as "emergencies" or "disasters."
- *Risk* refers to the combination of hazards and vulnerabilities facing collections and structures housing collections.
- *Structures housing collections* include museums, collection storage facilities, centers, furnished historic structures, galleries, visitor centers, spaces within buildings, and administrative offices housing collections.
- *Vulnerabilities* refer to the susceptibility to damage of collections and structures housing collections.

See Section M: Glossary and Section N: Abbreviations. See also DOI Departmental Manual 900 DM 4: Coordination of Emergency Incidents.

B. DOI and NPS Museum Emergency Planning Policies and Standards

Department of the Interior (DOI) and NPS policies and standards below apply to collections housed in NPS and non-NPS structures and repositories.

B.1. DOI Departmental Manuals

411 DM 1: Identifying and Managing Museum Property
1.11.B.3: Emergency Management Plan (EMP): "… identifies risks and vulnerabilities to museum property from events such as fires, earthquakes, floods, tornadoes, or civil disturbances. The EMP pertains to each bureau/ office facility and non-bureau facility housing museum property. The EMP must be reviewed every 5 years and updated, if necessary."

900 DM 1: Emergency Management Program
1.3.A: Policy: "All Bureaus/Offices must provide necessary resources to prevent, protect against, mitigate the effects of, respond to, and recover from an incident; declared Emergency and/or Major Disaster…"

900 DM 2: Continuity of Operations (COOP) Program
2.5: Policy: "…[U]nits will have in place a comprehensive and effective COOP program to ensure continuity of essential Federal functions …"

See also 112 DM 18: Office of Emergency Management, 900 DM 3: National Security Emergency Preparedness (NSEP), 900 DM 4: Coordination of Emergency Incidents, and 905 DM 1: Policy, Functions, and Responsibilities.

B.2. NPS Museum Emergency Planning and Preparedness Standards

Implement the following museum emergency planning and preparedness standards for collections and structures and spaces housing collections:

1. Develop, approve, keep current, and implement a Museum Collections Emergency Operations Plan (MCEOP) as part of the park Emergency Operations Plan in accordance with Director's Order (DO) 24.4.3.10: Emergency Operation, that addresses museum collection requirements for emergency protection, response, relocation, and salvage. Review the MCEOP annually and update every five years.

2. Develop Emergency Response Steps for different emergency incidents in the MCEOP.

3. Complete the NPS Checklist for Preservation and Protection of Museum Collections to identify and document hazards to and vulnerabilities of museum collections and structures and spaces housing collections in accordance with DO 24.4.3.21: Checklist. Review and submit to the National Catalog annually in accordance with DO 24.5.2: Checklist.

4. Develop a Museum Mitigation Action Plan that includes corrective actions to be implemented to remove or reduce hazards and vulnerabilities identified in risk assessments. Review annually and update every five years.

5. Mitigate hazards and vulnerabilities identified in the Museum Mitigation Action Plan ***or*** relocate objects at risk to a designated secure and stable location.

B.3. NPS emergency planning policies

NPS Management Policies 5.3.1.1: Emergency Management: "Measures to protect or rescue cultural resources in the event of an emergency, disaster, or fire will be developed as part of a park's emergency operations and fire management planning processes."

NPS-28: Cultural Resource Management Guideline 9.D: Standards: "Each park and center has identified threats to … its museum collection and has taken appropriate measures to deal with them, including emergency planning."

Director's Order 24: NPS Museum Collections Management 4.3.10: Emergency Operation: "Park superintendents, center managers, and others who manage collections (with the assistance of museum management staff) have the following responsibilities:…Approve, keep current, and implement a Museum Collections Emergency Operations Plan, as part of the park's Emergency Operations Plan and consistent with the National Incident Management System, identifying museum collection vulnerabilities to events (such as fire, earthquakes, and floods) and responses that will protect resources without endangering human health and safety. Ensure that staff trains, practices, and prepares for emergency response."

See NPS Management Policies 8.2.5.2: Emergency Preparedness and Emergency Operations, RM-55: Incident Management Program Chapter 4.1: National Program Management, DO 58: Structural Fire Management, NPS Reference Manual 77 Chapter 4: Emergency Management, NPS Environmental Safeguards Plan for All-Hazards Emergencies, NPS Division of Law Enforcement, Security, and Emergency Services (LESES) website, RM-9: Law Enforcement Chapter 26: Physical Security and CCTV, NPS Emergency Services Branch website, DOI Office of Emergency Management Resource website and sample emergency management plan.

C. Risk Assessment

Risk assessment identifies possible ways losses can occur by evaluating the severity of an emergency incident, probability of occurrence, and exposure to hazards in structures and spaces housing collections. The two most common risks to museums are fire and water.

C.1. What is risk assessment?

Risk assessment involves the:

- Identification of ***hazards*** and ***vulnerabilities*** based on:
  - natural factors (earthquake, severe weather)
  - geological, geographic, and climatic factors (location within a floodplain or Wildland-Urban Interface)
  - human factors (construction, hot work, uncorrected deficiencies)
  - frequency of park, local, and region-wide emergency incidents

- Identification of how likely each ***structure*** housing collections is to sustain damage during and after an emergency incident due to:

- nature and/or condition of the structure and building envelope (unstable foundation, leaks, or cracks)
- regular maintenance of the building envelope, systems, and utilities
- presence or absence of automatic fire detection and alarm systems and automatic fire sprinkler and/or suppression systems

- Evaluation of the likelihood of damage to the ***collection*** due to:

  - how objects are stored or exhibited
  - ease with which objects can be relocated to a designated secure and stable location
  - object composition and condition
  - condition and nature of storage furniture and cabinetry
  - maintenance of the building and equipment

- Assessment of potential damage from emergency incidents that may manifest subsequently (cracks or structural damage).

See Figure 10.2: Risk Assessment Worksheet and Appendix F, Figure F.2: NPS Checklist for Preservation and Protection of Museum Collections. See also DOI Risks to Museum Collections - A Tool for Self-assessment.

C.2. What risk assessments are used to identify hazards and vulnerabilities?

Use the risk assessments listed below to identify hazards and vulnerabilities for inclusion in the Museum Mitigation Action Plan. Evaluate the collection and all structures and spaces housing collections, including storage, exhibit, and work spaces, as well as outdoor exhibits. If there are multiple structures, determine and document which structures face greater hazards than others.

- ***NPS Checklist for Preservation and Protection of Museum Collections*** (Appendix F, Figure F.2), referred to as ***Checklist*** in this chapter, is a self-assessment that must be completed by the curator and submitted to the National Catalog annually in accordance with DO 24.5.2: Checklist.

- ***Risk Assessment Worksheet*** (Figure 10.2), is a self-assessment completed by the curator. It should be reviewed annually and updated every five years. This is a fillable worksheet.

- ***Object Assessment*** (Figure 9.3) should be completed by the curator to support the decision to relocate individual First Priority objects to a designated secure and stable location. It should be used with the Museum Collections Assessment Matrix in RM-58 Chapter 7, Appendix A: Structural Fire Protection of Cultural Resources in the National Park Service (NPS).

- ***Physical Security Assessment*** for structures housing collections must be conducted by the Physical Security Coordinator every three to five years, depending on the Facility Security Level (FSL) of each structure. It should be conducted with the curator to identify security hazards and vulnerabilities, recommend corrective actions, and determine the FSL of each structure housing collections. See Chapter 14: Museum Security and the NPS LESES Physical Security website.

- ***Risk assessments conducted by specialists*** in engineering, museum fire protection, architecture, collections management, and other areas. For the Fire Protection Condition Assessment (FPCA), see Chapter 9, Section C:3: What is the Fire Protection Condition Assessment?

D. Museum Mitigation Action Plan

D.1. Museum Mitigation Action Plan overview

The Museum Mitigation Action Plan lists corrective actions to remove or reduce identified hazards and vulnerabilities in structures housing collections, utilities and systems, and operational procedures. Corrective actions are generated from the Checklist, Risk Assessment Worksheet, Object Assessment, Physical Security Assessment, comprehensive condition assessment, and risk assessments conducted by specialists.

A Sample Museum Mitigation Action Plan (Blank and Completed) is provided in Figures 10.3 and 10.3a.

The curator develops the Museum Mitigation Action Plan in collaboration with the emergency operations coordinator, facility manager, safety officer, PSFC, AHJ or RSFM, regional curator, interdisciplinary team, and appropriate specialists. The Museum Mitigation Action Plan must be reviewed annually, and updated every five years in accordance with NPS Museum Emergency Planning and Preparedness Standard (4) (MH-I 10.B.2.4). It should also be reviewed and updated after a major emergency incident, addition of a new or renovated structure or space to house collections, new exhibit installation, or change in the curator.

The Museum Mitigation Action Plan is only effective when implemented.

The Museum Mitigation Action Plan lists:

- Mitigation category.
- FMSS Location (number) and Location Description.
- Date listed.
- Corrective actions to be completed.
- Mitigation priority (immediate, intermediate, or long-term).
- Work order or PMIS number.
- Individual(s) responsible for completing corrective action.
- Date completed.

D.2. Decision not to implement corrective actions

The decision ***not*** to implement corrective actions identified in the Museum Mitigation Action Plan should be made in consultation with the curator, facility manager, emergency operations coordinator, regional curator, and interdisciplinary team, using the Object Assessment (Figure 9.3). The curator documents this decision using the Record of the Decision Not to Implement Corrective Actions in a Structure Housing Collections (Figure 10.3b). This is a fillable form.

D.3. Mitigation funding

The curator works with the facility manager, emergency operations coordinator, Contracting Officer's Representative (COR), regional curator, and regional fee and business office to obtain funding for mitigation projects. Sources of funding include cyclic maintenance, equipment replacement, repair and rehabilitation (RERE), recreation fee program, and other sources.

Corrective actions identified in the Museum Mitigation Action Plan and comprehensive condition assessment of the structure and systems are used to generate work orders using FMSS. Work orders are entered into PMIS to obtain funding for projects and develop Scopes of Work to mitigate hazards and vulnerabilities. Work with the facility manager and PSFC to ensure that location and condition information in FMSS for structures housing collections is up-to-date and accurate.

D.4. Arranging services in advance of an emergency incident

The curator works with the emergency operations coordinator, facility manager, PSFC, and park administration to establish the following in advance of an emergency incident:

- Agreements (formal or informal) or Memoranda of Understanding (MOUs) with local emergency and fire services, including:
  - commitment to respond to emergency incidents in spaces housing collections
  - scheduling tours of spaces housing collections
  - identification of hazardous collections and non-collection materials
- Collaborative or contractual relationships with:
  - conservation laboratories
  - designated secure and stable location(s) to temporarily house relocated objects
  - institutions (museums, archives, etc.) that can provide assistance after an emergency incident
  - facilities with commercial-grade freezers, including those outside the impacted area
- Arrangements with contractors and vendors, including vehicles, freezer trucks and supplies to relocate objects, Indefinite Delivery Indefinite Quantity (IDIQ) contracts for emergency services, and Blanket Purchase Agreements (BPA) for emergency supplies.

The regional office may establish mutual support arrangements with other parks and federal, state, regional, and county emergency entities.

See Figure 10.22: Emergency Vendor and Sources of Assistance List (Sample) and Chapter 9, Section D.4: What special considerations should be addressed with the local fire department?

D.5. Planning for a secure salvage area

The curator, as designated by the superintendent, is responsible for implementing written museum access and key control policies and procedures for collections on exhibit, in storage, and temporarily housed in salvage areas.

The curator must establish secure access and key control procedures for the salvage area, including a daily sign-in log and locking doors.

See Section I.2: Access to the Salvage Area, Figure 10.24: Salvage Procedures, and Chapter 14: Museum Security.

D.6. Planning for rapid emergency entry to collections

During an emergency incident, first responders may need access to secured structures and spaces housing collections. The curator should develop rapid entry procedures for access to collections during an emergency incident in consultation with the emergency operations coordinator, interdisciplinary team, and local fire department or first responders.

Many fire departments use emergency access key box systems (such as Knox-Box® or SupraSafe™) that use a master key for all key boxes in their jurisdiction. The curator ***must*** ensure that the local fire department's access and key control policies and procedures are sufficient to maintain museum security. Implement the rapid entry system ***in addition to,*** not as a substitute for, museum security systems and procedures.

The emergency access key box should have electronic tamper switches that are connected to the intrusion detection system(s) and monitored by closed-circuit television 24/7. The intrusion detection system(s) should detect and notify the receiving and monitoring station or central station and the curator of unauthorized attempts to enter spaces housing collections.

See Chapter 9, Section H.2: Planning for rapid entry to structures housing collections during a fire and Chapter 14: Museum Security.

D.7. Protecting the accession (and deacession) book and folders

The accession book and folders and (optional) deaccession book and folders must be housed in a secure room above grade in a locked and insulated UL listed fire-resistive filing cabinet or vault when not in use, in accordance with NPS Museum Fire Protection Standard (7) (MH-I 9.B.1.7). The accession (and deaccession) book is ***always*** considered First Priority for relocation in the event of an emergency.

For paper records, house in an insulated filing cabinet, safe, or vault with a UL listing of (350°F one-hour). For electronic museum records, backups, and media files, house in an insulated media safe or box with a UL listing of (125°F one-hour). ***Do not*** house the accession (and deaccession) book and documents in basements or attics.

D.8. Completing regular backups and scans

The curator should establish and implement a schedule to regularly back up Interior Collections Management System (ICMS) data, and back up digital object images. Make museum-quality photocopies and digital scans of the accession (and deaccession) book and documents. Secure copies and scans in the curatorial office, superintendent's office, with the regional curator, and off-site.

D.9. Object location and inventory information

To facilitate access and security and aid in object recovery in the event of theft or loss, complete the annual inventory and arrange for photography of objects, including catalog numbers. Maintain current object location for objects in storage, on exhibit, and on loan. Complete the annual inventory in accordance with MH-II, *Museum Records*, Chapter 4: Inventory and Other Special Instructions. Attach object images to Museum Catalog Records in ICMS.

E. Mitigating Hazards and Vulnerabilities

Mitigation includes corrective actions and/or operational procedures implemented to remove or reduce hazards and vulnerabilities. Implement corrective actions listed in the Museum Mitigation Action Plan ***prior*** to an emergency incident, in collaboration with the facility manager, emergency operations coordinator, and interdisciplinary team.

Implement general mitigation actions together with those for specific emergency incidents.

E.1. Mitigation for objects in storage

Implement best collections care practices described in this *Handbook* and:

- Locate collections above grade.
- ***Do not*** house collections in basements, attics, or areas susceptible to flooding.
- House museum collections in dedicated spaces separate from curatorial, research, and work areas and:
  - house supplies separately from collections storage
  - separate collections spaces from maintenance facilities and preparation areas with fire-rated walls, doors, and barriers
- Raise storage cabinets and shelving 4 – 6 inches off the floor.
- Raise oversized objects off the floor.
- House and secure:
  - objects in well-sealed locked steel cabinets or mobile compact storage systems, and close after use and at the end of each day
  - framed artwork on storage screens with steel security hardware such as S-hooks, L-hooks, or double-end bolt snaps
- Stabilize, attach, and/or restrain storage cabinets and furniture, including securing to walls, floors, and ceilings.
- Practice good housekeeping and avoid clutter.
- Inspect, isolate and monitor new accessions and objects returning to storage to prevent mold or pest contamination.

See Chapter 5: Biological Infestations and Chapter 7: Museum Collection Storage.

E.2. Mitigation for objects on exhibit

Implement best collections care practices described in this *Handbook* and:

- Secure:
  - objects in closed display cases *or* restrain objects on open display well out of reach
  - fragile objects such as ceramics on open display using custom mounts, in consultation with a conservator
  - framed artwork with steel security hardware such as S-hooks, L-hooks, or double-end bolt snaps
- Locate objects away from windows, doors, and pipes.
- Use laminated or shatterproof glass with UV screening, plexiglass, or protective film in exhibit cases and shelving, in consultation with exhibit designers.
- Light objects in accordance with MH-III, *Museum Collection Use*, Chapter 7, Section I.4: How do I balance exhibit lighting needs with preservation requirements?

Caution: Objects housed on open display and/or in open shelving are more susceptible to damage from fire, environmental extremes, and water from leaks and fire sprinklers. Plastic or Tyvek® sheeting is flammable and can melt or drip onto objects, and may cause significant damage.

See Chapter 9, Section E.10: Fire prevention for objects on exhibit and MH-III, *Museum Collection Use*, Chapter 7: Using Museum Collections in Exhibits.

E.3. Mitigation for structures housing collections

Implement best practices described in this *Handbook* and work with the:

- Facility manager to secure air ducts, ceilings, light fixtures, walls, and floors to the structure, and to ensure regular maintenance of the building envelope, utilities, and mechanical systems.
- Park safety officer, PSFC, and facility manager to establish a safety inspection schedule for fire hazards and hazardous materials in spaces housing collections.
- Structural engineer to determine the structural integrity and floor loading capacity of each structure housing collections to prevent structural collapse.
- Historical architect advisor, facility manager, and regional curator to add shatterproof glass or interior storm windows with UV screening in furnished historic structures, and develop other appropriate modifications in historic structures housing collections.

See Chapter 9, Section E.11: Fire prevention for objects on exhibit in furnished historic structures.

E.4. Construction and hot work damage mitigation

Construction and hot work pose an extreme risk of loss or damage to collections, particularly from fire and water. Implement precautions to prevent fire and water damage ***before*** work begins.

- Work with the PSFC to ensure a hot work permit (Form HW-1) is in place in accordance with RM-58: Structural Fire.

- Relocate objects from the area(s) or structure(s) undergoing extensive construction or renovation to a secure and stable location or protect in place.

- Ensure that collections and spaces housing collections are not exposed to the elements from open roofs or windows.

See Chapter 9, Sections E.15: Construction and renovation precautions and E.16: Hot work procedures. See also *Preservation Tech Notes* 2: Specifying Temporary Protection of Historic Interiors During Construction and Repair and 3: Protecting a Historic Structure during Adjacent Construction.

E.5. Earthquake damage mitigation

All NPS sites may be susceptible to earthquakes of varying frequency and intensity. The extent of earthquake damage depends on magnitude and duration, distance of the structure from the epicenter, soil and building type, level of seismic structural mitigation, and securing and stabilizing cabinetry and objects. Earthquakes can trigger other emergency incidents, such as fire due to fractured gas lines, or water damage caused by burst pipes. Damage and/or casualties may occur from falling debris.

Identify potential local earthquake risk. Avoid housing collections near geological fault lines, where possible. Work to meet applicable seismic safety standards with park and regional staff and experts, including architects and structural engineers experienced in working with museums and furnished historic structures.

To mitigate earthquake damage:

- Containerize:

  – fragile and breakable objects such as ceramics and glass in cavity packing, cradle mounts, ring and tie-down supports, or collars, or secure with cotton twill tape
  – objects in boxes or polyethylene foam-padded cabinet drawers

- Stabilize, secure, or restrain:

  – storage cabinets, exhibit cases, and equipment by attaching to walls, ceilings, and floors
  – objects on open display and in cases to prevent movement
  – large or heavy objects in storage and on exhibit as appropriate
  – tall or oversized objects with custom restraints
  – office equipment and filing cabinets, and close when not in use

- Install restraining bars, cords, or similar devices to prevent objects from sliding off shelving.

- House collections in structures built or modified to withstand earthquakes. Work with the facility manager, structural engineer, and architect to reinforce the structure. Work with the historical architect advisor for furnished historic structures.

- Ensure natural gas meters and propane tanks that serve collections areas are equipped with seismic shutoff valves.

See Chapter 7, Section I: Using Containers and Supports to House Objects, *COG* 21/12: A Custom Restraint to Mitigate Against Damage to Museum Objects Due to Seismic Activity, *Preservation Brief 41*: The Seismic Rehabilitation of Historic Buildings, and the USGS Earthquake Hazards Program for more information.

E.6. Fire damage mitigation

Structural fire is one of the most common and serious threats to collections. It can lead to loss of life and catastrophic loss or irreversible damage to collections and/or structures housing collections. Construction, renovation, hot work, and open flames pose a major fire risk.

See Chapter 9, Sections E: Fire-Safe Practices and Design and F: Fire Protection Systems and Equipment for best practices to mitigate structural fire damage.

E.7. Hazardous materials spills, exposure, and explosion damage mitigation

Hazardous materials spills or exposure may result from broken gas or fuel pipelines, earthquakes, fuel spillage, and volcanic fumes. Spills can include hazardous and biological waste and radioactive materials. Exposure may result from sick, infected, or deceased animals and blood, bodily fluids, or infectious material. Work with the safety officer or specialist to identify and dispose of hazardous materials and address spills.

Explosions can be caused by bombs, earthquakes, fires, malfunctioning gas lines, construction and hot work, hazardous objects, suspicious packages and items, or transportation accidents. Terrorist attacks can result in explosions and bombings that can trigger structural collapse, and may be preceded by a called-in or mailed-in bomb threat.

To mitigate hazardous materials spills and exposure or explosion damage:

- House:

  – collections away from laboratories and other areas where hazardous or flammable materials are housed or used
  – hazardous materials used in collections preparation in accordance with Chapter 9, Section E.6: Housing flammable and combustible materials
  – cellulose nitrate-based materials in accordance with Chapter 9, Section E.8: Cellulose nitrate-based materials
  – historic vehicles separately from general collections storage and

away from maintenance facilities

- Ensure fuel and oil are drained from historic vehicles and machinery and tanks are vapor free. Disconnect and secure vehicle batteries.

- House and handle historic firearms and ordnance with extreme caution in accordance with Chapter 11: Curatorial Health and Safety.

- Immediately notify the park safety officer of any gas odors.

- Properly dispose of hazardous waste.

- Maintain a hazardous materials list with storage locations and safety data sheets (SDS).

See Chapter 9, Section E.7: Housing wet (fluid-preserved) specimens and Appendix M: Management of Cellulose Nitrate and Ester Film. See also *COG* 11/3: Storage Concerns For Fluid-Preserved Collections, NPS Hazardous Waste Operations & Emergency Response Training Manual, DO 24.4.3.23: Cellulose Nitrate and Cellulose Ester Film and the OSHA, NFPA, and the Department of Justice's Bureau of Alcohol, Tobacco, Firearms and Explosives and Department of Homeland Security Hazardous Response Program websites.

E.8. Medical incident mitigation

Medical incidents such as falling or tripping in collections storage and exhibit areas can cause bodily injury and/or damage to objects.

- To prevent or minimize medical incidents:

  – ensure adequate lighting and avoid abrupt changes in light levels from area to area
  – keep stairways, landings, passageways, and aisles well lit and unobstructed
  – secure mats to the floor
  – keep pathways free of debris and carts
  – use non-skid wax on floors
  – do not overload boxes, shelving, and cabinets
  – secure objects and materials to prevent falling
  – place heavier objects on bottom shelves or closer to the ground
  – post warning signs in areas of potential danger

- Maintain a list of medical emergency services, staff with first aid training, and local hospitals in the MCEOP.

- Maintain basic and complete first aid kit(s), check annually, and replace expired supplies as needed.

See Chapter 6: Handling, Packing, and Shipping and Chapter 11: Curatorial Health and Safety for additional information.

E.9. Mold outbreak mitigation

Mold outbreaks are indicative of excess moisture. Outbreaks generally occur at 65% Relative Humidity (RH) and above. HVAC malfunctions, leaking pipes, poorly-sealed windows and doors, fire sprinkler discharge, or severe weather are common causes of high humidity and mold outbreaks.

Mold may be hazardous to health, depending on exposure and individual risk factors, and can cause severe damage to collections. Address moisture problems immediately to prevent mold outbreaks.

To mitigate damage from mold outbreaks:

- Maintain RH well below 65% and a stable temperature in accordance with Chapter 4: Museum Collections Environment. The RH set point for most NPS collections lies between 45 – 55 %. Fluctuations should not exceed ± 5% from the set point.
- Inspect the collection regularly for dampness, signs of visible mold growth, or a telltale "musty" smell.
- Identify and promptly remove the cause of the mold or dampness within 48 hours to avoid increased mold growth or major outbreaks.
- Work with the facility manager to maintain a well-sealed building envelope, promptly repair leaks, and remove all sources of standing water, moisture, or excess humidity.
- Work with the safety officer and a specialist to have the mold identified and abated as soon as possible.
- If the mold is determined to be hazardous, restrict access until the mold has been abated and the area is safe to re-enter.
- Follow salvage procedures for mold, and work with a conservator to clean contaminated objects.

See Section E.14: Water leak and flood mitigation, Figure 10.24: Salvage Procedures, Chapter 11: Curatorial Health and Safety, *COG* 1/8: Using Silica Gel In Microenvironments, *COG* 3/4: Mold: Prevention of Growth in Museum Collections, OSHA's Fact Sheet: Mold Hazards during Disaster Cleanup, and the CDC's Facts about *Stachybotrys chartarum* and Other Molds.

E.10. Power outage mitigation

Power outages include the loss of electric power or HVAC system shutoff. They may occur due to severe weather, construction, and/or other related work. Power outages can incapacitate a park, culminating in a complex emergency incident. This can result in:

- High RH and temperature due to HVAC failure that can lead to mold outbreaks, pest infestations, and accelerated object deterioration.
- Failure of security and fire detection and/or suppression systems.
- Loss of access to collections and collections information.
- Inadequate lighting that can result in medical incidents.

To mitigate damage from power outages:

- Work with the facility manager to:

  – ensure adequate back-up power sources, including generators, for emergency exit lights, HVAC, fire detection and suppression, security, lighting, and other utilities and systems
  – regularly inspect, test, and maintain utilities and equipment, including back-up power sources and batteries
  – install emergency lights near electrical, fire, and security panels and along evacuation routes
  – ensure that elevators have an emergency alarm, working phone connected to a 24/7 receiving, monitoring, or central station, and emergency access
  – arrange for alternate means of relocating objects if elevators are non-functional
  – acquire generators and dehumidifiers for spaces housing collections

- Use UL listed surge suppressors on equipment, including computers and freezers.

- Work with the facility manager or safety officer to obtain advance notice for planned outages.

- Plan for alternate arrangements should a long-term outage occur.

E.11. Severe weather damage mitigation

Severe weather includes blizzards, electrical storms, hail, hurricanes, sleet, tornadoes, and wind and winter storms. Many severe weather incidents can be anticipated, allowing for advance preparation such as relocation of First Priority objects. Severe weather may contribute to a complex emergency incident, such as a hurricane that results in flooding and structural damage.

Monitor National Weather Service (NWS) advisories and watch for signs of approaching weather fronts. Contact the facility manager to evaluate the potential impact when severe weather is predicted. Notify staff if action is required.

To mitigate damage from severe weather:

- Locate collections and museum records above grade and outside areas susceptible to flooding.

- ***Do not*** house collections in basements or attics.

- Raise storage cabinets 4 – 6 inches off the floor.

- Raise oversized objects off the floor.

- Secure objects on exhibit:

  – in closed exhibit cases
  – on open display using mounts or restraints

– away from windows, doors, and pipes, or protect in place

- Work with the facility manager, architect, historical architect advisor, and structural engineer to:

  – ensure the structure and structural elements are secure
  – seal and waterproof building envelope, including doors, windows, roofs, and basements
  – secure the foundation, roof, HVAC systems, lighting, outbuildings, and drainage and water removal systems
  – install storm shutters and storm windows in storage and work areas, and in furnished historic structures as appropriate
  – remove dead tree branches adjacent to structures housing collections
  – install lightning rods on structures housing collections

See FEMA, NOAA, and NWS advisories. See also NPS's Climate Change Policy and Planning web page.

E.12. Vandalism damage mitigation

Vandalism may be carried out by staff, researchers, or visitors. It can occur together with the theft of objects, civil unrest, and acts of terrorism. Vandalism may also occur after an emergency incident if security procedures and systems are not operational.

To mitigate damage from vandalism:

- House objects on exhibit in well-sealed cases with alarms, secure mounts, locks, and/or security screws.

- Secure ceramics and other fragile objects on open display using special mounts and/or alarmed cases.

- Locate collections storage and work spaces in secure areas away from public or ceremonial spaces, where possible.

- Maintain and implement operational and physical security, including:

  – access and key control policies and procedures, the NPS Visitor Log, and opening and closing procedures
  – accompanying all non-curatorial staff (NPS and non-NPS) in collections and/or work spaces
  – ongoing monitoring of non-curatorial staff in research spaces
  – functioning intrusion detection and alarm systems and closed-circuit televisions monitored 24/7
  – securing doors, windows, and locks at all times

- Work with interpretation to ensure visitors are accompanied on tours of furnished historic structures, and keep objects out of reach using protective barriers, enclosures, and other security measures.

- Report vandalism immediately. Arrange for repairs and additional security measures as soon as possible.

See Chapter 14: Museum Security and DO 9.2.2: Law Enforcement Authority.

E.13. Volcanic damage mitigation

Volcanoes may emit hot ash and acidic gases and cause mudslides, flash floods, tsunamis, earthquakes, rock falls, and explosive lateral blasts. Noxious fumes, volcanic smog, and acidic, corrosive ash can spread from the source of the eruption, damaging collections and structures and threatening life safety.

To mitigate volcanic damage:

- Avoid locating museum storage, work, or exhibit areas near active volcanoes, where possible.

- Work with the facility manager to:

  – install furnace filters to screen out particulate ash
  – remove all sources of excess humidity
  – keep interior RH stable to prevent volcanic ash from concretizing

See NWS, FEMA, and the USGS Volcano Hazards Program.

E.14. Water leak and flood mitigation

Water is one of the most common causes of damage to collections and structures housing collections. Water damage frequently results from:

- Poorly-sealed building envelopes, including leaking roofs, windows, or skylights.
- Burst, leaking, or faulty pipes.
- Poorly-maintained or malfunctioning HVAC systems.
- Drainage back-ups.
- Unemptied or faulty dehumidifiers.
- Unintended fire suppression system discharge.

If moisture problems are not addressed immediately, mold outbreaks are likely to occur.

Water damage can also result from natural disasters such as flash floods, floods, heavy rains, hurricanes, and tidal action. Some flooding incidents can be anticipated, allowing for advance preparation such as relocation of First Priority objects. Parks located near bodies of water are especially vulnerable to flooding.

To mitigate water and flood damage:

- Locate structures housing collections outside the 100-year flood plain and away from bodies of water such as dams, underground streams, swamps, tidal rivers, or coastal areas, where possible.

- Design, build, and maintain well-sealed structures housing collections, including storage, work, and exhibit spaces, to avoid water penetration.

- Locate collections and museum records above grade.

- ***Do not*** house collections in basements, attics, or areas susceptible to moisture and water penetration.

- Maintain RH well below 65% and a stable temperature in accordance with Chapter 4: Museum Collections Environment. The RH set point for most NPS collections lies between 45 – 55 %. Fluctuations should not exceed ± 5% from the set point.

- House collections in well-sealed metal cabinets and return to cabinets when not in use.

- Raise storage cabinets 4 – 6 inches off the floor.

- Raise oversized objects off the floor.

- Install water alarms (water detectors) to detect flooding.

- ***Do not*** house collections:

  - directly against outside walls susceptible to condensation and RH fluctuations
  - directly below or adjacent to sources of running water such as restrooms and water, waste, steam, fuel, or other liquid pipes
  - near condensing or other moisture-generating mechanical units

- Avoid storing collections in chipboard trays or other open containers that can capture and retain water.

- Inspect the collection regularly for signs of visible mold growth or a telltale "musty" smell.

- Empty dehumidifier overflow pans regularly.

- Only run piping for systems that serve collections through spaces housing collections, such as fire sprinklers and HVAC.

- ***Do not*** run grey water mains through spaces housing collections.

- Work with the facility manager to ensure that:

  - door seals, foundations, gutters, piping, roofs, walls, windows, brick, masonry, mortar joints, and other structural components are maintained in good condition
  - utilities, including HVAC and sprinkler systems, are regularly inspected, tested, and maintained
  - faucets, humidifiers, dehumidifiers, and other equipment are regularly checked and functioning
  - check valves are installed in sewer traps to prevent backups
  - pumps are installed and functioning

– landscape and plantings drain away from the structure

- ***Do not*** use carpeting and wallpaper in storage and work areas.

- Exclude drains in storage and exhibit areas to prevent backups and minimize open sources of moisture that can lead to mold and pest issues.

- Identify and label the location of water and utility shutoff valves in the MCEOP and work with the facility manager to ensure that they are shut off in the event of a water emergency.

See Section E.11: Severe weather damage mitigation, NPS Management Policies 9.1.1.5: Siting Facilities to Avoid Natural Hazards, and the FEMA, NOAA, and NWS websites. See also Chapter 4, Sections F.5: What deterioration is caused by relative humidity? and F.6: What is the recommended RH set point and fluctuation range for general collections?

F. Museum Collections Emergency Operations Plan

The Museum Collections Emergency Operations Plan (MCEOP) includes life safety procedures, Emergency Response Steps, and other essential information needed to respond to emergency incidents. In accordance with DO 24.4.3.10: Emergency Operation and NPS Museum Emergency Planning and Preparedness Standard (1) (MH-I 10.B.2.1), parks with museum collections must have a MCEOP that is appended to the park EOP.

The MCEOP is aligned with and maintained on the same review and update schedule as the park EOP. Keep the MCEOP current and sufficiently detailed to be useful and easy to implement.

F.1. Museum Collections Emergency Operations Plan (MCEOP) contents

The MCEOP should include the following (***Note:*** section and figure references for MCEOP elements not described in this section are indicated (in parentheses) below):

- Museum Emergency Planning Standards and Policies (Section B: DOI and NPS Emergency Planning Policies and Standards)

  – DOI and NPS Museum Emergency Planning Policies
  – NPS Museum Emergency Planning and Preparedness Standards

- Incident Command System (ICS) (Section A.7: What is the Incident Command System (ICS)?)

- Collections and Structures Housing Collections Overview (Figure 10.4: Museum Collections Emergency Operations Plan (Sample))

- Risk Assessment (Section C: Risk Assessment)

  – Risk assessment documents on file
  – Risks to collections and structures housing collections

- MCEOP Team Responsibilities

- First Priorities for Relocation and Salvage (Section H: Relocating Museum Objects)
  - First Priority objects for Relocation and Salvage
  - Restricting First Priority Information
- Emergency Response
  - Evacuation plan
  - Emergency Response Steps
  - Designated assembly point(s)
- Security (Section D: Museum Mitigation Action Plan and Figure 10.4: Museum Collections Emergency Operations Plan (Sample))
  - Designated secure and stable location for relocated objects
  - Access and key control policies and procedures
- Emergency Contact Information
  - Emergency contact list
  - Vendor and sources of assistance list
- Emergency Equipment, Services, and Supplies
  - Utility and mechanical equipment shut-offs
  - Emergency supplies and equipment
- Salvage Procedures (Section I: Salvaging Museum Objects and Figure 10.24: Salvage Procedures)
- Post-Emergency Critique (Figure 10.26: Post-Emergency Critique)
- MCEOP Update and Review
- Figures and Floor Plans
  - Site map
  - List and floor plan(s) of First Priorities for Relocation and Salvage *(Restricted distribution)*
  - Emergency supplies and utilities floor plan(s)
  - Evacuation route floor plan(s)

A Sample Museum Collections Emergency Operations Plan (Figure 10.4) is provided for customization by parks.

F.2. MCEOP team leader responsibilities

The curator is the ***MCEOP team leader*** and collaborates with the MCEOP team, emergency operations coordinator, facility manager, regional curator, and interdisciplinary team to develop the MCEOP. The MCEOP team leader represents the collections at park emergency and ICS planning meetings, and is on the park emergency call list. The MCEOP team leader collaborates with

MCEOP team members to:

- Develop and implement the MCEOP, review annually, and update every five years.
- Append the MCEOP to the park EOP in collaboration with the emergency operations coordinator.
- Develop Emergency Response Steps.
- Develop emergency contact, vendor and sources of assistance, and supply and equipment lists.
- Select MCEOP team members, assign responsibilities, and schedule MCEOP meetings.
- Determine object First Priorities for Relocation and Salvage (See Section H: Relocating Museum Objects).
- Arrange for and coordinate:
    - designated secure and stable location(s) for relocated objects, including access and key control policies and procedures
    - emergency supplies, equipment, vendor and contractor agreements, purchases, and services
    - relocation and salvage activities
    - documentation of museum emergency planning, response, and salvage activities
    - training with the emergency operations coordinator and safety officer
    - assistance from nearby parks, local museums, and conservators
- Brief superintendent and emergency operations coordinator on museum program needs.

See Sections D.4: Arranging services in advance of an emergency incident and G.4: National sources of assistance.

F.3. MCEOP team member responsibilities

MCEOP team members perform relocation and salvage activities, and are assigned the following responsibilities by the MCEOP team leader:

- *Emergency registrar* manages response and salvage documentation, including labeling, salvage activities, and supplies/equipment orders.
- *Salvage coordinator* prioritizes objects for salvage and facilitates packing and relocation.
- *Security coordinator* ensures collections security and works with the facility manager and emergency operations coordinator on utility and service recovery.

Designated MCEOP members should be available to respond 24/7 when an emergency occurs.

F.4. Restricting Relocation and Salvage First Priority information

Secure collections by limiting distribution of the Relocation and Salvage First Priority list and floor plan(s). The MCEOP team leader will:

- Maintain the MCEOP (paper copy) with the First Priority list and floor plan(s) in a secure, locked cabinet in the curatorial office, and limit access to electronic copies.

- Distribute MCEOP copies with the First Priority list and floor plan(s) to the superintendent and regional curator that must be secured in a locked cabinet.

- Provide copies of the MCEOP with the First Priority list and floor plan(s) ***redacted*** to the emergency operations coordinator and safety officer.

- Provide MCEOP team members with copies of the MCEOP with the First Priority list and floor plan(s) ***redacted***, and distribute First Priority list and floor plan(s) as needed.

- Maintain the MCEOP in a loose-leaf binder. Mark pages with First Priority information with "Sensitive Information: Do Not Distribute."

F.5. Emergency Response Steps included in the MCEOP

Include the following Emergency Response Steps in the MCEOP:

Active shooter; disruptive individual; earthquake; explosion; fire; hazardous materials spill, odor, and gas leak; medical emergency; mold outbreak; power outage; severe weather; suspicious package or item; suspicious person and vandalism; threat (threatening call or bomb threat); volcanic eruption; and water leak and flood.

See Section G.1: Emergency Response Steps for different emergency incidents and Figures 10.5 – 10.19: Emergency Response Steps.

F.6. Emergency contact list

The emergency contact list includes contact information and titles for:

- MCEOP team members and other museum staff.
- Park staff, including park EOP staff.
- Regional staff.
- Local sources of assistance, including fire, hospital, and police.
- Contractors and vendors.

Set up the list so that each staff member is responsible for calling several others at the time of the emergency to free up the MCEOP team leader for emergency response coordination. Post copies of the list in work and collections storage areas. Team members should keep a current copy of the contact list at home.

See Figure 10.21: Emergency Contact List (Sample) and Figure 10.22: Emergency Vendor and Sources of Assistance List (Sample).

F.7. Emergency supplies and equipment

Assemble emergency supplies and equipment for response, salvage, and environmental control in advance of an emergency incident. Store emergency supplies in an emergency cache labeled, “For Emergency Use Only.” Indicate cache locations and equipment such as dehumidifiers and fans on floor plans. Inventory and restock supplies and equipment annually and as needed. Maintain an emergency cache in each structure or space housing collections.

MCEOP team members should maintain a “ready bag” for use during and after emergency incidents. Bags should include documents, clothing, small tools, flashlight and batteries, hard hat, mask, and gloves. Centers and regional curators should maintain emergency supply and equipment caches to assist parks as needed.

See Figure 10.23: Emergency Supplies and Equipment (Sample). See also the DOI sample cache inventory and inspection form.

F.8. Floor plans

Develop and annotate floor plans in consultation with the facility manager and emergency operations coordinator. Indicate locations of:

- First Priorities for Relocation and Salvage, including paper and electronic museum records *(**redact** as described in Section F.4: Restricting Relocation and Salvage First Priority information).*

- Hazardous collections and non-collection materials.

- Emergency supplies and utilities, including:

  - emergency access key box
  - emergency and salvage equipment and supply caches
  - fire alarm pull boxes, fire control panels, extinguishers, and suppression equipment
  - utility locations, such as shutoff valves for water and power

- Evacuation route(s) and designated assembly point(s) from the park Occupant Emergency Plan (OEP).

Exclude security alarm panel, camera, or sensor locations on floor plans.

F.9. Review and update cycle

Review the MCEOP annually and update all copies every five years in accordance with NPS Museum Emergency Planning and Preparedness Standard (1) (MH-I 10.B.2.1). The MCEOP should also be reviewed and updated after each major emergency incident, change in the MCEOP team leader, large acquisition, new exhibit, when moving collections to another space or structure, identifying new risks, or entering into new cooperative relationships with emergency responders.

G. Museum Emergency Response

During an emergency incident, implement the Emergency Response Steps provided in Figures 10.5 – 10.19 and follow evacuation plans in the park Occupant Emergency Plan (OEP). Follow Incident Command System (ICS) procedures when activated.

During an emergency, life safety is paramount.

G.1. Emergency Response Steps for different emergency incidents

Emergency Response Steps are one-page action plans developed in advance of emergency incidents to ensure timely and effective response. Include Emergency Response Steps (listed in alphabetical order below) in the MCEOP.

- Active Shooter
  Figure 10.5
- Disruptive Individual
  Figure 10.6
- Earthquake
  Figure 10.7
- Explosion
  Figure 10.8
- Fire
  Figure 10.9
- Hazardous Materials Spill, Odor, and Gas Leak
  Figure 10.10
- Medical Emergency
  Figure 10.11
- Mold Outbreak
  Figure 10.12
- Power Outage
  Figure 10.13
- Severe Weather
  Figure 10.14
- Suspicious Package or Item
  Figure 10.15
- Suspicious Person and Vandalism
  Figure 10.16
- Threat (Threatening Call or Bomb Threat)
  Figure 10.17
- Volcanic Eruption
  Figure 10.18
- Water Leak and Flood
  Figure 10.19

Work with the emergency operations coordinator to align museum Emergency Response Steps with park EOP action plans and determine designated Shelter in Place locations for each structure housing collections.

G.2. Actions taken with advance notice

Take the following steps when there is advance notice of an emergency incident, such as severe weather:

- Monitor NWS and other advisories as appropriate.
- Tape refrigerators, freezers, and cold storage units shut and:
  - turn units to the coldest settings
  - seal with polyethylene sheeting and duct tape
  - mark with "Do not open" and name and date
- Secure objects in storage and on exhibit:
  - house in closed cabinets
  - move to center of the room and cover with polyethylene sheeting
  - cover large, freestanding non-moveable objects and furnishings with polyethylene sheeting, and restrain and/or brace as needed
  - raise oversized objects off the floor
- Relocate First Priority objects, accession (and deaccession) book, NPS Visitor Log, and a paper copy of the MCEOP to a designated secure and stable location.
- Back up and secure electronic museum files in a designated secure and stable location.
- Deinstall objects from exhibit and move to a designated secure and stable location as time permits.
- Work with facilities management to check back-up power sources for fire protection, security, and HVAC systems, and emergency lights.
- Secure and close all doors and windows and cover with storm shutters, boards, or tape.
- Brace exterior doors and place sandbags in front of doors as needed.

G.3. Shelter in Place

During certain emergency incidents, it may be safer to Shelter in Place than to evacuate. See specific Emergency Response Steps for appropriate Shelter in Place procedures.

G.4. National sources of assistance

Federal and private organizations listed below (in alphabetical order) provide assistance and training in emergency response and salvage.

- American Institute for Conservation Alliance for Response Tool Kit
- American Institute for Conservation National Heritage Responders
  24-hour assistance telephone number: (202) 661-8068
- Federal Emergency Management Agency (FEMA) Emergency Management Institute (EMI)

- Heritage Emergency National Task Force (HENTF) (FEMA)
- National Park Service conservators at centers and regional offices
- Northeast Document Conservation Center (NEDCC)
  24-hour assistance telephone number: (978) 470-1010
- Smithsonian Institution Cultural Rescue Initiative

G.5. Posting emergency response information

Post Emergency Response Steps, emergency contact list, and OEP evacuation routes and floor plans in accessible locations in storage and work areas.

H. Relocating Museum Objects

Determine which objects should be relocated to a secure and stable alternate structure or space ***in advance*** of emergency incidents. Establish priorities for relocation and salvage of objects, including “First Priority” objects and others as time permits. Designate a secure and stable location in advance to avoid confusion and delay during emergency response and salvage.

H.1. How are object First Priorities for Relocation and Salvage determined?

Determine relocation and salvage priorities by reviewing the Scope of Collection Statement and accession and catalog records, and using the First Priority Criteria for Object Relocation and Salvage (Figure 10.20) and Object Assessment (Figure 9.3). Consult with the Collections Advisory Committee and MCEOP team to establish priorities for relocation and salvage. For centers or parks serving as repositories for multiple units, work with parks to establish relocation and salvage first priorities.

First Priority Criteria for Object Relocation and Salvage
• Associated with Eminent Individual(s) or Event(s) or Resource(s) • Essential for Resource Management • High Frequency of Use • High Interpretive and/or Educational Value • High Monetary Value • High Research and Scientific Value • Mission Critical • On Loan to the Park • Rare or Irreplaceable • Type Specimen • Voucher Specimen

Figure 10.20. First Priority Criteria for Object Relocation and Salvage

In certain cases, a single criterion will determine that an object should be designated as First Priority, such as Rare or Irreplaceable, Type Specimen, or High Monetary Value. For others, a preponderance of criteria will determine if an object should be designated as First Priority, such as Association with Eminent Individual(s) or Event(s) or Resource(s), High Interpretive Value, and Mission Critical. Evaluate these criteria together with ease of access and relocation, as well as object size, mobility, and susceptibility to damage.

ONLY use First Priority determinations for relocation and salvage.

The accession (and deaccession) book ***must*** be First Priority for Relocation and Salvage. The NPS Visitor Log should also be a First Priority.

H.2. How are First Priority objects and museum records identified for relocation?

Mark cabinets containing First Priority objects with red tags to facilitate relocation by first responders during emergency incidents. Tag First Priority objects as "First Priority for Relocation." Only use object tags made of Tyvek® without metal grommets and strung with non-reactive, unsized string. ***Never*** adhere labels directly onto objects.

Include a floor plan and a list of First Priority objects with storage or exhibit locations in the MCEOP. ***Restrict distribution*** in accordance with Section F.4: Restricting Relocation and Salvage First Priority information.

Designate and maintain an ICMS data field for First Priority Objects for Relocation and Salvage.

Caution: Creating a First Priority list and tagging first priority objects has the potential to create a "shopping list" that increases ease of theft. As many thefts occur due to internal security breaches, the curator must balance the need to relocate and salvage objects during an emergency with collections security.

See Figure 10.4: Museum Collections Emergency Operations Plan (Sample) for a sample list and floor plan of First Priorities for Relocation and Salvage.

H.3. What are the considerations for seasonal, remote, and high risk areas?

Evaluate objects housed in seasonally-open or remote locations on a case-by-case basis. The curator should assess risk and whether objects should be relocated in consultation with the emergency operations coordinator, PSFC, and regional curator. Relocate objects designated as First Priority. Be aware that repeated packing, handling, and relocation is likely to damage objects.

If object(s) are to remain *in situ*, the structure needs to be secure and free of identified risks. Electrical wiring needs to be in good condition, and electrical appliances disconnected.

H.4. When does relocation happen?

Relocation may occur ***prior to*** an emergency incident, when there is advance warning, or ***immediately after*** the emergency incident, once the affected space is cleared for entry. Relocate First Priority objects ***only*** when a greater danger is posed by leaving them in storage or on exhibit.

H.5. Where should objects be relocated?

In advance, arrange for a designated secure location to house collections that has stable RH and temperature and excludes UV. This location may be in another structure in the park or at another park, center, or institution.

I. Salvaging Museum Objects

The first 48 – 72 hours after an emergency incident are critical to prevent further object damage or loss. Relocate and salvage First Priority objects first. Consider variables such as object condition and damage, access, and ease of movement when determining which other objects should be relocated and salvaged.

The goal of salvage is to stabilize affected objects. Salvage should not be considered conservation treatment. Remember, "less is more." Do the minimum necessary to prevent loss or irreversible damage to the object. After 48 – 72 hours, arrange for professional conservation of objects that need treatment.

I.1. Procedures before beginning salvage

Re-enter the structure to assess the affected area(s) and collections once cleared. Set up and secure the salvage area and relocate objects. Work with the regional curator and a conservator to determine if and what professional treatment is needed after the objects have been removed from immediate danger. Document damage and salvage procedures with written reports and photographs. Include catalog numbers in object images.

I.2. Access to the salvage area

The curator needs to ensure access and key control policies and procedures for affected structures and spaces are in place. The curator sets up procedures to secure and control access to the salvage area, including a daily sign-in log for MCEOP team members, volunteers, and service providers.

I.3. Determining which objects should be salvaged

Salvage First Priority objects first, including the accession (and deaccession) book. If multiple structures housing collections are affected, address the structure housing the greatest number of First Priority objects first. Determine which other objects should be salvaged, as time permits, in consultation with the regional curator and a conservator. Consider variables such as object condition and damage, size and weight, access, and ease of movement. Be aware that certain materials, such as animal skins, basketry, glass plate negatives, metals, paintings, photographic materials, and works on paper may require professional treatment after the first 48 – 72 hours have passed.

I.4. Salvage procedures for different types of damage

See Figure 10.24: Salvage Procedures for the following procedures:

- Before Salvage
- Preparing the Salvage Area
- General Salvage Procedures
- Mold
- Water Damage to Objects
- Water Damage to Spaces Housing Collections

See Section K: Bibliography, *Conserve O Gram* series 21: Disaster Response and Recovery, and *Primer on Disaster Preparedness, Management & Response*, issued by the Smithsonian Institution, National Archives and Records Administration, Library of Congress, and National Park Service. See also the Emergency Response & Salvage Wheel, published by AIC.

J. Training and Documentation

J.1. What training is needed?

Arrange for hands-on training for museum staff, including the MCEOP team, ***before*** emergency incidents occur. To avoid compromising life safety and minimize damage to collections, the team must know what to do without having to think about it. Training improves efficiency and builds "muscle memory" that allows Emergency Response Steps and salvage procedures to be adapted to the specifics of each emergency incident. Have the entire team undergo training annually and whenever a team member is replaced.

The MCEOP team leader should take the following:

- FEMA IS-700.B: An Introduction to the National Incident Management System (online).
- DOI All-Hazards Resource Advisor Basic Course.

Museum staff, including the MCEOP team, should take the following:

- FEMA IS-100.C: Introduction to Incident Command System (online).
- FEMA IS-200.C: Basic Incident Command System for Initial Response (online).
- Situational awareness training provided by the emergency operations coordinator.
- CPR/first aid training.
- PPE training for designated MCEOP team members.

Museum staff, including the MCEOP team, should become familiar with:

- Handling objects in emergency situations.
- Locating and using emergency equipment, including portable fire extinguishers.
- Basic object salvage techniques.
- Documentation, including how to complete a Collection Damage and Salvage Overview (Figure 10.25) to record damage.

Familiarize non-museum staff in regular contact with collections on exhibit in visitor centers and furnished historic structures, such as interpreters, with appropriate sections of the MCEOP.

J.2. What emergency drills and exercises should be conducted?

Conduct hands-on museum emergency preparedness, response, and salvage exercises in collaboration with the emergency operations coordinator, safety officer, and PSFC. Ensure museum program needs are incorporated into the park's annual emergency training, emergency drills, and mock emergency and tabletop exercises. Conduct drills and exercises annually and when MCEOP team composition changes.

J.3. What documentation is needed?

Document emergency planning and preparedness activities, object movement, and relocation, damage, and salvage activities. House documents in the curatorial office and limit distribution as appropriate. Documentation includes:

- *Planning and mitigation:* Checklist and other risk assessment documents, current Museum Mitigation Action Plan, relocation and salvage First Priority determinations (***restricted access***), and MCEOP.

- *Implementation of corrective actions:* Museum Mitigation Action Plan (Figure 10.3), Object Assessment (Figure 9.3), and Record of the Decision Not to Implement Corrective Actions in a Structure Housing Collections (Figure 10.3b).

- *Relocation:* Tracking and object relocation and storage information, including packing inventories.

- *Salvage:* Written reports, logs, Collection Damage and Salvage Overview (Figure 10.25), condition reports describing the type(s) of object damage sustained, salvage activities (freezing, drying, etc.) and who authorized them, and other information.

- *Photography:* Images of affected objects and salvage activities.

J.4. What are the Post-Emergency Critique and After-Action Review?

The Post-Emergency Critique (Figure 10.26), conducted once salvage has ended, evaluates the effectiveness of the MCEOP. It is used to update the MCEOP. The MCEOP team leader and team members should collaboratively complete the Post-Emergency Critique to identify strengths and weaknesses and improve performance. Complete the Post-Emergency Critique within a month of the emergency incident to ensure that lessons learned are documented.

The park, region, or WASO will conduct an After-Action Review (AAR) after all incidents in accordance with DO 55.5.3.7: After Action Review (AAR). The MCEOP team leader should represent the museum program at the AAR review discussion.

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L. List of Figures

See also Appendix F, Figure F.2: NPS Checklist for Preservation and Protection of Museum Collections.

Museum Risk Assessment Worksheet (Excel) January 2022

(Note: Microsoft Edge users, please download file.)

MUSEUM MITIGATION ACTION PLAN (SAMPLE) (BLANK)

Park Name: ______________________________ **Completed By:** ________________________
(Name, Title)

Mitigation Category	**FMSS Information**		**Date Listed**	**Corrective Actions to be Completed**	**Mitigation Priority (Immediate / Intermediate / Long-Term)**	**Work Order / PMIS #**	**Individual(s) Responsible for Completing Corrective Action (Name, Title)**	**Date Completed**
	Location (Number)	**Location Description**						
Building envelope								
Building utilities & systems								
Spaces storing collections								
Spaces exhibiting collections								
Collections								
Operational Procedures								

Figure 10.3. Museum Mitigation Action Plan (Sample) (Blank)

MUSEUM MITIGATION ACTION PLAN (SAMPLE) (COMPLETED)

Park Name: Beautiful Home National Historic Site **Completed By:** Marianne Kuratur, Curator
(Name, Title)

Mitigation Category	FMSS Information		Date Listed	Corrective Actions to be Completed	Mitigation Priority (Immediate / Intermediate / Long-Term)	Work Order / PMIS #	Individual(s) Responsible for Completing Corrective Action (Name, Title)	Date Completed
	Location (Number)	Location Description						
Building envelope	555555	Hilltop House	8/20/2020	Repair cracked window near north entrance.	Immediate	9081127	Chris Fixit, Facility Manager	9/1/2020
Building envelope	555555	Hilltop House	10/25/2020	Fix drainage near downspout footings.	Immediate	9082085	Chris Fixit, Facility Manager	10/30/2020
Building envelope	555556	Curatorial Facility	3/28/2020	Acquire new HVAC system.	Long-Term	9082006	Chris Fixit, Facility Manager	10/19/2020
Building envelope	555556	Curatorial Facility	11/13/2020	Repair building structural seals around windows, doors, etc.	Intermediate	N/A	Chris Fixit, Facility Manager	Scheduled for Spring 2021
Building utilities & systems	555556	Curatorial Facility	11/15/2020	Arrange for back-up power source for security, emergency lighting, and HVAC.	Intermediate	N/A	Marianne Kuratur, Curator Chris Fixit, Facility Manager	Scheduled for Spring 2021
Building utilities & systems	555556	Curatorial Facility, Room 1104	8/1/2020	Replace fire detection and suppression system.	Intermediate	9081203	Marianne Kuratur, Curator Chris Fixit, Facility Manager	9/5/2020
Spaces storing collections	555556	Curatorial Facility, Room 1105	9/14/2020	Bolt and brace storage cabinets to structural walls.	Immediate	9081298	Chris Fixit, Facility Manager	9/17/2020
Spaces exhibiting collections	555555	Hilltop House	7/13/2020	Install water alarms.	Intermediate	9081105	Chris Fixit, Facility Manager	8/8/2020
Operational procedures	555556	Curatorial Facility, Room 1106	10/22/2020	Store hazardous chemicals in labeled flammable liquid safety cabinets.	Intermediate	N/A	Marianne Kuratur, Curator Andrew Neat, Safety Officer	11/14/2020

Figure 10.3a. Museum Mitigation Action Plan (Sample) (Completed)

Record of the Decision Not to Implement Corrective Actions
in a Structure Housing Collections

Park Name	
FMSS Location (Number)	FMSS Location Description
Number of Floors	Floor Area (Sq. Ft.)

Completed by: ____ Date: ____________________
(Print Name, Title)

Indicate if the building or structure is (Check all that apply):			
☐ Storage	☐ Work Room	☐ Preparation Area	☐ Research Room
☐ Exhibit Gallery	☐ Furnished Historic Structure		☐ Visitor Center
☐ Other			

Type of construction (concrete, wood, steel, masonry, etc.) for the following:	
Walls	
Floors	
Ceilings	
Roof	
Supporting Members	
Other	

List and describe proposed corrective actions identified in the Museum Mitigation Action Plan for this structure:

Indicate the rationale for ***not*** implementing proposed corrective actions in this structure:

Figure 10.3b. Record of the Decision Not to Implement Corrective Actions in a Structure Housing Collections

[*Beautiful Home National Historic Site (BEHO)*]

MUSEUM COLLECTIONS EMERGENCY OPERATIONS PLAN (SAMPLE)*

Recommended by Curator	Name (Print)	Signature	Date
Concurred by Chief Ranger	Name (Print)	Signature	Date
Concurred by Park Emergency Operations Coordinator	Name (Print)	Signature	Date
Concurred by Park Facility Manager	Name (Print)	Signature	Date
Concurred by Regional Curator	Name (Print)	Signature	Date
Approved by Superintendent	Name (Print)	Signature	Date

*Customize this plan as needed.

Figure 10.4. Museum Collections Emergency Operations Plan (Sample)

Record of Changes to the Museum Collections Emergency Operations Plan

The following information in the MCEOP has been updated:

Page	Section	Change	Made by, Title	Date
3	Section E	New MCEOP team member added.	Marianne Kuratur, Museum Curator	1/18/2020
5	Section I	Appended updated list of emergency vendors and sources of assistance	Marianne Kuratur, Museum Curator	2/15/2020

Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

[*BEHO*] Museum Collections Emergency Operations Plan

Title Page

Record of Changes to the Museum Collections Emergency Operations Plan

TABLE OF CONTENTS

Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

[*BEHO*] MUSEUM COLLECTIONS EMERGENCY OPERATIONS PLAN

This Museum Collections Emergency Operations Plan (MCEOP) provides guidance for responding to emergency incidents that impact life safety and museum collections at [*Beautiful Home National Historic Site (BEHO)*]. It includes Emergency Response Steps, First Priorities for Relocation and Salvage, emergency contact, vendor and sources of assistance, and supply and equipment lists, floor plans, access and key control policies and procedures, designated secure and stable location, and salvage procedures.

This MCEOP has been appended to the [*BEHO*] park Emergency Operations Plan (EOP). It is reviewed annually and updated every five years. It is activated when the Incident Command System (ICS) becomes operational.

A. MUSEUM EMERGENCY PLANNING STANDARDS AND POLICIES

1. DOI and NPS Museum Emergency Planning Policies

This MCEOP is developed in accordance with:

411 DM 1: Identifying and Managing Museum Property 1.11.B.3: Emergency Management Plan (EMP): "… identifies risks and vulnerabilities to museum property from events such as fires, earthquakes, floods, tornadoes, or civil disturbances. The EMP pertains to each bureau/office facility and non-bureau facility housing museum property. The EMP must be reviewed every 5 years and updated, if necessary."

900 DM 1: Emergency Management Program 1.3.A: Policy "All Bureaus/Offices must provide necessary resources to prevent, protect against, mitigate the effects of, respond to, and recover from an incident; declared Emergency and/or Major Disaster…"

NPS Management Policies 5.3.1.1: Emergency Management: "Measures to protect or rescue cultural resources in the event of an emergency, disaster, or fire will be developed as part of a park's emergency operations and fire management planning processes."

NPS-28: Cultural Resource Management Guideline 9.D: Standards: "Each park and center has identified threats to the security and protection of its museum collection and has taken appropriate measures to deal with them, including emergency planning."

NPS Director's Order 24.4.3.10 Emergency Operation: "Park superintendents, center managers, and others who manage collections (with the assistance of museum management staff) have the following responsibilities:…Approve, keep current, and implement a Museum Collections Emergency Operations Plan, as part of the park's Emergency Operations Plan and consistent with the National Incident Management System identifying museum collection vulnerabilities to events (such as fire, earthquakes, and floods) and responses that will protect resources without endangering human health and safety. Ensure that staff trains, practices, and prepares for emergency response."

2. NPS Museum Emergency Planning and Preparedness Standards

1. Develop, approve, keep current, and implement a Museum Collections Emergency Operations Plan (MCEOP) as part of the park Emergency Operations Plan in accordance with Director's Order (DO) 24.4.3.10: Emergency Operation, that addresses museum collection requirements for emergency protection, response, relocation, and salvage. Review the MCEOP annually and update every five years.
2. Develop Emergency Response Steps for different emergency incidents in the MCEOP.
3. Complete the NPS Checklist for Preservation and Protection of Museum Collections to identify and document hazards to and vulnerabilities of museum collections and structures and spaces housing collections in accordance with DO 24.4.3.21: Checklist. Review and submit to the National Catalog annually in accordance with DO 24.5.2: Checklist.
4. Develop a Museum Mitigation Action Plan that includes corrective actions to be implemented to remove or reduce hazards and vulnerabilities identified in risk assessments. Review annually and update every five years.
5. Mitigate hazards and vulnerabilities identified in the Museum Mitigation Action Plan *or* relocate objects at risk to a designated secure and stable location.

1

Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

B. INCIDENT COMMAND SYSTEM (ICS)

The superintendent activates the Incident Command System (ICS). In accordance with Director's Order 55.3.12: Chain of Command, "During emergencies or special events, the chain of command still exists. However, any level of the chain may delegate authority to an Incident Commander or Area Commander."

The MCEOP team leader, as a resource advisor, will familiarize the Incident Commander (IC) or designee with the MCEOP and the needs of the collection.

C. COLLECTIONS AND STRUCTURES HOUSING COLLECTIONS OVERVIEW

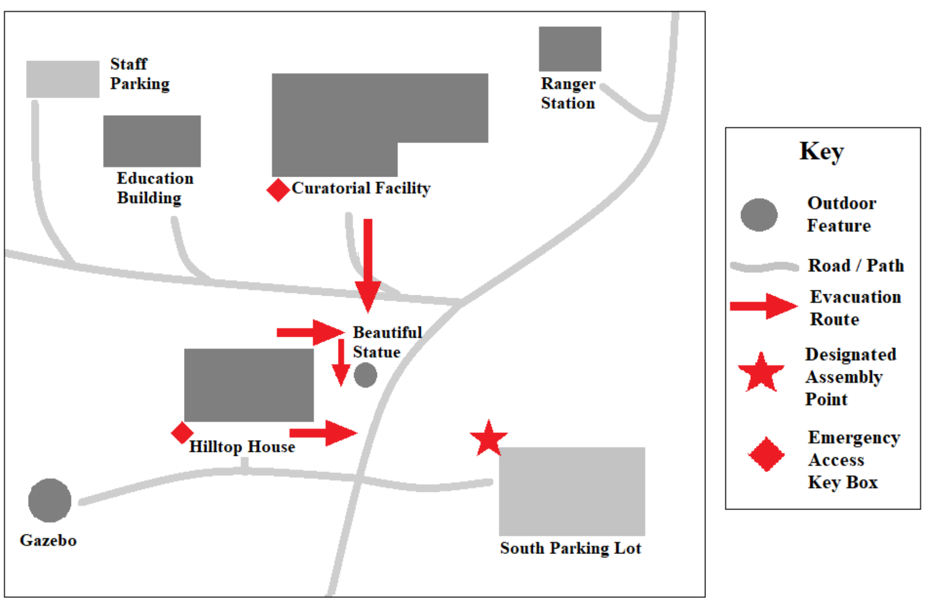
Structures housing collections at [*BEHO*] include [*Hilltop House, a furnished historic structure built in 1898,*] and [*a purpose-built Curatorial Facility*] (see Site Map). The [*BEHO*] collection numbers [*16,000 objects,*] including [*artwork, archeology, history, furnishings, historic photographs, and archival items original to the site.*]

The [***BEHO***] collections and museum records are housed in the [*Curatorial Facility*], with [*550 objects*] on exhibit in [*Hilltop House.*] [*Emergency access key boxes are located in front of Hilltop House and the Curatorial Facility.*] A museum-quality photocopy of the accession book and digital scans of the accession book, accession documents, Edgar Beautiful diary, backup copies of ICMS records, and digital collection images are housed in [*the Superintendent's office*], off-site at [*RELO Park*], and with the regional curator as of [*Oct 13, 2019.*]

[***Hilltop House***] (FMSS Location # [*77777*], [*National Register of Historic Places (#99999999)*]), built in [*1898, is the home of Edgar and Augusta Beautiful and family.*] It is a furnished [*two*] story structure with a [*stone*] foundation and a [*slate shingle*] roof. There are [*two*] exterior doors on the [*ground floor.*] Each floor has [*four single pane shuttered sash*] windows. Floors are [*original hard wood.*] Doorways to furnished rooms have [*plexiglass barriers installed.*] The building is equipped with [*intrusion detection, fire detection, and wet pipe fire sprinkler*] systems. Hilltop House is located [*two miles from the town center.*] Public access to Hilltop House is [*by scheduled ranger-led tour.*]

The [***Curatorial Facility***] (FMSS Location# [*77776*]), located [*a quarter mile from Hilltop House*], is a [*one*]-story, [*purpose-built concrete block structure*] with [*two*] exterior doors built in [*1993.*] It includes [*the curatorial offices, work and research spaces, and a supply room*] and [*is open to researchers by appointment.*]

[*Park administration*], including the Superintendent's office, is located [*in the town center.*]



BEHO Site Map

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Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

D. RISK ASSESSMENT

1. Risk Assessment Documents on File

The following risk assessment documents are on file in the [*curator's office in the Curatorial Facility*]:

- NPS Checklist for Preservation and Protection of Museum Collections
- Risk Assessment Worksheet
- First Priorities for Relocation and Salvage
- Object Assessment
- Museum Mitigation Action Plan
- Physical Security Assessment for structures housing collections

A paper copy of the current Museum Mitigation Action Plan is on file in the [*facility manager's office and emergency operations coordinator's office.*]

2. Risks to Collections and Structures Housing Collections

The park is at high risk from the following emergency incidents:

- [*Fire: Hilltop House's historic wood furnishings increase susceptibility to damage from structural fire.*
- *Severe Weather: The park is located in a hurricane zone.*
- *Water Damage: The original copper pipes in Hilltop House are prone to pinhole leaks.*]

E. MCEOP TEAM RESPONSIBILITIES

MCEOP team leader is on call 24/7 to respond to emergency incidents affecting collections and structures housing collections and will, in collaboration with the MCEOP team:

- Develop and implement the MCEOP, review annually, and update every five years.
- Append the MCEOP to the park EOP, in collaboration with the emergency operations coordinator.
- Develop Emergency Response Steps.
- Develop emergency contact, vendor and sources of assistance, and supply and equipment lists.
- Select MCEOP team members, assign responsibilities, and schedule MCEOP meetings.
- Determine object First Priorities for Relocation and Salvage.
- Arrange for and coordinate:
  - designated secure and stable location(s) for relocated objects
  - emergency supplies, equipment, vendor and contractor agreements, purchases, and services
  - relocation and salvage activities
  - documentation of museum emergency planning, response, and salvage activities
  - training with the emergency operations coordinator and safety officer
  - assistance from nearby parks, local museums, and conservators
- Brief superintendent and emergency operations coordinator on museum program needs.

MCEOP team members perform relocation and salvage activities, and include:

Emergency registrar manages response and salvage documentation, including labeling, salvage activities, and supplies/equipment orders and availability.

Salvage coordinator prioritizes objects for salvage and facilitates packing and relocation.

Security coordinator ensures collections security and works with the facility manager and emergency operations coordinator on utility and service recovery.

3

Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

F. FIRST PRIORITIES FOR RELOCATION AND SALVAGE

1. First Priority Objects for Relocation and Salvage

First Priority objects on exhibit in [*Hilltop House*] and in storage in the [*Curatorial Facility*] are identified in the list and floor plans on [*pages 7 - 8*]. Storage cabinets containing First Priority objects are identified with red tags.

2. Restricting First Priority Information

The MCEOP team leader will:

- Maintain the MCEOP (paper copy) with the First Priority list and floor plan(s) in a secure, locked cabinet in the curatorial office, and limit access to electronic copies.
- Distribute MCEOP copies with the First Priority list and floor plan(s) to the superintendent and regional curator that must be secured in a locked cabinet.
- Provide copies of the MCEOP with the First Priority list and floor plan(s) ***redacted*** to the emergency operations coordinator and safety officer.
- Provide MCEOP team members with copies of the MCEOP with the First Priority list and floor plan(s) ***redacted***, and distribute First Priority list and floor plan(s) as needed.
- Maintain the MCEOP in a loose-leaf binder. Mark pages with First Priority information with "Sensitive Information: Do Not Distribute."

G. EMERGENCY RESPONSE

1. Evacuation Plan

[*Attach*] a copy of the Evacuation Plan for [*Hilltop House*] and the [*Curatorial Facility*] from the park Occupant Emergency Plan (OEP).

2. Emergency Response Steps

[*Attach*] the following Emergency Response Steps:

Type of Emergency Response Step	Figure Number
Active Shooter	10.5
Disruptive Individual	10.6
Earthquake	10.7
Explosion	10.8
Fire	10.9
Hazardous Materials Spill, Odor, and Gas Leak	10.10
Medical Emergency	10.11
Mold Outbreak	10.12
Power Outage	10.13
Severe Weather	10.14
Suspicious Package or Item	10.15
Suspicious Person and Vandalism	10.16
Threat (Threatening Call or Bomb Threat)	10.17
Volcanic Eruption	10.18
Water Leak and Flood	10.19

4

Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

3. Designated Assembly Point

The designated assembly point is the [*South Parking Lot.*] See Site Map.

H. SECURITY

1. Designated Secure and Stable Location for Relocated Objects

The designated secure and stable location for relocated objects is [*RELO Park.*]

2. Access and Key Control Policies and Procedures

The curator develops and implements access and key control policies and procedures and maintains keys and keycards for [*Hilltop House*] and the [*Curatorial Facility*], including cabinets and exhibit cases, and the salvage area. The curator maintains a sign-in log for the salvage area.

[*Attach*] list of all individuals with keys, key cards, or security system access codes for [*Hilltop House*], the [*Curatorial Facility*], and the salvage area, including structures, spaces, and room(s) to which they have access.

I. EMERGENCY CONTACT INFORMATION

1. Emergency Contact List

[*Attach*] Emergency Contact List (Figure 10.21).

2. Vendor and Sources of Assistance List

[*Attach*] Emergency Vendor and Sources of Assistance List (Figure 10.22).

J. EMERGENCY EQUIPMENT, SERVICES, AND SUPPLIES

1. Utility and Mechanical Equipment Shut-Offs

[*Attach*] list of utilities and mechanical equipment, including electrical, cooling, HVAC, fire protection, and security systems, with shut-off locations and responsible individual(s).

2. Emergency Supplies and Equipment

[*Attach*] list of emergency supplies and equipment (Figure 10.23).

K. SALVAGE PROCEDURES

Quickly and safely relocate affected objects in accordance with the First Priority list to a designated secure and stable location outside the impacted area. *Relocate objects **only** when a greater danger is posed by leaving them in storage or on exhibit.*

[*Attach*] Salvage Procedures (Figure 10.24) to this plan, including: Before Salvage, Preparing the Salvage Area, General Salvage Procedures, Mold, Water Damage to Objects, and Water Damage to Spaces Housing Collections.

L. POST-EMERGENCY CRITIQUE

[*Attach*] the Post-Emergency Critique (Figure 10.26), completed within one month of the emergency incident.

M. MCEOP UPDATE AND REVIEW

The MCEOP is reviewed annually and updated every five years by the MCEOP team leader in collaboration with the MCEOP team. This MCEOP is also reviewed and updated after each major emergency incident, change in the MCEOP team leader, addition of a new or renovated structure or space to house collections, large acquisition, new exhibit, when new risks are identified, or when entering into new cooperative relationships with emergency responders.

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Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

N. LIST OF FIGURES

[*Attach*] the following figures:

First Priority Object List for Relocation and Salvage (***Restricted distribution***)
Floor Plan: Curatorial Facility First Priorities for Relocation and Salvage (***Restricted distribution***)
Floor Plan: Hilltop House First Priorities for Relocation and Salvage (***Restricted distribution***)
Floor Plan: Curatorial Facility Emergency Supplies and Utilities
Floor Plan: Hilltop House Emergency Supplies and Utilities
Floor Plan: Curatorial Facility Evacuation Route
Floor Plan: Hilltop House Evacuation Route

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Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

FIRST PRIORITY OBJECT LIST FOR RELOCATION* AND SALVAGE

RESTRICTED INFORMATION
Distribute ONLY to the superintendent, MCEOP team leader, and regional curator.
Remove this page from other copies of the MCEOP.

First Priority Objects for Relocation and Salvage

Catalog Number	Object Name	Room	Location
N/A	*Accession Book*†	*Curatorial Facility Room 1106*	*Fire-Resistive Cabinet 2, Shelf 1*
BEHO 45, BEHO 237	*Navajo Rugs*	*Curatorial Facility Room 1105*	*North Wall, Rolled Storage, Rolls C1 and C2*
BEHO 1645, BEHO 1723	*Type Specimens*	*Curatorial Facility Room 1105*	*East Wall, Cabinet A3, Shelves 3 and 4*
BEHO 124	*Washington Letter*	*Curatorial Facility Room 1105*	*South Wall, Cabinet B5, Shelf 4*
BEHO 97	*Buffalo Hide Tipi*	*Curatorial Facility Room 1105*	*South Wall, Cabinet C6, Shelf 2*
BEHO 3	*Edgar Beautiful Diary*	*Hilltop House, Master Bedroom, Second Floor*	*West side of room, on end table next to bed*
BEHO 5	*Portrait of Augusta Beautiful*	*Hilltop House, Library, First Floor*	*East wall, hanging in center of wall parallel with entrance*

*First Priority objects are to be relocated to [*RELO Park*] in the event of an emergency.

†A museum-quality photocopy of the accession book and a digital scan of the accession book and documents were deposited in the [*Superintendent's office*] and with the regional curator on [*Oct 13, 2019.*] A digital scan of the accession book is housed off-site at [*RELO Park.*]

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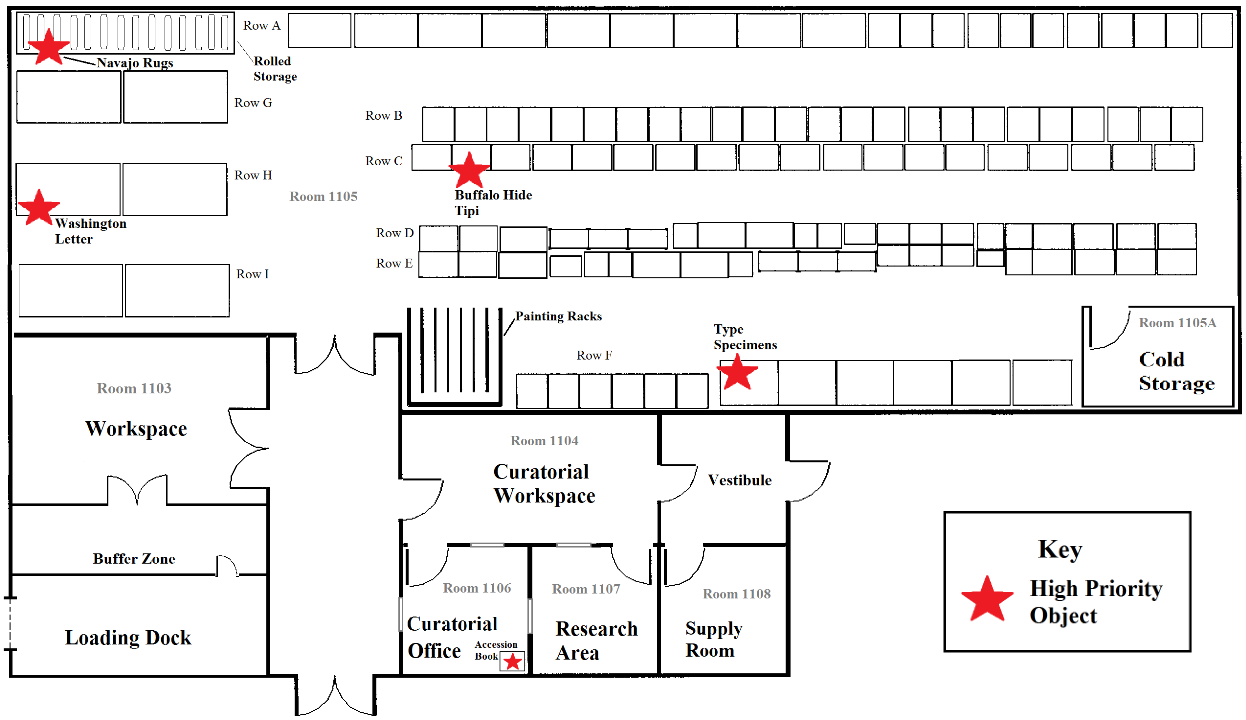
Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

RESTRICTED INFORMATION

Distribute ONLY to the superintendent, MCEOP team leader, and regional curator. Remove this page from other copies of the MCEOP.

Floor Plan: CURATORIAL FACILITY FIRST PRIORITIES FOR RELOCATION AND SALVAGE



Floor Plan: HILLTOP HOUSE FIRST PRIORITIES FOR RELOCATION AND SALVAGE

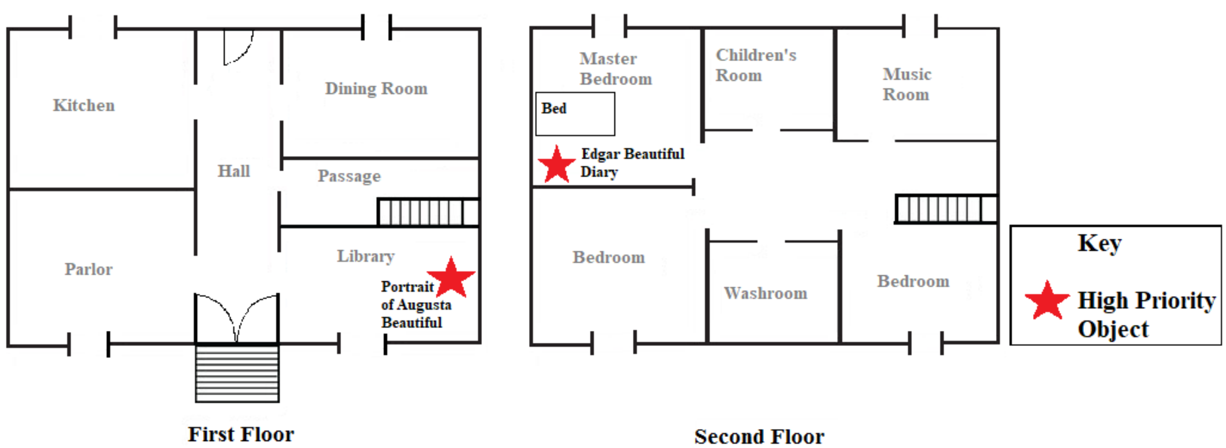


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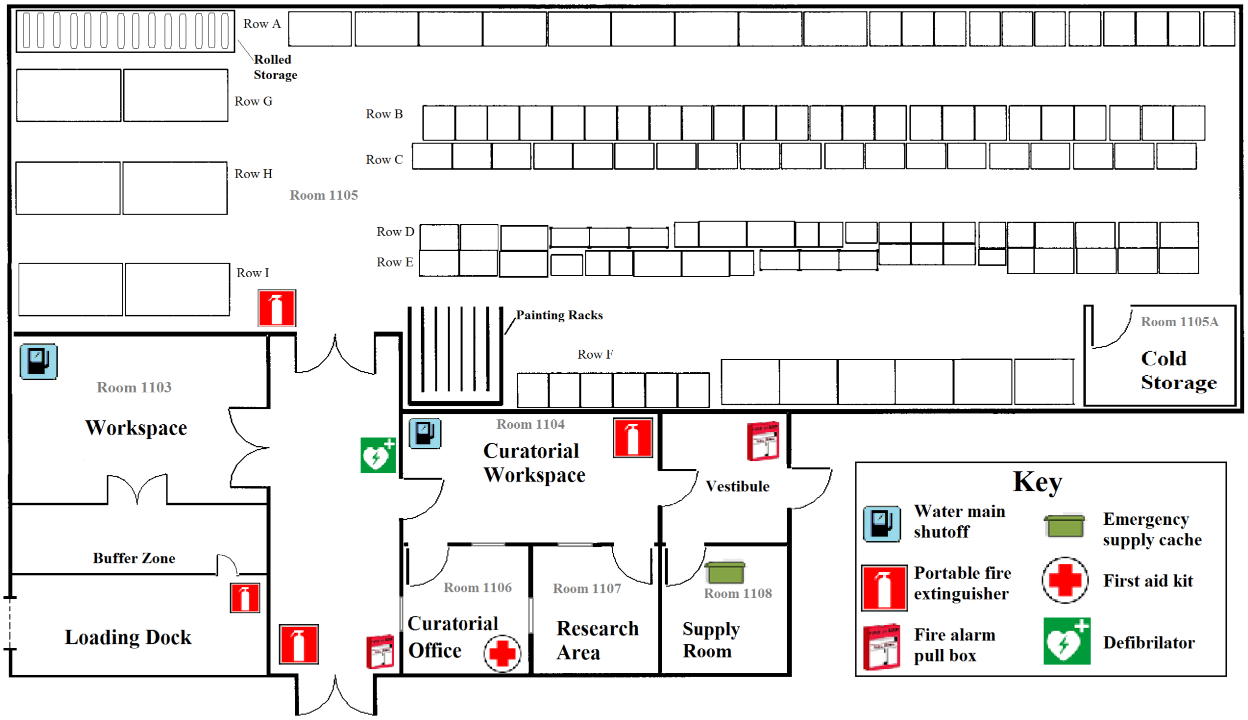
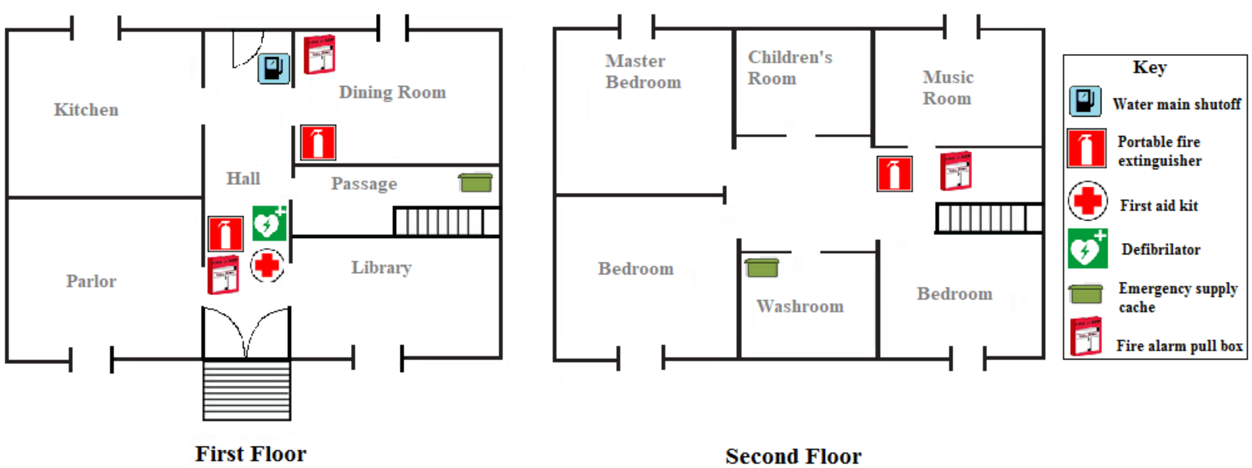
Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

Floor Plan: CURATORIAL FACILITY EMERGENCY SUPPLIES AND UTILITIES



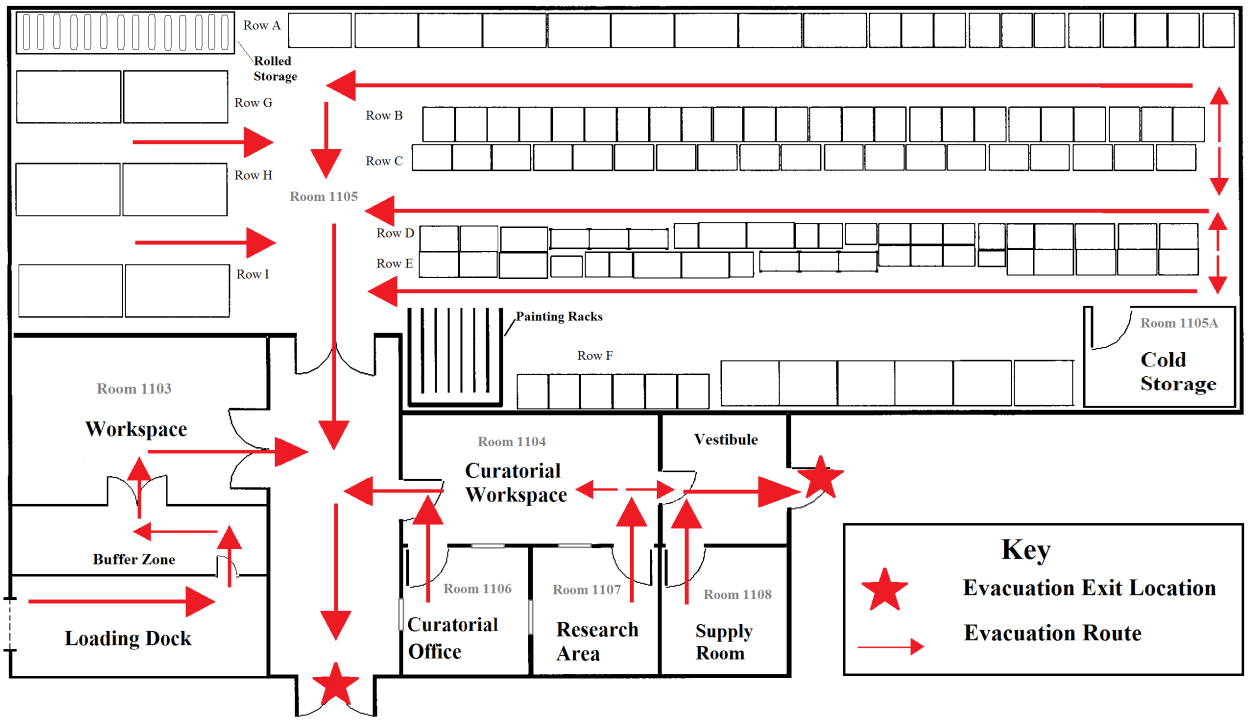
Floor Plan: HILLTOP HOUSE EMERGENCY SUPPLIES AND EQUIPMENT



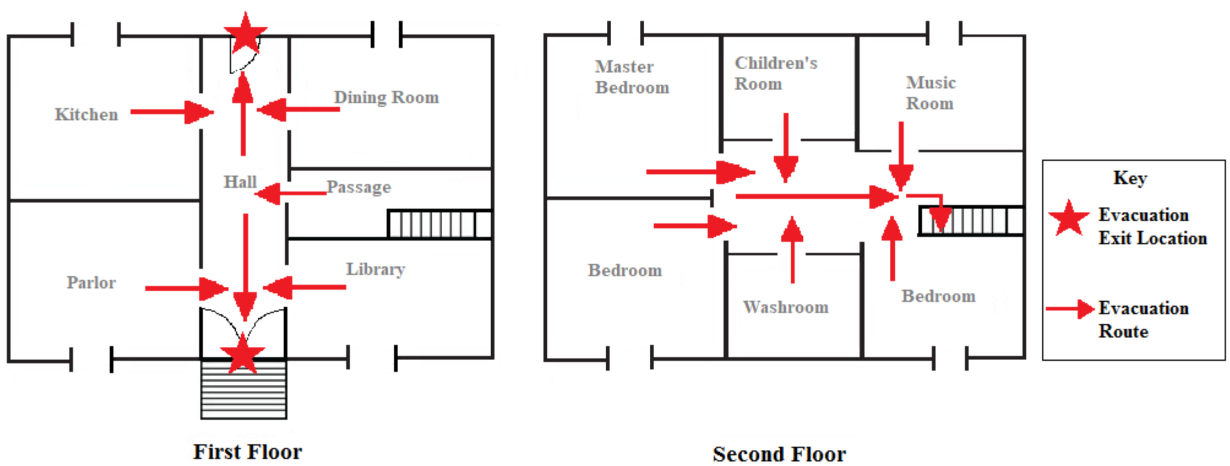
9

Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

Floor Plan: CURATORIAL FACILITY EVACUATION ROUTE



Floor Plan: HILLTOP HOUSE EVACUATION ROUTE



★ Meet at the designated assembly point at the [*South Parking Lot.*]

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Figure 10.4. Museum Collections Emergency Operations Plan (Sample) (continued)

EMERGENCY RESPONSE STEPS

- Active Shooter
  Figure 10.5
- Disruptive Individual
  Figure 10.6
- Earthquake
  Figure 10.7
- Explosion
  Figure 10.8
- Fire
  Figure 10.9
- Hazardous Materials Spill, Odor, and Gas Leak
  Figure 10.10
- Medical Emergency
  Figure 10.11
- Mold Outbreak
  See Figure 10.12
- Power Outage
  Figure 10.13
- Severe Weather
  Figure 10.14
- Suspicious Package or Item
  Figure 10.15
- Suspicious Person and Vandalism
  Figure 10.16
- Threat (Threatening Call or Bomb Threat)
  Figure 10.17
- Volcanic Eruption
  Figure 10.18
- Water Leak and Flood
  Figure 10.19

Emergency Response Steps

ACTIVE SHOOTER
EMERGENCY RESPONSE STEPS

COPING
WITH AN ACTIVE SHOOTER SITUATION

- Be aware of your environment and any possible dangers
- Take note of the two nearest exits in any facility you visit
- If you are in an office, stay there and secure the door
- Attempt to take the active shooter down as a last resort

Contact your building management or human resources department for more information and training on active shooter response in your workplace.

PROFILE
OF AN ACTIVE SHOOTER

An active shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area, typically through the use of firearms.

CHARACTERISTICS
OF AN ACTIVE SHOOTER SITUATION

- Victims are selected at random
- The event is unpredictable and evolves quickly
- Law enforcement is usually required to end an active shooter situation

CALL 911 WHEN IT IS SAFE TO DO SO

HOW TO RESPOND
WHEN AN ACTIVE SHOOTER IS IN YOUR VICINITY

1. RUN
- Have an escape route and plan in mind
- Leave your belongings behind
- Keep your hands visible

2. HIDE
- Hide in an area out of the shooter's view
- Block entry to your hiding place and lock the doors
- Silence your cell phone and/or pager

3. FIGHT
- As a last resort and only when your life is in imminent danger
- Attempt to incapacitate the shooter
- Act with physical aggression and throw items at the active shooter

CALL 911 WHEN IT IS SAFE TO DO SO

HOW TO RESPOND
WHEN LAW ENFORCEMENT ARRIVES

- Remain calm and follow instructions
- Put down any items in your hands (i.e., bags, jackets)
- Raise hands and spread fingers
- Keep hands visible at all times
- Avoid quick movements toward officers such as holding on to them for safety
- Avoid pointing, screaming or yelling
- Do not stop to ask officers for help or direction when evacuating

INFORMATION
YOU SHOULD PROVIDE TO LAW ENFORCEMENT OR 911 OPERATOR

- Location of the active shooter
- Number of shooters
- Physical description of shooters
- Number and type of weapons held by shooters
- Number of potential victims at the location

Reproduced from: Department of Homeland Security, "Active Shooter Pocket Card." 2017. https://www.dhs.gov/sites/default/files/publications/active-shooter-pocket-card-508.pdf.

Figure 10.5. Active Shooter Emergency Response Steps

DISRUPTIVE INDIVIDUAL
EMERGENCY RESPONSE STEPS

- Call park dispatch and 911.
- Stay calm.
- Be courteous and attentive.
- Direct staff and visitors to move away from the area.
- Stay within sight of the disruptive individual until law enforcement/ranger arrives.
- Do not jeopardize your personal safety.
- Be prepared to describe the individual (age, appearance, gender, etc.).

Figure 10.6. Disruptive Individual Emergency Response Steps

EARTHQUAKE
EMERGENCY RESPONSE STEPS

During the Earthquake

- Stay inside.
- Shelter under the nearest sturdy desk or table.
- **DROP, COVER, then HOLD ON**
  - drop to hands and knees
  - cover head and neck
  - hold on to sturdy desk or table until shaking stops
- Move away from bookshelves, cases, cabinets, exterior walls, overhead light fixtures, and windows.
- *Do not:*
  - shelter under doorways
  - rush outside
  - use elevators
- If there is no cover, drop to the floor against an interior wall and cover head and neck.
- Shelter in Place until cleared for evacuation.

After Cleared for Evacuation

- Be prepared for aftershocks and tremors.
- Call 911 and park dispatch.
- Evacuate the building.
- *Do not* use elevators.
- Once outside, move away from the building.
- Avoid falling debris, electrical lines, standing water, broken water pipes, and fuel leaks.
- Meet at the designated assembly point.
- Do not re-enter the building until cleared for re-entry.

Figure 10.7. Earthquake Emergency Response Steps

EXPLOSION
EMERGENCY RESPONSE STEPS

Bomb or Explosion Inside the Building

- Take cover under a sturdy desk or table away from windows until debris stops falling.
- Call 911 and park dispatch.
- Evacuate the building.
- *Do not* use:
  - elevators
  - matches, lighters, and other open flames
- Check for fire and other hazards.
- Cover nose and mouth with a wet cloth as needed.
- Stay low if there is smoke.
- Meet at the designated assembly point.
- Do not re-enter the building until cleared.

If Trapped Inside the Building

- Use a flashlight or tap on pipes to signal location.
- Shout only as a last resort to avoid inhaling dangerous dust.

Bomb or Explosion Outside the Building

- Avoid windows, doors, and exterior walls.
- Shelter in Place in the building until cleared.

Figure 10.8. Explosion Emergency Response Steps

FIRE
EMERGENCY RESPONSE STEPS

- Activate the fire alarm.
- Call 911 and park dispatch.
- Use a portable fire extinguisher to put out a small fire *only* if properly trained.
- *Do not* attempt to put out a nitrate or plastics fire.
- Do not jeopardize your personal safety.
- Evacuate the area immediately.
- If smoke is present, keep close to the ground.
- Cover nose and mouth with a wet cloth as needed.
- *Do not:*
  - use elevators
  - open windows
- Close doors when evacuating to confine the fire.
- If clothing catches fire, **STOP, DROP, and ROLL**.
- Meet at the designated assembly point.

Figure 10.9. Fire Emergency Response Steps

HAZARDOUS MATERIALS SPILL, ODOR, AND GAS LEAK EMERGENCY RESPONSE STEPS

Hazardous Materials Spill (Liquid or Powder)

- Call 911 and park dispatch.
- *Do not* try to clean the spill.
- Cover the spilled material.
- Remove affected clothing using gloves if splashed.
- Wash hands with soap and water.
- Restrict access to the contaminated area.
- Leave the room and close the door.
- Evacuate the building.
- Meet at the designated assembly point.

Exposure to Blood, Bodily Fluids, or Infectious Material

- Assume all blood or bodily fluids carry blood-borne pathogens.
- Avoid coming into contact with blood and bodily fluids.
- If exposed, wash affected area(s) with soap and water immediately.
- Call 911 and park dispatch.
- Restrict access to the contaminated area.
- Await first responders.

Odor or Gas Leak

- Open a window if there is hissing or a gas odor.
- Call 911 and park dispatch.
- *Do not* turn electrical appliances on or off to prevent sparking.
- Evacuate the building immediately.
- Meet at the designated assembly point.
- Notify the facility manager to turn off the gas main valve.

Figure 10.10. Hazardous Materials Spill, Odor, and Gas Leak Emergency Response Steps)

MEDICAL EMERGENCY
EMERGENCY RESPONSE STEPS

- Call 911 and park dispatch.
- Be prepared to describe the nature and location of the medical emergency.
- Keep the injured person calm and indicate help is on the way.
- Provide care *only* if trained to do so.
- Remain with the injured person.
- Keep the area clear.
- *Do not:*
  - move the injured person
  - give the injured person anything to eat or drink
  - attempt to administer first aid without consent
- Arrange to meet first responders.

Figure 10.11. Medical Emergency Response Steps

MOLD OUTBREAK
EMERGENCY RESPONSE STEPS

Mold on Objects

- Wear gloves and protective clothing.
- Be aware of potential allergic reactions to all molds.
- Isolate affected objects:
  - in a room with low relative humidity and temperature
  - with separate air handling from other collections
- Remove all sources of moisture or excess humidity within 48 hours.
- Identify mold in consultation with a specialist.
- Follow salvage procedures for mold.

Large-scale Mold Outbreak in Spaces Housing Collections

- Evacuate the contaminated area.
- Restrict access to the contaminated area.
- Contact:
  - park safety officer and facility manager
  - specialist to identify the mold
  - professional abatement team
- *Do not:*
  - touch contaminated materials
  - re-enter the area until cleared

Figure 10.12. Mold Outbreak Emergency Response Steps

POWER OUTAGE
EMERGENCY RESPONSE STEPS

- Report the outage to the facility manager and park dispatch.
- Ensure continued security coverage and fire protection.
- Keep HVAC operational using back-up power systems.
- Use a flashlight.
- Tape refrigerators, freezers, and cold storage units shut and:
  - turn units to the coldest settings
  - seal with polyethylene sheeting and duct tape
  - mark with "Do not open" and name and date
- *Do not* use matches, lighters, and other open flames.
- Evacuate the building and:
  - move single file with caution along the evacuation route
  - close doors and windows en route
  - meet at the designated assembly point
- Secure the building.
- Restrict access until regular services and security are restored.

Figure 10.13. Power Outage Emergency Response Steps

SEVERE WEATHER
EMERGENCY RESPONSE STEPS

Hurricane

- Monitor National Weather Service and other advisories.
- Check battery-powered equipment, back-up power sources, and emergency exit lights.
- Ensure collections are safely stored and secured.
- Cover and secure objects with polyethylene sheeting or tarp.
- Relocate First Priority objects to the designated secure and stable location.
- Tape refrigerators, freezers, and cold storage units shut and:
    - turn units to the coldest settings
    - seal with polyethylene sheeting and duct tape
    - mark with "Do not open" and name and date
- Back up and secure electronic museum records in a secure and stable location.
- Close and secure doors, windows, and shutters, and cover with boards.
- Brace exterior doors and place sandbags in front of doors.
- Shut down and unplug electrical appliances.
- Evacuate the building.
- Meet at the designated hurricane assembly point.
- Shelter in Place in a windowless interior room above ground level if evacuation is not possible.

Thunderstorm

- With advance notice, move objects away from windows and doors.
- Close and secure windows and doors.
- Disconnect electrical appliances.
- *Do not* use landline telephones or electrical equipment.
- Avoid metal structural elements, outlets, faucets and sinks.
- Use battery operated equipment.
- Remain indoors.
- Shelter in Place in a windowless interior room until the storm passes.

Tornado or Wind Storm

- With advance notice, move objects away from windows and doors.
- Avoid doors, outside walls, and windows.
- Shelter in Place in the basement or windowless interior room on the lowest level.
- Take cover under a sturdy desk or table until cleared.
- If stranded on an upper floor, go to a closet or windowless hallway.

Figure 10.14. Severe Weather Emergency Response Steps

SUSPICIOUS PACKAGE OR ITEM
EMERGENCY RESPONSE STEPS

- Be suspicious of a package or item displaying:
  - excessive postage weight
  - excessive tape or string
  - foreign mail, airmail, or special delivery
  - hand written/poorly typed address or no return address
  - incorrect title or title with no name
  - markings such as "Confidential" without a return address
  - misspellings of common words
  - oily stains or discoloration
  - protruding wires or tinfoil
  - rigid, lop-sided, or uneven envelope
  - ticking or buzzing
  - vapors or odors
- *Do not:*
  - handle, open, or move the package/item
  - activate fire alarm pull bars to avoid activating explosive devices
  - use a cell phone or radio to avoid activating explosive devices
- Restrict access to the area and package/item.
- Evacuate the building.
- Move to a safe area (100 feet away) before calling 911 and park dispatch.
- Meet at the designated assembly point.
- Be alert for a possible second explosive device.

Figure 10.15. Suspicious Package or Item Emergency Response Steps

SUSPICIOUS PERSON AND VANDALISM
EMERGENCY RESPONSE STEPS

Suspicious Person

- Call 911 and park dispatch.
- *Do not* engage the suspicious person.
- Keep a safe distance.
- Evacuate occupants using the nearest exit.
- Meet at the designated assembly point.
- Be prepared to describe the individual, vehicle, license plate, and direction of escape.

Vandalism

- *Do not* interfere with or physically restrain the vandal.
- Call 911 and park dispatch.
- Be prepared to describe the individual, vehicle, license plate, and direction of escape.
- Do not touch or move anything until cleared by law enforcement.
- Gather vandalized museum object(s), label broken pieces, and keep together in storage.

Figure 10.16. Suspicious Person and Vandalism Emergency Response Steps

THREAT (THREATENING CALL OR BOMB THREAT)
EMERGENCY RESPONSE STEPS

- Listen carefully.
- Do not interrupt the caller.
- Write down what the caller says in their own words.
- Make notes on:
  - age, sex, accent, tone of voice
  - background noises
  - location and timing of threat or bomb
  - reason for threat or bomb
- Stay on the phone as long as possible.
- Discretely signal a coworker to call 911 and park dispatch.
- Only notify employees directly involved to prevent panic.
- For bomb threats, ***do not:***
  - activate fire alarm pull bars to avoid activating explosive devices
  - use a cell phone or radio to avoid activating explosive devices
- Evacuate if instructed to do so.*
- Meet at the designated assembly point.

*****Note: Evacuations may move people to locations that could become targets for active shooter situations.

Figure 10.17. Threat (Threatening Call or Bomb Threat) Emergency Response Steps

VOLCANIC ERUPTION
EMERGENCY RESPONSE STEPS

- Monitor National Weather Service and other advisories.
- Seal cabinet doors with tape.
- Cover storage cabinets, exhibit cases, and furnishings with polyethylene sheeting or tarps.
- Move objects away from doors and windows.
- Cover freestanding objects with polyethylene sheeting.
- Work with the facility manager to:
  - shut down the HVAC system to prevent clogging
  - tape HVAC ducts and vents shut
  - place coverings over chimneys
- *Do not* shut off the intrusion detection and alarm and automatic fire protection systems.
- Cover windows with boards and/or plastic sheeting.
- Seal exterior doors with tape.
- Evacuate the building immediately.
- Meet at the designated assembly point.
- When evacuating, stay on high ground where possible.
- Avoid areas where lava or mudslides can accumulate.

Figure 10.18. Volcanic Eruption Emergency Response Steps

WATER LEAK AND FLOOD EMERGENCY RESPONSE STEPS

- Call park dispatch, 911, and the facility manager.
- Stop the flow of water immediately if safe to do so.
- Determine which objects are in jeopardy.
- Move First Priority and small objects out of the affected area to a designated secure and stable location.
- Cover the following with polyethylene sheeting or tarps:
  - freestanding non-moveable objects
  - storage cabinets and exhibit cases
- *Avoid:*
  - flooded spaces and standing water
  - appliances or outlets near the leak or water
- Restrict access until the leak or flood has been safely controlled.
- Evacuate if danger is imminent.
- Meet at the designated assembly point.

Figure 10.19. Water Leak and Flood Emergency Response Steps

EMERGENCY CONTACT LIST (SAMPLE)

Park Dispatch .... **[*5999*]**
Emergency **911**

Museum:

MCEOP Team:
Supervisory museum curator (MCEOP team leader) .... [*5555*]
Museum collections manager (Emergency registrar) .... [*5556*]
Museum technician (Salvage coordinator) .... [*5557*]
Museum specialist (Security coordinator) .... [*5546*]

Other museum staff:
Museum technician .... [*5550*]
Intern .... [*5560*]

Park:
Facility manager .... [*5553*]
Emergency operations coordinator .... [*5552*]
Structural Fire Coordinator .... [*5559*]
Fire Management Officer .... [*5558*]
Safety officer .... [*5542*]
Chief Ranger .... [*5548*]
Law enforcement .... [*5540*]
Superintendent .... [*5551*]
Administrative Officer .... [*5533*]
Information technology .... [*5543*]

Region / Center:
Regional curator .... [*(555) 555-9991*]
Conservator .... [*(555) 555-9992*]
Historical architect advisor .... [*(555) 555-9993*]
Cultural landscape specialist .... [*(555) 555-9994*]

Local sources of assistance:
Fire Chief .... [ ]
Police Chief .... [ ]
Medical services .... [ ]
Hospital .... [ ]
Local utility provider .... [ ]
Structural/mechanical engineer .... [ ]
Local park/museum .... [ ]

Figure 10.21. Emergency Contact List (Sample)

EMERGENCY VENDOR AND SOURCES OF ASSISTANCE LIST (SAMPLE)

Name	Contact Type	Phone #	Email	Cooperative Agreement/ Order #
	Abatement services (pest and hazardous materials)			
	Architect			
	Chemical testing laboratory			
	Cleaning services			
	Cold storage vault or freezer rental			
	Computer data recovery			
	Conservation laboratory			
	Dehumidification services			
	Electrician			
	Engineer (structural)			
	Fire detection and suppression system services			
	Freezer truck rental			
	Generator supplier			
	Glazier			
	HVAC services			
	Local library			
	Local museum			
	Portable equipment supplier			
	Public health consultant			
	Scientific monitoring equipment rental			
	Security system services			
	Transportation rental			

Figure 10.22. Emergency Vendor and Sources of Assistance List (Sample)

EMERGENCY SUPPLIES AND EQUIPMENT (SAMPLE)

Supply Category	Emergency and Salvage Supplies
Collections Salvage Supplies	aluminum trays, archival tape, blank newsprint, blotting paper, brushes with soft natural bristles, buckets, cheesecloth, clothesline, cotton cloth, Emergency Response & Salvage Wheel, freezer bags, garbage bags, garbage cans (clean), Japanese tissue paper, mesh screens (plastic), Mylar, packing boxes, packing tape, porch screen, polyethylene bags, polyethylene sheeting (inert), polyester boxes, precision knife with spare blades, rope, sandbags (small), sponges (cleaning, soot, etc.), towels (cloth and paper), tulle mesh, twill tape, twine, Tyvek® rolls and tags, wax paper, weights
Construction Materials	glue, lumber, nails, plywood, screws, twine, wire
Documentation Supplies	cameras, clipboards, color and gray scale cards, erasers, file folders, hole punch, laptop computers with Interior Collections Management System (ICMS) installed, notebooks, paper, pencils, pencil sharpeners, photo ID stand with numbers (magnetic), portable computer printer, rulers, staplers, tripods
Emergency Supplies and Equipment*	air compressors, baker's racks, batteries, bleach, brooms, calculators, cellular phone, containers, disinfectants, dumpsters, duct tape, dust pans, extension cords, fans, flashlights, freezer (commercial grade), generators, hair dryer with a cool setting, hand trucks, headlamps, hoses, knives, ladders, masking tape, mops, movable flood barriers, polyurethane ice chests, portable lights, portable tables, pumps, radios (battery-powered, wind-up, etc.), rope, sandbags (large), scissors, scrub brushes, shovels, spill-absorbent materials, squeegees, storage cart, surge protector, tarps (fire-retardant), trays, weights, wet/dry vacuum cleaners with HEPA filters and mesh screening material *Store equipment and manuals together.
First Aid Equipment	antibiotic cream, blankets, burn packs, cortisone cream, first aid kits, stretcher, 3 – 4 days of clean water for museum staff
Hand Tools	block and tackle pulleys, hammers, pliers, ropes, saws, scissors, screwdrivers, staple gun, staples, tape measures, tin snips, utility knives with spare blades, wire cutters, wood saws, wrenches
Museum Environmental Equipment	dataloggers, dehumidifiers, fans, hygrometers, hygrothermographs with extra paper, silica gel, space heaters (closed coil)
Protective Clothing	masks (N-95, HEPA respirator), nitrile gloves, protective coveralls, rain ponchos, rubber aprons and boots, safety glasses, safety goggles, safety vests, shoes

Figure 10.23. Emergency Supplies and Equipment (Sample)

SALVAGE PROCEDURES

*Follow these salvage procedures during the **first 48 – 72 hours** following an emergency incident to stabilize affected objects and prevent further damage or loss.*

Certain materials such as animal skins, basketry, glass plate negatives, metals, paintings, photographic materials, and works on paper may require professional treatment after the first 48 – 72 hours have passed. Consult the regional curator and a conservator to determine treatment needed.

See NPS *Conserve O Grams* Section 21: Disaster Response and Recovery; *Primer on Disaster Preparedness, Management & Response*, issued by the Smithsonian Institution, National Archives and Records Administration, Library of Congress, and National Park Service; and the Emergency Response & Salvage Wheel, published by AIC.

BEFORE SALVAGE

- Work with the Incident Commander, emergency operations coordinator and facility manager to ensure the salvage space has functioning HVAC, stable relative humidity (RH) and temperature, and excludes ultraviolet radiation.
- Work with the safety officer to arrange for professional abatement services as needed.
- Set up and secure back-up generators, dehumidifiers, and ventilation and/or fans.
- Contact contractors and service providers, including conservators.
- Establish secure access and key control policies and procedures, including a daily sign-in log.
- Set up environmental control and monitoring systems.
- Set up documentation procedures, including inventory control.
- Arrange for photography of damage and salvage activities.
- Ensure Personal Protective Equipment (PPE) is available for designated MCEOP team members.
- Set up mobile communications.

PREPARING THE SALVAGE AREA

- Set up a secure salvage area, including locking doors and key control.
- Assemble and allocate necessary equipment and supplies.
- Set up access to computers, including ICMS.
- Separate work areas from break areas.
- Clean and cover work surfaces, including tables.
- Place and secure mats at entrances to avoid tracking dirt into the salvage area.
- Prepare work stations for various activities, including documentation, photography, rinsing, air-drying, interleaving, and packing.
- Establish work teams with assigned responsibilities.
- Ensure staff and volunteers wear appropriate protective clothing, masks, nitrile gloves, and shoes.

GENERAL SALVAGE PROCEDURES

Use these general salvage procedures together with specific salvage procedures below.

- Relocate First Priority objects first, including the accession (and deaccession) book, to the salvage area.
- Determine which other objects should be relocated as time permits.
- Record temporary object storage locations.
- Salvage and stabilize First Priorities and other objects in consultation with the regional curator and conservator.
- List damage sustained and salvage activities using the Collection Damage and Salvage Overview (Figure 10.25).
- Do the minimum necessary to stabilize affected objects. Remember: “less is more.”
- Keep handling to a minimum. Handle objects carefully.
- Keep components of broken objects together.
- Use supports when handling weak or damaged objects.
- Ensure objects are labeled and packed into boxes that are labeled and include an inventory list.

Figure 10.24. Salvage Procedures

- Number and maintain an inventory of all boxes and containers.
- Document work in writing, including salvage activities.
- Photograph object damage and salvage activities. Include catalog numbers with all object images.
- Update ICMS records.

MOLD

- Isolate affected objects.
- If many objects are affected, or if there is a large-scale mold outbreak, contact an organization specialized and experienced in mold identification and abatement.
- Place affected objects in polyethylene bags to prevent cross-contamination.
- ***Only*** keep objects in bags for a short time to prevent further mold growth.
- House in a secure area with functioning HVAC and stable low RH and temperature.
- If wet and moldy materials cannot be dried immediately, place in cold storage or freezer.
- Wear appropriate protective clothing, including gloves and masks, when handling moldy objects.
- Avoid touching or blotting moldy objects, as this spreads mold spores.
- ***Do not*** attempt to remove mold until it is completely dry and powdery.
- Clean mold ***only*** in a well-ventilated area, such as under a fume hood.
- Determine whether to vacuum dried mold ***only*** after consulting with a specialist and conservator.
- If vacuuming is recommended, use a HEPA filtered vacuum on low suction to avoid damaging the object:
  - cover the nozzle with screening material to catch any dislodged material
  - dispose of the used vacuum bag, filter, and screening material
- Clean and wash protective clothing separately with soap and bleach.
- Dispose of contaminated protective clothing and cleaning equipment appropriately.

For detailed information, see *Conserve O Grams* 3/4: Mold: Prevention of Growth in Museum Collections and 16/1: Causes, Detection, and Prevention of Mold and Mildew on Textiles.

WATER DAMAGE TO OBJECTS

- ***Do not*** clean, rinse, remove mud, or treat objects without consulting with a conservator and the regional curator, as this may cause permanent damage or loss.
- Support wet and damaged objects using trays or boxes during relocation and salvage.
- Ensure that RH and temperature return to acceptable levels gradually to prevent shrinkage, cracking, loss in finishes, and/or loss of attached parts.
- Separate wet objects by degree of wetness.

Air Drying

- Air dry organic materials such as paper, skins, and leather, and inorganic materials such as glass, metals, and fired ceramics. Consult with a conservator and the regional curator for iron and unfired ceramics.
- Place damp or slightly wet objects in a clean environment that has stable low RH and temperature, functioning HVAC or ventilation, and excludes ultraviolet radiation.
- Place objects on flat surfaces covered with sheets of absorbent paper or blank newsprint.
- Space objects and items so air can circulate freely.
- If needed, use space heaters to hasten the drying process. ***Never*** use open-coil heaters; they are fire hazards.
- When books and paper are dry, close, lay flat on a table or other horizontal surface, gently form into their normal shape, and hold in place with a light weight.
- Check frequently for mold growth.
- *Do not:*
  - blow air directly onto fragile objects
  - use adhesives, metal clips, or detergents on wet materials
  - stack drying books on top of each other
  - open wet books, close books that have swollen open, or separate stuck together books and paper
- If many objects are affected, contact an organization experienced in handling water-damaged museum objects.

Figure 10.24. Salvage Procedures (continued)

Freezing and Cold Storage

- Determine which objects to place in cold storage or freezer after 48 – 72 hours, in consultation with a conservator and the regional curator.
- Arrange for a commercial-grade freezer or freezer truck for large volumes of water-damaged museum objects.
- ***Do not freeze*** sensitive objects such as:
  - bone, horn, ivory, shell, and teeth
  - canvas and wood-panel paintings
  - ceramics
  - composite objects containing inorganic materials (ceramics, glass, metals)
  - glass and glass plate negatives
  - inlaid, lacquered, painted, or varnished wood and furniture
  - objects under tension, such as drums
  - painted or treated leather
- Interleave paper items and blot to remove excess water using unprinted blotting paper, lint-free towels, or blank newsprint.
- Retain the original order of archival items.
- Wrap and pack objects safely for cold storage or freezing as appropriate.
- Label and inventory each container and include an inventory list.

For detailed information, see *Conserve O Grams* 21/3: Salvage of Water-Damaged Collections: Salvage At A Glance and 21/6: Salvage At A Glance Part III: Object Collections.

WATER DAMAGE TO SPACES HOUSING COLLECTIONS

- Limit access to the affected area(s).
- Work with the facility manager and safety officer to ensure there are no live electrical appliances or power lines in contact with water before entering.
- Arrange for the removal of water and:
  - keep the HVAC system running
  - set up dehumidifiers, pumps, fans, and other needed equipment
  - dehumidify the space or structure
- Lower the RH and temperature to avoid mold outbreaks.
- Arrange for set points for HVAC systems to return gradually to acceptable levels, based on monitoring data from impacted spaces.
- If using tarps, avoid direct contact with objects by draping from shelving supports and uprights.
- Be aware that:
  - moisture absorbed by organic material will continue to release over time
  - pressure from swollen objects may strain shelving and cause buckling or collapse
  - paper products such as boxes and archival storage will absorb water and may collapse
  - wooden doors may swell and stick
  - RH and temperature may take time to return to collection set points
- After the incident and when immediate risk is mitigated, remove protective coverings to allow air circulation and prevent mold outbreaks.

Figure 10.24. Salvage Procedures (continued)

COLLECTION DAMAGE AND SALVAGE OVERVIEW

Completed by: ______________________________ **Date:** ______________________________
Name, Title (Print)

Catalog Number	Object Name	Damage Sustained	Salvage Activities Taken	Conservation Treatment Needed (Y/N)	Photo (Y/N)	Temporary Location

Total number of objects affected: ____

Total number of objects requiring conservation treatment: ______________________________________

Figure 10.25. Collection Damage and Salvage Overview

POST-EMERGENCY CRITIQUE

Park Name: ____

Completed by: ______________________ Date: ______________________

Name, Title (Print)

Collections Care

Were emergency response and salvage activities well-coordinated and adequate? If not, what changes are needed?
Response / Comments:

Were object relocation and temporary storage arrangements and activities well planned, implemented, and documented? If not, what changes are needed?
Response / Comments:

Were object First Priorities for Relocation and Salvage adequately implemented? If not, what changes are needed?
Response / Comments:

Team Efficiency and Communication

Were MCEOP team members including team leader, staff, and volunteers working with collections given timely notice of the emergency and their assigned responsibilities? If not, what changes are needed?
Response / Comments:

Did MCEOP team members function according to their assigned responsibilities? If not, what changes are needed?
Response / Comments:

Were sufficient personnel available and effectively deployed? If not, what changes are needed?
Response / Comments:

What MCEOP team communication methods were used, and were they effective? If not, how could they be improved?
Response / Comments:

Was communication and coordination between the MCEOP team, Incident Commander, and park emergency responders effective? What changes are needed?
Response / Comments:

Implementation

Were museum emergency preparedness, response, relocation, and salvage procedures followed? If not, what changes are needed?
Response / Comments:

Were MCEOP team members provided with accurate and sufficient information? If not, what changes are needed?
Response / Comments:

Did serious unexpected problems or circumstances occur? If so, were they handled appropriately? If not, what changes are needed?
Response / Comments:

Were emergency supplies and equipment sufficient? If not, what supplies were needed? Were they obtained? If not, what changes are needed?
Response / Comments:

Was there a delay in response, and did it play a significant role in the outcome? If so, what changes are needed?
Response / Comments:

Did staff from other parks assist? Were they effective? If not, what changes are needed?
Response / Comments:

Figure 10.26. Post-Emergency Critique

What other sources of assistance were used? Were they effective? If not, what changes are needed?
Response / Comments:

Were major decisions promptly documented? Were activities photographed? If not, what changes are needed?
Response / Comments:

General Post-Emergency

Were Emergency Response Steps adequate and followed?
Response / Comments:

How could the emergency and damage have been avoided/reduced? Were corrective actions identified in the Museum Mitigation Action Plan implemented?
Response / Comments:

Did other unidentified impacts/weaknesses occur? If yes, what were they?
Response / Comments:

What documents, procedures, and lists require revision?
Response / Comments:

What lessons were learned during and after the emergency incident?
Response / Comments:

Additional recommendations:
Response / Comments:

Figure 10.26. Post-Emergency Critique (continued)

M. Glossary

Chain of Command: "The orderly line of authority within the ranks of the incident management organization." FEMA, "Emergency Management Institute Glossary," 2019.

Complex Emergency: "Two or more individual incidents located in the same general area that are assigned to a single Incident Commander." NPS RM-55.3: Definitions.

Designated secure and stable location: A structure or space designated in advance with physical security, including access and key control policies and procedures, as well as appropriate stable relative humidity and temperature and exclusion of ultraviolet radiation.

Disaster: An emergency posing a significant threat to life safety and/or collections, which may occur at a large scale.
_____ "An occurrence of a natural catastrophe, technological accident, or human-caused event that has resulted in severe property damage, deaths, and/or multiple injuries." FEMA, "Emergency Management Institute Glossary," 2019. *See* Emergency.

Emergency: An incident threatening collections and/or life safety. Emergencies may be large- or small-scale, occur due to natural or human causes, occur individually or as a complex of two or more, with or without warning.

Hazard: A natural or human-caused occurrence (such as volcanic eruption, vandalism, or flood) that can negatively impact life safety, collections, and structures housing collections. *See* Risk and Threat.

Hot work: "Work involving burning, welding, or a similar operation that is capable of initiating fires or explosions. Common hot work processes are welding, soldering, cutting, and brazing. When flammable materials are present, processes such as grinding and drilling become hot work." RM-58 7.2.3.8: Hot Work.

Incident: "An occurrence, natural or human-caused, that requires a response to protect life or property. Incidents can, for example, include major disasters, emergencies, terrorist attacks, terrorist threats, civil unrest, wildland and urban fires, floods, hazardous materials spills, nuclear accidents, aircraft accidents, earthquakes, hurricanes, tornadoes, tropical storms, tsunamis, war-related disasters, public health and medical emergencies, and other occurrences requiring an emergency response." FEMA, "Emergency Management Institute Glossary," 2019.

Incident Commander (IC): "The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and release of resources. The Incident Commander has overall authority and responsibility for conducting incident operations and is responsible for the management of all incident operations at the incident site." FEMA, "Emergency Management Institute Glossary," 2019.

Incident Command System (ICS): "A standardized on-scene emergency management construct specifically designed to provide an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. The Incident Command System is the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to aid in the management of resources during incidents. ICS is used for all kinds of emergencies and is applicable to small as well as large and complex incidents. ICS is used by various jurisdictions and functional agencies, both public and private, to organize field-level incident management operations." FEMA, "Emergency Management Institute Glossary," 2019.

Major Disaster: "…[A]ny hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other catastrophe in any part of the United States which, in the determination of the President, causes damage of sufficient severity and magnitude to warrant major disaster assistance by the Federal Government to supplement the efforts and resources of State and local governments and relief organizations." 905 DM 1: Policy, Functions, and Responsibilities.

Mitigation: "Includes activities to reduce the loss of life and property from natural and/or human-caused disasters by avoiding or lessening the impact of a disaster and providing value to the public by creating safer communities. Mitigation seeks to fix the cycle of disaster damage, reconstruction, and repeated damage. These activities or actions, in most cases, will have a long-term sustained effect. Examples: Structural changes to buildings, elevating utilities, bracing and locking chemical cabinets, properly mounting lighting fixtures, ceiling systems, cutting vegetation to reduce wildland fires, etc." FEMA, "Emergency Management Institute Glossary," 2019.

Museum Collections Emergency Operations Plan (MCEOP): A document containing museum emergency planning standards and policies; Incident Command System (ICS); collections and structures housing collections overview; risk assessment; MCEOP team responsibilities; First Priorities for Relocation and Salvage; emergency response, including Emergency Response Steps; security; emergency contact information; emergency equipment, services, and supplies; salvage procedures; Post-Emergency Critique; MCEOP update and review; and figures and floor plans. Part of the park's Emergency Operations Plan (EOP).

Museum Mitigation Action Plan: A plan with specific corrective actions to be implemented to remove or reduce deficiencies in storage, exhibit, and work spaces that could cause or increase the risk of emergency incidents.

National Incident Management System (NIMS): "A national program consisting of five major subsystems which collectively provide a total systems approach to all-hazard incident management. The subsystems are the Incident Command System, Training, Qualifications and Certification, Supporting Technologies, and Publications Management." NPS RM-55.3: Definitions.

Portable Fire Extinguisher: A portable canister filled with pressurized chemicals or water to put out fires.

Preparedness: "A continuous cycle of planning, organizing, training, equipping, exercising, evaluating, and taking corrective action in an effort to ensure effective coordination during incident response. Within the National Incident Management System (NIMS), preparedness focuses on the following elements: planning, procedures and protocols, training and exercises, personnel qualification and certification, and equipment certification…" FEMA, "Emergency Management Institute Glossary," 2019.

Recovery: The long-term process of restoring normal park operations and structural stability after an emergency, as well as conducting conservation and treatment of affected objects. Salvage is the most immediate phase of recovery pertaining to museum collections.

Relocation: The movement of collections to a designated secure and stable location before or immediately after an emergency.

Response: "Activities that address the short-term, direct effects of an incident. Response includes immediate actions to save lives, protect property, and meet basic human needs. Response also includes the execution of emergency operations plans and of mitigation activities designed to limit the loss of life, personal injury, property damage, and other unfavorable outcomes. As indicated by the situation, response activities include applying intelligence and other information to lessen the effects or consequences of an incident; increased security operations; continuing investigations into nature and source of the threat; ongoing public health and agricultural surveillance and testing processes; immunizations, isolation, or quarantine; and specific law enforcement operations aimed at preempting, interdicting, or disrupting illegal activity, and apprehending actual perpetrators and bringing them to justice. Examples: Lockdown, shelter-in-place, evacuation of students, search and rescue operations, fire suppression, etc." FEMA, "Emergency Management Institute Glossary," 2019.

Risk: The combination of hazards (or threats) and vulnerabilities faced by collections and structures housing collections. *See* Hazard, Threat, and Vulnerability.

Risk Assessment: Analyzing hazards (or threats) and vulnerabilities and their probability of occurrence to identify possible ways losses to collections, structures housing collections, and life safety may occur.

Salvage: "[T]he systematic recovery of damaged cultural heritage objects, building fragments and decorative elements from a site negatively impacted by a hazard event. Salvage of movable cultural heritage involves an evacuation process…, with the inclusion of additional actions for the triage and stabilization of cultural heritage material, designed to prevent further damage until professional intervention can take place…" ICCROM, *First Aid to Cultural Heritage in Times of Crisis*, 2018.

Severity: The level of damage sustained by collections and structures housing collections as the result of an emergency incident.

Threat: Natural factors (such as earthquake, hurricane and other severe weather), geological, geographic, and climatic factors and location (such as proximity to a tidal river, coast, or volcano; placement within a major earthquake zone, Wildland-Urban Interface, or canyon prone to floods; or near an area with a high concentration of hazardous materials), or human factors (such as construction work, fire, terrorism, and vandalism) that can cause harm to life safety, collections, and structures housing collections. *See* Hazard and Risk.

Vulnerability: The susceptibility of collections or structures housing collections to sustain damage based on the composition and condition of the collection (such as glass or film), nature and/or condition of structures housing collections (such as adobe, wood, or flat-roofed masonry structures), presence or absence of well-maintained systems and equipment (such as automatic fire detection and alarm and automatic fire sprinkler and/or suppression systems, HVAC, and/or water alarms) and ease of object removal from storage or exhibit before or during an emergency incident. *See* Risk.

N. Abbreviations

AAR	After-Action Review
BPA	Blanket Purchase Agreement
COOP	Continuity of Operations Plan
COR	Contracting Officer’s Representative
EOP	Emergency Operations Plan
FMSS	Facility Management Software System
FSL	Facility Security Level
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
IC	Incident Commander
ICMS	Interior Collections Management System
ICS	Incident Command System
IDIQ	Indefinite Delivery Indefinite Quantity (applied to a contract)
MCEOP	Museum Collections Emergency Operations Plan
MOU	Memorandum of Understanding
NFPA	National Fire Protection Association
NIMS	National Incident Management System
NOAA	National Oceanographic and Atmospheric Administration
NWS	National Weather Service
OEP	Occupant Emergency Plan
OSHA	Occupational Safety and Health Administration
PII	Personally Identifiable Information
PMIS	Project Management Information System
PPE	Personal Protective Equipment
PSFC	Park Structural Fire Coordinator
RERE	Repair and Rehabilitation
RH	Relative Humidity
RSFM	Regional Structural Fire Manager
SDS	Safety Data Sheet
UL	Underwriters Laboratory
UV	Ultraviolet Radiation

O. Index

Chapter 11: Curatorial Health and Safety

CHAPTER 11: CURATORIAL HEALTH AND SAFETY

A. Overview

1. *What information will I find in this chapter?*

This chapter has information on occupational health and safety hazards that are unique to the museum work environment. You will find guidance to assist you in ensuring a healthful and safe curatorial environment. Appendix H has additional information on laws, regulations, policies, and guidelines on the NPS health and safety program.

Review other chapters in this handbook that contain important health and safety information including:

- Chapter 9: Museum Collections Security and Fire Protection, for information on fire safety
- Chapter 7: Museum Collections Storage, for information on structural floor load limits
- Appendix M: Management of Cellulose Nitrate and Cellulose Ester Film, for information on hazards from deteriorating historic film.

2. *What kinds of health and safety hazards will I find in museum collections?*

When you work with museum collections, you may face a wide variety of potential health and safety hazards, including:

- hazardous materials used in collections care:
  - toxic and flammable solvents, such as solvents in waxes or lacquers
  - preservatives, such as alcohol and formalin, used for storing natural history specimens
  - pesticides used to kill or discourage pests
- hazardous objects and conditions in collections
  - pesticide residues from past treatment of collections, such as arsenic
  - objects with inherent vice such as unexploded ordnance or cellulose nitrate film
  - biological hazards such as mold, hantavirus, and insects/arachnids
  - sharp or broken edges on objects

You may also create safety hazards through carelessness in handling collections and supplies (for example, careless lifting and carrying).

You need to know your own susceptibility to allergens and irritants (for example, bee stings or dust) and take appropriate precautions.

You need to acquaint yourself with typical hazards and how you can ensure a healthful and safe curatorial environment.

3. *What is the goal of a health and safety program?*

The ultimate goal of your curatorial health and safety program is to reduce or eliminate occupational illness and injury.

The servicewide policy outlined in Director's Order (DO) #50B, Occupational Safety and Health, outlines a framework for establishing and implementing a Risk Management process that provides for the safety and health of NPS employees and the public. The Reference Manual 50B, Occupational Safety and Health Program, provides more detailed guidance on specific implementation requirements and strategies for the Risk Management Program in the NPS.

Also familiarize yourself with 29 CFR 1910, Occupational Safety and Health Standards for General Industry. You can find the Federal Register on the web at: <http://www.access.gpo.gov/su_docs/>.

Build your curatorial health and safety program on these guidance documents. Address these goals:

- Recognize and identify the hazards.
- Evaluate the hazards.
- Reduce or eliminate the hazards to the extent possible.

4. *What are the general categories of occupational hazards?*

Learn the four general categories of occupational hazards. All of these categories are present in the museum work place:

- ***Chemical Hazards***—including any chemical that can cause a physical or a health hazard. Hazardous chemicals can be in the form of liquids, mists, vapors, dusts, fumes, gases, and solids
- ***Physical Hazards***—including radiation, extreme temperature levels, and noise
- ***Biological Hazards—***including exposures to bacteria, fungi, viruses, and parasites and allergic reactions to plants, animals, and other substances
- ***Ergonomic Hazards***—including problems with the design and selection of a work environment and poor choices in tools and equipment so that excess physical strain and stress occur

Common hazardous materials you should be aware of include: asbestos, biological samples, cellulose nitrate and cellulose acetate, decaying animal matter, disinfectants and other cleaning chemicals, heavy metal-based dyes and paints, laboratory and photographic chemicals, lead-based paints, medications, munitions, oil-filled electrical equipment (such as transformers and large capacitors), pesticides, and some rocks and minerals. The sections in this chapter discuss these materials in more detail.

B. Understanding Health and Safety Issues

1. *What basic occupational health concepts should I understand?*

There are a number of basic concepts you should understand in order to develop a good safety program.

A hazardous substance is any material that can harm the body if it is absorbed in large enough quantities over a period of time. Each hazardous material, or group of materials, has specific toxic effects.

- ***Toxicity*** is the material's capacity to produce injury to the human body. The higher the toxicity of a substance, the smaller the quantity of this substance needed to cause injury.

- ***Chronic health effects*** result from a slow accumulation of small amounts of a hazardous substance. The quantities may seem insignificant; however, with daily exposure over a period of years, material can accumulate in the body. Health effects include respiratory problems, cancer, birth defects in offspring, and damage to the heart, liver and kidneys.

- ***Acute health effects*** result when a worker is accidentally exposed to large quantities of a hazardous substance. A few symptoms are burning eyes, dizziness, and light-headedness.

- ***The exposure limit*** for a substance is the highest exposure level recommended in a work area when workers are in that area without any special protection. The two most widely used criteria are:

  – *Permissible Exposure Limit (PEL):* The PEL, established by the Occupational Health and Safety Administration (OSHA), is the concentration and time of exposure that cannot be exceeded. This standard is enforceable by federal law. Many substances also have a determined ceiling for concentration and time of exposure.

  – *Threshold Limit Value (TLV):* The TLV is a guideline based on current studies of exposed animals. It is the recommended maximum average concentration of a chemical during a 40-hour week (five 8-hour days). Results of these studies are issued annually by the American Conference of Governmental Industrial Hygienists (ACGIH). It is a recommended level and is not enforceable by law. The TLV is typically more stringent than the PEL.

  The NPS uses 50% of the PEL limit as an action level. If the concentration of a contaminant in a workspace is at or above 50% of the PEL, you must take action to monitor the exposure level and reduce the exposure.

2. *How will I know that I am being exposed to hazardous materials?*

Many hazardous materials have good initial warning properties that signal exposure to a potential injury:

- odor
- burning eyes
- skin, nose and throat irritation
- breathing difficulty

However, after a time, olfactory fatigue may set in, and you will no longer be able to smell the contaminant. Other hazardous materials, especially particulates, give little or no warning. These materials can cause harm when they are present in quantities too small to be detected by odor or other unpleasant indications.

You must identify all hazardous materials in the workplace.

Identifying all hazardous materials in the workplace allows you to identify ways to block and limit exposure.

3. *How does the body absorb substances?*

There are three ways your body absorbs substances:

- ***Skin Contact:*** Healthy, undamaged skin often provides an effective barrier against the absorption of many hazardous substances. Some substances, however, will dissolve or destroy the skin's protective layer. Punctures, scrapes, and cuts increase the risk of absorption. Once a substance is absorbed through the skin, it can cause systemic damage. Be aware of any burning, pain, redness, or irritation when using substances.
- ***Inhalation:*** Hazardous substances are very often airborne (for example, dusts, mists, fumes, vapors, gases). When you inhale these materials, they are absorbed into the blood stream and distributed to all parts of your body. Some materials will damage your lungs; others will pass through into your blood stream. Be aware of common warning signs, such as coughing, a burning sensation, heaviness in the chest, and wheezing or breathing difficulty.
- ***Ingestion:*** You may unknowingly absorb small quantities of a toxic substance into your gastrointestinal system from food or drink or from contaminated hands.

4. *How do I evaluate the degree of a health hazard?*

The factors that determine the degree of a health hazard from a given substance are:

- toxicity of a substance
- amount of a substance
- duration (length and frequency) of exposure

- protective measures used (for example, ventilation, respirators, gloves)
- susceptibility (your health condition at the time of exposure)
- environmental conditions at time of exposure (Temperature, airflow, and humidity affect the dispersion of a hazardous substance, its availability for absorption, and the amount and speed of absorption.)

By looking at each of these factors, you can decide how to limit the hazard to yourself and others in the workplace. For example, you may choose to use a less toxic substance. You might limit how long each day you use the substance. You could choose to wear gloves and protect yourself from direct skin exposure. Looking at each of these factors gives you a number of ways to minimize the hazard.

You should also understand the concept of the breathing zone. The breathing zone is the area around your nose and mouth. Many curatorial tasks are done near the breathing zone, including numbering objects, pulling objects from storage shelves, and dusting. When identifying concentrations of airborne contaminants in a workspace, it is important to determine concentrations in the breathing zone, not just in the general airspace.

Because exposure may occur in more than one way (for example, both ingestion and inhalation of a particulate such as arsenic), biological monitoring may be appropriate. Biological monitoring measures individual absorption by all routes of entry and may include testing of:

- exhaled breath
- urine
- blood

Contact your park safety officer to develop a plan for airborne exposure monitoring and/or biological monitoring if you are concerned about your exposures to hazardous materials.

5. *What is the Job Hazard Analysis?*

The Job Hazard Analysis (JHA) is a written document that evaluates hazards in your workspace (office, storage space, work area, laboratory and research spaces). The purpose of the JHA is to prevent or reduce the risk of job-related injuries and fatalities. The JHA is a tool you use to examine and evaluate activities in the curatorial workplace and to decide on corrective actions to take to prevent accidents. A JHA should be completed for all jobs that:

- have an associated history of injury, illness, or death
- require the use of personal protective equipment (PPE)
- involve activities that are clearly dangerous

Obvious hazards in the curatorial workspace include:

- exposure to toxic chemicals, such as pesticides, preservatives, and solvents
- exposure to dangerous microorganisms, such as hantavirus
- exposure to hazardous materials in collections (for example, nitrate film, radioactive specimens)
- falls from ladders or step stools
- injuries from power tools when constructing storage racks
- injuries from lifting and carrying objects

There may be other hazards specific to your park or its collections.

You can obtain more information about the JHA from:

- Department of Interior Manual (DM), Part 485, Chapter 14
- Reference Manual 50B, Occupational Safety and Health Program, Section 13, available on the web at: <http://www.nps.gov/riskmgmt/>
- OSHA 3071, 1998 (Revised), *Job Hazard Analysis*, an informational booklet that provides a generic overview to conducting a JHA (Available through OSHA on the web at: <http://www.osha.gov/>.)
- OSHA *Self Inspection Checklists,* 1997, checklists that use a question and answer format to guide the user in examining conditions and evaluating hazards, including sections on evaluating a safety and health program and using personal protective equipment (Available through OSHA on the web at: <http://www.osha.gov/>.)

Your park or regional safety officer can also provide specific guidance on conducting a JHA.

C. Controlling Exposure to Hazardous Substances

1. *How do I control exposure to hazardous substances in the workplace?*

When evaluating ways to control exposure in the workspace consider:

- limiting the use of hazardous materials
- installing proper ventilation (including fume hoods, when necessary)
- wearing appropriate personal protective equipment
- practicing good housekeeping and personal hygiene

- storing, handling, and labeling hazardous materials appropriately

- disposing of hazardous materials properly

2. *How do I limit the use of hazardous material?*

Where possible, use a less hazardous material, or use a different method. For example, substitute water-based paints and inks for solvent-based paints and ink. Substitute an IPM monitoring program for use of traditional museum pesticides such as paradichlorobenzene or Vapona. Nitrate negatives can be duplicated and copies provided for research use.

Limit the time of exposure to hazardous substances. Break up tasks that require exposure to hazardous substances into short blocks of time over a number of days.

Close all containers of chemicals when they are not in use. For example, keep the top on the lacquer that you use for numbering objects.

Provide waste receptacles with lids for disposal of toxic materials (especially solvents that will evaporate).

3. *What kinds of ventilation systems are available?*

There are two basic types of ventilation systems:

General or dilution ventilation is designed to keep you comfortable by heating, cooling, and controlling the air's moisture content. The HVAC system for your workspace is a general ventilation system. **Don't** rely on general ventilation to control moderate to high toxicity materials, or reduce concentrations from a "spot source" in your breathing zone.

Local exhaust ventilation captures the hazardous substance where it is generated and carries it away from your breathing zone. It is very effective in removing substances of moderate to high toxicity by using a system of fume or exhaust hoods, ducts, air cleaners, and fans. You should have local exhaust ventilation if you regularly work with hazardous materials. This is the preferred method for removal of air contaminants.

If only low concentrations of hazardous materials are used in your workspace, portable ventilators may be a practical solution. Portable fume or air scrubbers draw air through a charcoal absorption filter with a fan. The filtered air is then released back into you workspace. This is a less expensive alternative, but you must change the filter regularly for these ventilators to remain effective.

Ventilation: A Practical Guide by Clark and others (1984) provides detailed guidance on ventilation systems, including the criteria for designing an exhaust hood system. See Figure 11.1 for the advantages and disadvantages of different types of ventilation. Work with your regional risk manager and park safety manager, the regional/SO curator, and the park's maintenance staff to evaluate the need to improve ventilation in the curatorial workspace.

Ventilation is the key engineering control for protecting staff from the effects of hazardous substances. You should make proper ventilation a high priority when evaluating a curatorial workspace.

4. *How do I install proper ventilation?*

You must work with a ventilation engineer to ensure proper ventilation if a fume hood is installed. For proper ventilation:

- Make sure air in the workspace flows **away** from the breathing zone of each worker to a non-occupied area of the building or to the exterior.
- Pull contaminated air out of the workspace with an exhaust fan. If you try to use a fan to blow air out of a workspace, you will only disperse the contaminant within the workspace.
- Locate the ventilation system's exhaust opening close to the source of the contaminant. Move work to the exhaust area.
- Promote maximum effectiveness of the exhaust system by preventing cross-drafts from interrupting the direct outward flow of air.
- Be sure that the air exhausted from the workspace is replaced. This avoids negative pressure that reduces the ability of the exhaust system to remove contaminants. An engineer will know how quickly air is replaced in the space.
- Ensure that exhaust outlets are not near air intake valves that would pull the contaminant back into the workplace. Work with a ventilation engineer to be sure that outlets are placed properly.
- Avoid polluting the surrounding area with the contaminated exhausts. The level of environmental pollution from exhausts depends on the toxicity and concentration of the substance being vented. These levels must be evaluated by a ventilation engineer.
- Consult local or state environmental regulations on what materials can be directly exhausted. Some materials may require scrubbers in filters under Clean Air Act regulations.

5. *When should I wear Personal Protective Equipment (PPE)?*

Use Personal Protective Equipment (PPE) only when other management controls (for example, ventilation, adoption of an alternative procedure or substance, time limitations on exposure) are not possible. ***Never consider PPE as your primary source of protection.***

PPE includes:

- respiratory devices
- eye and face protection devices
- protective clothing

There is no personal protective equipment designed for universal use. The type of PPE you wear depends on the specific hazardous substances you are using. Material Safety Data Sheets (MSDS) (see Section C) provide specific information about appropriate types of PPE to be used with a specific hazardous substance. See OSHA CFR 1910, Section I, for requirements for PPE usage.

6. *What are respiratory protective devices?*

OSHA CFR 1910.134 specifies that you must use respiratory equipment when engineering controls are not feasible (for example, if you must work temporarily in a dusty attic or basement) or in an emergency. There are two types of respirators: supplied-air devices and air-purifying devices.

- Supplied-Air Respirators bring a fresh air supply from a pressurized tank or compressor. These respirators are complex and expensive. You will rarely need this kind of device in your workspace.

- Air-Purifying Respirators purify air drawn through filters or cartridges before you inhale it. This type of respirator may be made out of a variety of materials depending on the application.

Don't use air-purifying respirators as a substitute for proper ventilation.

7. *How do I select a respirator?*

Use the following criteria to select a respirator:

- OSHA requires a thorough medical exam for anyone who must wear a respirator. This physical must verify that the employee's health will not be at risk while breathing through a respirator.

- Work with your safety officer to select the proper respirator. Be sure it has been approved by the National Institute for Occupational Safety and Health (NIOSH).

- You must have a leak-tight seal between the face and respirator face piece. Facial hair that interferes with this seal is prohibited by law. You must be fit-tested and trained on the use and maintenance of your respirators. Consult with your safety officer for fit-test procedures.

- Choose the proper filtration system. Air-purifying respirators use two types of purifying material—a filter or a chemical cartridge. Filters trap dusts and mists. For chemical vapors you must use a cartridge. Choose a cartridge that is designed for the specific substance in your workspace. Consult the applicable MSDS for the specific type of respirator required (see Section C).

- Consider comfort. Respirators can become uncomfortable after a few hours. Some materials may be more irritating to a wearer than the presence of the contaminant.

- Consider cost and maintenance. Some respirators (for example, paper) are disposable. Others are not and require periodic maintenance and cartridge replacement.

Refer to Appendix H for sources of respirators. Good sources of information on respiratory protection can be found in *Conserve O Gram* 2/13, “An Introduction to Respirator Use in Collections Management,” and on the OSHA Website at <http://www.osha-slc.gov/SLTC/respiratoryprotection/index.html>.

8. *How do I know which gloves to wear?*

There are many types of gloves manufactured to protect against different types of materials. Consider the chemicals you are handling and the permeability rate. For example, gloves made from butyl give the best protection from acetone. You may use properly maintained butyl gloves for over 17 hours before replacing them. In contrast, neoprene gloves provide only 10 minutes of protection from acetone before it penetrates to your skin. Refer to the MSDS or check with manufacturers for each chemical that you are using to identify recommended types of gloves.

Refer to Appendix H for sources of gloves.

9. *What good housekeeping and personal hygiene habits do I need to develop?*

Good housekeeping and personal hygiene can go far in protecting you and others from contact with hazardous substances. Follow these rules:

- Establish a routine program for cleaning floors and work surfaces.
- Change filters in ventilation systems regularly.
- Clean up any spills immediately.
- Don't allow smoking in workspaces.
- Don't allow eating or drinking in workspaces.
- After working with objects, wash your hands before eating, applying makeup, brushing your hair or leaving work.
- Take special note of personal habits and refrain from biting your nails or chewing on pencils.

10. *How do I store, handle, and label hazardous material?*

Follow these rules:

- Store all chemicals in an approved dedicated space and only with compatible materials. Never store these materials in the same space with a museum collection.
- Store large quantities of flammable and combustible materials in special cabinets that meet OSHA and NFPA specifications. Refer to Appendix H for sources of these cabinets.
- Label all containers. Post appropriate warning signs in the storage area. Refer to Section C for information on labeling.
- Close all chemical containers when they are not being used.
- Wear appropriate personal protective equipment when using chemicals.

11. *How do I dispose of hazardous waste?*

Hazardous waste is any hazardous solid, liquid, or contained gaseous material that you no longer use. You must recycle, discard, or store hazardous waste. Common materials that you use in museum tasks may become hazardous waste, such as alcohol and formaldehyde, pesticides, and other solvents.

Under the Federal Hazardous Waste Management Program, you will have to follow different rules depending on the amount of hazardous waste you generate in a given month. Work with your safety officer and the Regional Hazardous Waste Coordinator on proper disposal methods for all hazardous materials, including empty hazardous materials containers.

You must dispose of all hazardous waste in accordance with the Resource Conservation and Recovery Act (RCRA) of 1976. All cataloged museum objects that are disposed of because of hazards must first be evaluated and deaccessioned.

For a detailed explanation of the regulations, obtain a copy of the Environmental Protection Agency (EPA) publication, *Understanding the Hazardous Waste Rules: A Handbook for Small Businesses—1996 Update.* See *MH-II*, Chapter 6: Deaccessioning, Sections B.5 and H.

D. Hazardous Chemicals and Materials Used in Collections Care

Collections care requires the use of numerous hazardous chemicals. The following information gives you basic information about commonly used materials; however, you should evaluate your own workspace and identify all hazardous substances.

1. *What solvents are used regularly?*

You may find numerous hazardous substances in the curatorial workspace. These can include:

- paints
- varnishes
- waxes
- cleaning materials
- preservatives and consolidants
- adhesives

Some of the common hazardous solvents are: acetone, ethanol, kerosene, methanol, mineral spirits, toluene, turpentine, and xylene. Mineral spirits, V.M.&P® Naphtha, and Stoddard Solvent are used in cleaning wooden furniture. The clear and white lacquers recommended by the Supply and Equipment Program for numbering objects contain acetone. In natural history collections, formaldehyde, ethanol, and methanol are used to preserve wet specimens.

Rapid Guide to Hazardous Chemicals in the Workplace by Richard Lewis (2000) is an easy-to-use reference. It deals with the properties and harmful health effects of 700 common substances.

2. *What fumigants and other pesticides do museums use?*

Museums have traditionally used chemicals to control biological infestations, including fumigation and topical application of pesticides. In more recent years, Integrated Pest Management (IPM) has become the standard for protecting collections (see Chapter 5: Biological Infestations). However, many collections are still contaminated with residues from these past treatments.

Fumigation introduces a toxic gas into a fixed space that contains the objects. Fumigants that have been used on museum collections include:

- dichlorvos (DDVP, Vapona)
- ethylene oxide
- methyl bromide
- paradichlorobenzene
- naphthalene (moth balls)
- sulfuryl flouride (Vikane®)
- thymol

Materials that have been applied through topical application include:

- arsenic
- DDT
- mercuric chloride

3. *What should I know about pesticide use?*

Pesticide residues are a serious problem in museum collections and the full extent of the problem is just becoming known. In many cases there is little documentation on past pesticide usage. Repatriated objects are of particular concern because they are returning to communities that may have little or no knowledge of the hazards of pesticide contamination.

Information in Chapter 5: Biological Infestations will help you to identify problems in your collections and show you how to limit or halt the future use of pesticides by using IPM techniques. Refer to Appendix H: Section E, for a list of fumigants that were traditionally used in museums and for health and reactivity information. The *Conserve O Gram* series has additional health and safety information about these materials. Review these publications to acquaint yourself with the dangers of pesticide use and how to manage contaminated collections.

Vikane (sulfuryl fluoride) is now the only fumigant that is legally available to use on collections. All others have been banned. It is a restricted use pesticide that requires park and regional IPM approval before application. See Chapter 5: Biological Infestations and the *Conserve O Gram* series for information on alternative non-toxic treatment strategies if you find an infestation in your collections. Work with your regional/SO curator and park IPM coordinator to develop alternative strategies to pesticide use.

Use of any pesticide must follow policy in NPS-77: Natural Resources Management Guideline, Integrated Pest Management (Chapter 2, p. 217-266).

You must obtain approval for using a pesticide through the Pesticide Use Proposal System (PUPS) or by telephone, as described in NPS-77. A regional/SO or WASO IPM specialist must review and approve all pesticides prior to use.

The regional/SO IPM specialist:

- consults with the regional curator to evaluate the need for pesticide use and to ensure that any approved use is an integral part of the integrated pest management process

- consults with WASO IPM specialist for concurrence if the pesticide is a restricted use product, will be used on or near an aquatic system, may affect threatened or endangered species, or is to be applied over 400 contiguous acres

- responds to park IPM coordinator within five working days with either approval or denial with suggested alternative management strategies

The park IPM coordinator:

- works with curatorial staff to ensure that pest management activities, including use of pesticides, are directed by technical experts and follow pesticide label instructions

- submits PUPS use to regional/SO IPM coordinator at end of each calendar year as directed in NPS-77

There may be times when it is appropriate to use a fumigant on museum objects. It may also be appropriate to use pest deterrent chemicals, such as crack and crevice solutions, in the museum space around collections. However, be sure you make the decision to use pesticides with the approval and advice of experienced and trained NPS staff.

4. *Are there special precautions for using silica gel in exhibition and storage cases?*

Yes. Silica gel may cause irritation to skin, eyes, and the respiratory tract. Goggles, a lab coat, vent hood (or appropriate respirator), and proper gloves should be used when working with bulk silica gel. Obtain a Material Safety Data Sheet (MSDS) from the silica gel manufacturer for further information. (Also see Sections D.5 and D.6 below.)

Cobalt impregnated silica gel should be phased out of use and replaced by Sorbead Orange, Silica Gel Yellow, or other biodegradable indicating gels. Cobalt is a skin and respiratory system sensitizer. Contact your park or regional HAZMAT coordinator to obtain information on appropriate disposal of cobalt impregnated silica gel. (See *COG* 2/15, Cobalt Indicating Silica Gel Health and Safety Update.)

5. *What is the Hazard Communication Standard?*

Your park must implement a program to communicate essential information on hazardous chemicals. This is required by OSHA's 29 CFR 1910.1200 (the Hazard Communication Standard) and NPS policy. This means you must:

- inventory all hazardous substances
- obtain and maintain a Material Safety Data Sheet (MSDS) for all hazardous chemicals
- label all hazardous substances
- receive training in the Hazard Communication Standard

6. *What is a Material Safety Data Sheet (MSDS)?*

A MSDS is a concisely written information sheet that explains the hazards of substances and how you are required to handle and use them. The OSHA standard does not require that MSDS be uniform in format; however, each sheet must contain the following information:

- product name and identification of chemicals including:
  - identification of the substance
  - manufacturer's name
  - both chemical and trade names and any synonyms
  - chemical family and chemical formula
  - name and address of the manufacturer with emergency telephone number
  - hazardous ingredients
  - percentage of each ingredient
  - recommended exposure limits for these ingredients
- physical and chemical characteristics of each hazardous chemical including:
  - physical properties (boiling point, melting point, appearance and odor threshold, solubility in water, evaporation point)
  - fire or explosion hazards (flash point, flammable limits, fire extinguishing equipment needed)
  - list of substances that cause it to burn, explode, or release toxic gases (for example, water or other chemicals)
  - list of environmental conditions that cause a dangerous reaction (for example, heat or direct sunlight)

- health hazards including:
  - known acute and chronic effects
  - exposure limits (PEL and TLV)
  - known or suspected carcinogenic effects
  - emergency and first aid procedures
  - primary route of exposure (for example, skin, nose and mouth)
- special protective information including:
  - special control measures, such as ventilation requirements
  - appropriate personal protective equipment (for example, respirators, gloves, goggles, or clothing)
- spill or leak procedures, handling and storage information:
  - special handling and storage precautions
  - procedures for cleaning up spills and leaks and disposing of resulting waste

This last information is often regulated by the U.S. Department of Transportation and by statues and laws like the Toxic Substances Control Act and the Resource Conservation and Recovery Act. This information is especially important when you prepare your emergency operations plan (EOP).

7. *How do I get and maintain a MSDS?*

You should be able to obtain a MSDS when you purchase a hazardous chemical or a product that contains a hazardous material. If you currently have hazardous materials in your workspace and do not have a MSDS for them, you can get it by contacting the manufacturer. Always ask the manufacturer first. The manufacturer is obliged by law to provide a MSDS. There are also several institutions that maintain collections of material safety data sheets on the Web; however, they may not be the specific formulation you are using. You can search for these at <http://palimpsest.stanford.edu/bytopic/health/#msds>.

Request the MSDS whenever you make a purchase from the Government Services Administration (GSA) and other vendors. Keep the MSDS in an easily accessible file that is available to everyone in the curatorial workspace.

See Figure 11.2, Sample Material Safety Data Sheet and Figure 11.3, MSDS for Formaldehyde.

8. *How should I label hazardous substances?*

OSHA's Hazard Communication Standard requires that all chemical labels include a hazard warning. Prepare labels for chemicals you use in your daily work, such as the lacquer you use for numbering objects. Refer to Appendix H for sources of vendors who provide a variety of label materials.

Include the following information (recommended by the American National Standards Institute) on all labels:

- chemical name and any synonym
- signal word to indicate the degree of severity of a hazard (in increasing order):
  - CAUTION!
  - WARNING!
  - DANGER!
  - POISON! (used only for highly toxic chemicals)
- statement of hazard
- precautionary statement
- effects of over exposure
- first aid procedures
- chemical abstract service number

9. *What is the NFPA Hazard Symbol?*

The National Fire Protection Association (NFPA) Hazard Symbol is an effective labeling system that you should consider using. This system uses a diamond-shaped symbol to rate the health, fire, and reactivity hazard of a substance to warn personnel if there is a fire. See Figure 11.4. The hazard warning system uses a 0 to 4 rating with 0 being the least hazardous and 4 the most hazardous. You can use this label on any size container. You can also post the label on access doors to storage rooms or cabinets containing hazardous materials (for example, cellulose nitrate film). It is a warning to all employees and to firefighters. Refer to Figure 11.4 for an explanation of the NFPA warning rating system.

10. *How can I get occupational safety and health training?*

Your employer must provide you with appropriate occupational safety and health training to equip you with the knowledge and skills to safely perform your job and to respond to potential emergencies.

Contact your Regional Training Coordinator, or your Regional Safety Manager for Safety and Health for available training.

E. Hazardous Objects in Collections

1. *What type of hazardous objects are in collections?*

This section describes what to do with the most common hazards in collections including:

- pesticide residues
- hazardous geological specimens (radioactive minerals, asbestos, toxic minerals)
- cellulose nitrate and cellulose acetate film and negatives
- firearms, edged weapons, ammunition, and unexploded munitions
- medical objects and drugs/chemicals
- objects containing asbestos

You should familiarize yourself with the types of hazardous objects that are typically found in collections. Be aware of the health and safety risks. Review *Conserve O Gram* 2/10, Hazardous Materials in Your Collections, as well as references listed in Section H, to get additional information about hazardous collections and how to protect yourself.

2. *Why should I be concerned about pesticide residues in biological specimens and organic ethnographic and historic objects?*

Many historical biological specimens (birds, mammals, and plants) and ethnographic and historic organic materials were treated with pesticides. These pesticides can leave residues. See the article "Masked Hazard" listed in the references for a discussion of the problems that pesticide residues can cause.

At this time, arsenic is a residue that you can identify with a simple test. See Section E.4 below. The mercuric chloride spot tests that are currently available do not work consistently. Other pesticide residues that may be present don't have simple identification tests. A number of researchers are working in this area, and new information will be published in the *Conserve O Gram* series as it becomes available. The following *Conserve O Gram* leaflets have health and safety information on commonly used pesticides:

- 2/2, Ethylene Oxide Health and Safety Update
- 2/3, Arsenic Health and Safety Update
- 2/4, Dichlorvos (Vapona) Update
- 2/10, Hazardous Materials in Your Collection

Under no circumstances should any taxidermy mount be used for "hands-on" demonstrations for children or adults before it has been tested for the presence of arsenic.

Collect and document information on pesticide use in your collection. Talk to individuals who worked in the park in the past. Search documents such as:

- accession and catalog records
- annual reports
- maintenance records
- purchasing records
- diaries or other informal records from previous curators
- conservation records

3. *What do I do if I have specimens contaminated with arsenic?*

Arsenic can be readily absorbed through the skin, inhaled, and ingested. Arsenic can cause acute symptoms or may lead to chronic disorders. It is a known human carcinogen. In working with contaminated ethnographic and biological collections (especially bird and mammal specimens) use the following handling precautions:

- Do not touch specimens with bare skin. Wear plastic gloves and a protective smock or lab coat. Wear a dust mask rated for toxic dust. If possible, handle an object or specimen by a container or a mount.
- Always wash hands after working with specimens. Discard gloves. Keep the protective smock or lab coat clean. Do not take protective clothing home to wash—especially if you live with small children or elderly people.
- Obtain a Material Safety Data Sheet (MSDS) on arsenic and keep in the park's curatorial workspace/office. Consult the MSDS for specific information on arsenic.
- Label museum cabinets or storage spaces that house specimens contaminated with arsenic with the warning sign "ARSENIC." Also label individual specimens that have been tested. Prepare and post a written set of instructions for handling specimens contaminated with arsenic.

4. *How do I identify specimens that are contaminated with arsenic?*

You should inspect all biological collections (birds, mammals) and ethnographic objects made from organic materials (leather, basketry, textiles). These collections were typically treated with arsenic.

Test all bird and mammal specimens collected and prepared prior to the mid-1970s.

Follow these procedures to identify arsenic:

- Wear plastic gloves and a lab coat or smock while you inspect each specimen or object. Look for powdery or crystalline deposits. On bird and mammal specimens, look on the tips of feathers and hair, along eyes, in or at the base of ears, around mouth or bill, along ventral incision, at the base of tail, and on foot pads. On ethnographic objects, look along seams, at the base and tips of feathers or hair, in areas of stitching, in folds and on the shelving beneath an object. Some application techniques, however, dispersed the arsenic as such fine powder that you may not be able to see it.

- Study each specimen and object's history. Try to determine who collected and prepared the specimen, when it was collected, and where it was collected.

- Follow the instructions for identifying arsenic residues provided in *Conserve O Gram* 2/6, Arsenic Health and Safety Update. Refer to NPS *Tools of the Trade* for sources of the EM Science arsenic test kit. Document each test with a written report and keep the reports in the museum records accession or catalog folder.

- Tag specimens and objects testing positive for arsenic with an "ARSENIC" warning sign.

- Inform the park safety office about the project and the results.

- Disclose any test results or information on suspected pesticide contamination to researchers or visitors who may touch objects and also to recipients when repatriating objects.

- Develop an emergency response plan to deal with the rescue of contaminated objects after a flood or fire. These objects are a severe health risk when wet.

5. *What hazards will I find in geological collections?*

A few types of geological specimens are hazardous. See *Conserve O Gram* 11/2, Storage Concerns for Geological Collections, for a basic discussion of health hazards. The main hazards are:

- radiation from radioactive specimens (for example, pitchblende [uraninite] is strongly radioactive)

- radon from fossils

- toxic minerals (for example, antimony, arsenic, barium, boron, copper, fluorine, lead, uranium, zinc)

- asbestos (a carcinogen)

- clay and quartz dust

- off-gassing from mercury compounds

Certain individuals may also have allergic responses, such as dermatitis, from particular minerals.

Label all known hazardous materials.

6. *Why are cellulose nitrate and diacetate negatives hazardous?*

Both aging cellulose nitrate and acetate film off-gas chemicals that can be irritants and toxic hazards. Cellulose nitrate emits nitrogen oxide gas, which has a sweet odor; cellulose acetate emits acetic acid, which has a sharp vinegar odor.

Cellulose nitrate is also volatile and flammable. Motion picture film is especially dangerous and in extreme cases has been known to self-ignite when stored improperly. The by-products can also cause deterioration of other materials stored in the same space.

Acute symptoms include:

- eye irritation
- rashes and sores on the face and skin
- vertigo
- nausea
- headaches
- swollen glands
- respiratory irritation and difficulty breathing

Repeated exposure by inhalation to the emissions of these deteriorating films may result in chronic symptoms, such as bronchia irritation or development of an emphysema-like condition. See Appendix M: Management of Cellulose Nitrate and Ester Film, for more information on the hazards of cellulose nitrate and acetate film.

In addition, the silver salts present in negative emulsions may irritate the skin.

7. *How can I protect myself when working with cellulose nitrate and acetate film?*

To protect yourself when working with nitrate and acetate film follow these steps:

- Plan for your project. Make sure you have the required work-space, equipment, and time. Identify any special protective equipment you will need.
- Ensure that the workspace has proper ventilation to remove emitted gases from your breathing zone. See Section C for a discussion of ventilation and respirators.
- Wear goggles unless proper ventilation is established. Do not wear contact lenses. Gases can concentrate under contact lenses causing eye injury and damage to the contact lens.
- Wear plastic gloves (vinyl, latex, nitrile) to minimize the risk of skin irritation. You can wear cotton gloves over the plastic gloves.
- Don't work with nitrate and acetate negatives more than two or three hours a day.

- After each work session, clean the work surface with a solution of baking soda and water. Mix one teaspoon baking soda with one pint of water. This solution neutralizes any acid that the negatives deposit.

- Keep a log in the work area. Note any odors you detect, the time spent each day on the project, and physical discomfort you have during or after work. If you experience any ill effects, notify your supervisor and the park safety officer.

8. *What particular concerns should I have with archival records?*

Other major archival health and safety issues are:

- asbestos that has contaminated records (See *Conserve O Gram* 2/11, Health and Safety Risks of Asbestos.)

- broken glass plate negatives and transparencies, which can be difficult to handle without cutting yourself

- bird, bat, insect, and rodent contaminated materials or flooded materials that may have viral or bacterial contamination, including hantavirus (See *Conserve O Gram* 2/8, Hantavirus Disease Health and Safety Update.)

- chemically or radiologically contaminated records

- mold, fungi, and yeasts, which can cause allergies, asthma, histoplasmosis, and ringworm (See *Conserve O Gram* 3/4, Mold and Mildew: Prevention of Microorganism Growth on Museum Collections.)

9. *What do I need to know about firearms and live ammunition?*

You must inspect all firearms when you acquire them to make sure they are not loaded. Until a historic firearm is examined, treat it as if it were loaded. Inspect all breach loading firearms and pistols for cartridges. Remove any cartridges that you find.

Follow these steps to check a muzzleloader for live ammunition. You will need a wooden dowel smaller in diameter than the firearm's caliber and longer than its barrel.

- Select a safe, dedicated work area. Place the firearm on a padded table. Point the muzzle so nothing will be harmed if it accidentally fires. ***Never stand in front of a firearm's muzzle.***

- Wear leather gloves and safety goggles.

- Be sure the firearm is not cocked.

- Standing to the side of the firearm, gently push the dowel into the muzzle until it stops. Hold the dowel between the thumb and forefinger so that the dowel will be propelled ***between*** the fingers should the firearm discharge. ***Do not hold the dowel in such a way that it can be propelled <u>into</u> your hand.***

- Place a pencil mark on the dowel where it just clears the muzzle of the barrel.

- Gently withdraw the dowel from the barrel.

- Place the dowel on top of the barrel with the pencil mark aligned with the muzzle. If the other end of the dowel extends the full length of the barrel, the weapon is not loaded. However, if the measurement indicates that the dowel stopped forward of the touch-hole, consider the firearm to be loaded with a live round.

- Inform the Park Safety Officer of the potential problem. Label the firearm as unsafe and arrange to store it in a secure space.

- Contact the regional/SO curator for instructions on disarming the weapon.

See *Conserve O Gram* 10/1, Caring for Historic Longarms: Storage and Handling Requirements, for more information on safely disarming weapons.

10. *What do I need to know about small arms ammunition?*

Small arms ammunition includes Revolutionary and Civil War paper musket cartridges; metallic cartridges used in the American West; and contemporary pistol, rifle, and machine gun ammunition from World Wars I and II. These small arms cartridges do not pose a serious risk unless they are damaged. Tests conducted by the U.S. Army, the National Rifle Association, the arms industry, and several fire and insurance companies have repeatedly demonstrated that such ammunition will not detonate by itself. This kind of ammunition requires a direct blow to its primer or a direct spark or flame to detonate the powder. If this ammunition is accidentally detonated when it's not confined within the barrel of a firearm, the pressure drops rapidly. The bullet will fly out of the cartridge with about the same velocity as a cork from a champagne bottle.

Follow these general rules for safely handling small arms ammunition:

- Never attempt to deactivate small arms ammunition. Procedures such as drilling holes in a cartridge case or pulling a bullet to remove the powder and charge can be extremely dangerous. If you must deactivate the ammunition, contact a specialist.

- As with all museum collections, prohibit smoking.

- In parks with large collections, store live cartridges in a separate museum specimen cabinet. Clearly label the cabinet with a warning sign to notify fire-fighting personnel.

- If you want to put fixed ammunition on exhibit, it must be rendered inert. Contact the regional/SO curator for guidance in rendering ammunition inert.

11. *What do I need to know about unexploded munitions?*

Unexploded munitions (e.g., cannon balls, Borman fuses, grenades, artillery projectiles) constitute a major health and safety risk.

Treat any unexploded ordnance discovered in a collection with extreme caution. Considerations for the safety of staff, visitors, and resources take precedence over the preservation of even rare ordnance.

Don't handle this material unless you have received specific training and authorization in writing by the superintendent. If you discover ordnance that you suspect is unexploded, immediately take the following steps:

- Do not move or disturb the object.
- Keep all other persons away from the object. Secure the storage space.
- Notify the Chief Park Ranger or other designated protection officer and the Park Safety Officer. Contact the regional/SO curator.
- Work with the Chief Park Ranger and the regional/SO curator to have the object(s) examined and evaluated by an appropriate authority to identify the type of ordnance, manufacturer, historic period, and significance.

If the object is rare, novel, or limited in production (for example, Whitworth projectile, Armstrong projectile, Confederate Mullane projectile) or is identified in the park's approved Scope of Collection Statement, make every attempt to defuse it and preserve the inert object in the collection.

12. *What types of hazardous medical objects and drugs/ chemicals are in collections?*

Museum collections can contain a variety of hazardous medical objects and drugs/chemicals.

Handle old medical equipment and medicine or chemical bottles with extreme caution.

Knives, saws, scissors, and other objects from military and civilian medical kits may still carry viable germs and may contain active toxic substances (for example, strychnine, opium, and morphine). The active ingredients of drugs or chemicals, originally very potent, may have become even more potent over time. Drugs, medicinals, and other preparations in pharmaceutical collections may contain toxic materials and/or controlled substances (for example, narcotics). The Controlled Substances Act of 1970 regulates these types of substances. Watch for bottles containing:

- acids and other corrosive liquids (for example, nitric acid)
- fuels (for example, kerosene, naptha®)
- solvents (for example, paint thinners, turpentine)

These chemicals are hazardous and pose the threat of fire. Very often old chemicals contain such labels as "Oil of Vitriol" (sulfuric acid) and "Aqua Fortis" (nitric acid).

13. *What should I do with medical objects and drugs/chemicals?*

Survey the park's collections to determine if they contain any drugs, medicinals, or other preparations that pose potential health or safety hazards. Report findings to the park Safety Officer. If the survey identifies that such materials are in the collection, notify the regional/SO curator and regional Risk Manager and proceed with the following steps:

- Prepare an inventory of the drugs and medicinal chemicals. Start with the containers that have labels. Include the following information in the inventory:

  – name of the substance

  – all information on the label

  – type of container (for example, glass bottle, metal canister, cardboard box) and its lid or stopper

  – condition of container (for example, condition of seal; cracked, chipped bottle; rusty metal; punctured box)

  – other (for example, strong odor being emitted from container)

- List material that cannot be identified and isolate it on a separate shelf for a more detailed examination. Agents of the U.S. Department of Justice, state agencies (such as state crime labs), local pharmacists, and local pharmaceutical manufacturers can provide assistance with identifying this material.

- Conduct a detailed examination. Based on the inventory list or an examination by appropriate specialists, divide the substances into the following groups:

  – "over-the-counter" preparations that are considered non-toxic if precautions are followed and that are not controlled substances

  – non-controlled drugs or preparations that may be toxic or potentially hazardous in some applications or that would require a physician's prescription to get today

  – controlled substances (such as narcotics and dangerous drugs) as defined by the Controlled Substances Act of 1970

  – drugs that may pose a health/safety hazard because of their age or level of deterioration

- Implement an action plan. Based on your inventory and on the detailed examination, pursue the following actions:

If drugs, medicinals, and preparations…	Then you should…
are not controlled, are non-toxic (with usual precautions), and pose no other hazards to the rest of the collection or to the staff,	retain them.
are not controlled but may be toxic or require a prescription to obtain,	retain them only if they are stable and pose no health- hazards to the staff or risk to the rest of the collection. House this material in a locked utility cabinet.

If these materials will become a hazard in the future, consider depositing a sample with the Division of Medical Sciences at the Smithsonian Institution, National Museum of American History (NMAH) and destroying the remainder. This ensures that future staff will not be exposed to hazards from these substances. Check with the division in advance to determine what size sample to save.

- Destroy drugs and medical chemicals that are:
  - controlled substances as defined by the Controlled Substances Act of 1970
  - so toxic that their continued presence in the collection poses an unacceptable risk
  - an immediate hazard to the rest of the collection or the staff because they are dangerously unstable, corrosive, or explosive

If you must destroy material, for whatever reason, retain a small sample for research and reference purposes, and deposit it with the Division of Medical Sciences at the NMAH. Take, account for, and transmit samples of controlled substances in accordance with Drug Enforcement Administration (DEA) procedures. Contact the DEA for assistance. If the specimen to be destroyed is not a controlled substance, contact the Regional Hazardous Waste Coordinator for instruction on proper disposal of the material.

14. *What should I do with original containers?*

Take into account preservation of the original containers when saving or destroying drugs and medical chemicals in the collection. You can open an original, unopened container for the purpose of removing its contents only when:

- the act of opening will not permanently damage the container or diminish its value
- there are urgent and compelling health and safety reasons for opening the container
- the contents are endangering the container (for example, by corrosion) and removal of the contents is the only way to stop the problem

- the act of opening the container poses no safety problem (for example, container exploding or releasing toxic material)

If you are keeping substances in the collection, you may want to transfer them to modern containers. Do this if the original containers can no longer hold them safely. Preserving the original containers is a high priority.

If your collections include original, unopened containers of substances that must be destroyed to comply with the law, the containers are in good condition and thus would not have to be opened otherwise, but can't be opened without causing unacceptable permanent damage, then the containers and their contents shall be deaccessioned (out of scope) and transferred to the Division of Medical Sciences at the Smithsonian Institution.

Keep full descriptive information about the transferred objects, including one or more photographs, with the park's catalog records. Refer to *MH-II*, Chapter 6: Deaccessioning, for information on deaccessioning hazardous material.

When substances in the collection are to be destroyed, save the original containers. Previously opened containers may be emptied as necessary with routine precautions taken for their preservation. Clean emptied containers thoroughly before returning them to storage or exhibit.

If the container held a controlled substance, NO residue may remain in the container according to DEA regulations.

F. Safety Rules for Lifting and Carrying

Chapter 6 in this handbook discusses the importance of using proper techniques when lifting and carrying museum objects. Improper handling techniques may lead to accidental damage to the object. You may injure yourself by improperly lifting and carrying boxes of objects, furniture, and other large and heavy objects. Safely lifting and carrying museum objects requires planning.

1. *How should I plan for lifting and moving objects?*

Careful planning before lifting and moving objects can minimize the chance of injury. Follow these guidelines:

- Consider the size and weight of the load and ask for help if the object is too heavy or bulky to lift and carry safely by yourself.

- Examine the objects for hazards: sharp or broken edges, or contamination, such as mold, or asbestos.

- Have mechanical help at hand. Use a push cart or handtruck to move heavy or bulky objects.

2. *How do I lift and carry an object safely?*

Follow these rules:

- Get close to the object.
- Keep your back ***straight*** (not arched) when lifting.
- Keep head high and chin tucked.
- Keep feet apart, one foot ahead and one foot behind, to maintain a wide base of support.
- Use legs to help with the lift.
- Push or pull large, heavy objects on a cart, when possible, rather than carry them.
- Use teamwork and good communication when two or more are helping with a load.
- Pivot your feet rather than twisting them when turning with a load.

3. *How do I reach for an object safely?*

Follow these rules to avoid injury when reaching for museum objects.

- Use a step stool for objects slightly out of reach.
- Use an appropriate and sturdy ladder to reach objects on high shelves.
- Maintain proper posture when reaching overhead.
- Store heaviest objects between knee and chest height.

G. Workspace Conditions

1. *What makes a safe and healthy curatorial workspace?*

A safe and healthy curatorial work environment includes good lighting, ventilation, good housekeeping, appropriate type and number of fire extinguishers, and a comfortable chair. Consult with your safety officer on steps that you can take to improve your workspace. You can find information about creating or improving your workspace by referring to sources in Section I, Web Resources, and Section J, References.

2. *When should I worry about radon?*

Radon may be a concern in some curatorial workspaces, especially in basements or certain well-sealed spaces. The natural disintegration of uranium generates radon gas. Radon is prevalent in areas where soils and rocks naturally contain uranium, phosphates, and pitchblende. It may also be a problem where the soil is contaminated with the by-products from uranium or phosphate mining. This colorless, odorless gas seeps into structures through dirt floors, cracks in concrete floors and walls, floor drains, sumps, slab joints, and cracks and pores in concrete block walls. Radon tends to accumulate in enclosed spaces. Levels of radon depend on the structure's construction and on the concentration of radon in the soil.

Radon in the short-lived gaseous state is not harmful. However, the gas breaks down into radioactive particulates (for example, heavy metals) called "radon daughters." These radioactive decay products attach themselves to dust or exist as free ions. If you inhale these particles, they can become trapped in the lung tissues and eventually cause lung cancer. Curatorial staff should determine if there is a potential radon problem in museum collection spaces, especially in work and storage areas (for example, basements or well-sealed spaces).

3. *How do I know if there is radon in my workspace?*

Discuss a radon monitoring program with the park Safety Officer or the Regional Risk Manager. Radon may already have been identified in park structures.

If radon levels have not been determined, request a short-term screening measurement. There are numerous types of monitoring equipment. Work with an individual who has experience and training in monitoring. For assistance in finding individuals experienced in testing for radon you can contact your state radon office. Contacts are listed on the EPA website at <http://www.epa.gov/iaq/contacts.html>. You can also contact the EPA at: U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Indoor Environments Division (6609J), 401 M Street SW, Washington, DC 20460; (202) 564-9370; fax: (202) 565-2038.

The amount of radon in the air is measured in "picocuries of radon per liter of air," or "pCi/L." Sometimes test results are expressed in Working Levels (WL). A level of 0.02 WL is equal to about 4 pCi/L.

Practical remediation methods typically can reduce the indoor radon concentrations to well below 4 pCi/L, the current EPA action level for all occupied buildings. EPA indicates that most structures can be reduced readily to below 2 pCi/L.

4. *What do I do if there is a radon problem in the workspace?*

Work with other park staff to reduce the flow of radon into the space. The methods for reducing radon flow include covering exposed earth and sealing cracks and openings (for example, pores in concrete blocks, openings around utility pipes, joints between basement floors and walls, floor drains). This method can achieve the desired reduction in radon levels at small cost. You must implement this method before using other methods. If the radon remains at an unacceptable level, try one or both of the following methods:

- Ventilate the space with natural, forced, or heat recovery systems. Ventilation reduces radon levels by replacing radon-laden indoor air with outdoor air. Change in ventilation, however, may cause problems maintaining the appropriate environment for museum objects.

- Install a system to keep radon from entering space. These more expensive methods include drain-tile suction, sub-slab suction, and block-wall ventilation prevention of space depressurization, and space pressurization.

For a detailed discussion on radon reduction methods, get a copy of the EPA publication *Consumer's Guide to Radon Reduction: How to Reduce Radon Levels in Your Home* (1992) from the nearest EPA Regional Office, or download it from the EPA Website at <http://www.epa.gov/iedweb00/radon/pubs/consguid.html>.

H. Glossary*

Acute conditions: severe, often dangerous conditions in which relatively rapid changes occur

Acute exposure: intense exposure to a hazardous substance over a relatively short period of time

Boiling point: temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which the liquid changes to a vapor. The boiling point is usually expressed in degrees Fahrenheit. *If a flammable material has a low boiling point, it indicates a special fire hazard.*

Breathing Zone: ambient environment in which a person performs normal respiration (around nose and mouth)

Ceiling ("C"): concentration of a substance that should not be exceeded, even for an instant. It may be written as Threshold Limit Value-Ceiling or TLV-C.

Carcinogen: substance or physical agent that may cause cancer in animals or humans

Chronic conditions: persistent, prolonged, or repeated conditions

Chronic exposure: exposure occurring over a period of days, weeks, or years

Combustible liquids: liquids with flash points at or above 100°F (37.8°C) or those that will burn. They do not ignite as easily as flammable liquids. However, combustible liquids can be ignited under certain circumstances, and must be handled with caution. (Substances, such as wood and paper are termed "ordinary combustibles.")

Flammable liquids: liquids with flash points below 100°F

Flash Point: lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture and burn when a source of ignition (e.g., sparks, open flames, cigarettes) is present. Two tests are used to determine the flash point: open cup and closed cup. The test method is indicated on the MSDS after the flash point.

Hazardous material: chemical or mixture of chemicals that is toxic, highly toxic, an irritant, a corrosive, a strong oxidizer, a strong sensitizer, combustible, flammable, extremely flammable, dangerously reactive, pressure-generating, or otherwise may cause substantial personal injury or substantial illness during or as a direct result of any customary or reasonable foreseeable handling or use

Lower Explosive Limit (LEL): lowest concentration of a substance that will produce a fire or flash when an ignition source (for example, flame, spark) is present. It is expressed in percent of vapor or gas in the air by volume. Below the LEL the air/contaminant mixture is theoretically too "lean" to burn.

Mutagen: anything that can cause a change (or mutation) in the genetic material of a living cell

Narcosis: stupor or unconsciousness caused by exposure to a chemical substance

Odor threshold: minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor

Permissible Exposure Limit (PEL): exposure limit that is published and enforced by OSHA as a legal standard. PEL may be a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short-term exposure limit (STEL), or a ceiling (C). The PELs are found in Tables Z-1, Z-2, or Z-3 of OSHA regulations 1910.1000.

Reactivity: substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosion, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, or mixing with water and dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on a MSDS.

Short Term Exposure Limit (STEL): maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures

Threshold Limit Value (TLV): airborne concentrations of substances established by the ACGIH that represent conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLVs: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C).

Time Weighted Average (TLV-TWA): average time, over a given work period (for example, 8-hour workday), of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period.

Toxicity: potential of a substance to exert a harmful effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place

Trade name: commercial name or trademark by which a chemical is known. One chemical may have a variety of trade names depending on the manufacturers or distributors involved

Upper Explosive Limit (UEL): highest concentration (expressed in percent of vapor or gas in the air by volume) of a substance that will burn or explode when an ignition source is present. Theoretically, above this limit, the mixture is said to be too "rich" to support combustion. The difference between the LEL and the UEL constitutes the flammable range or explosive range of a substance. That is, if the LEL is 1 ppm and the UEL is 5 ppm, then the explosive range of the chemical is 1ppm to 5 ppm.

Vapor: gaseous form of substances that are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids, such as solvents. Solvents with low boiling points will evaporate readily.

* This glossary was prepared by excerpting selected terms and definitions from the Glossary (Appendix D), 1161-1234, in *Fundamentals of Industrial Hygiene* (Second Edition), edited by Julian B. Olishifski.

I. Web Resources

NPS Occupational Safety and Health Program: <http://www.nps.gov/riskmgmt>. (Director's Order #50B and Reference Manual 50B are also available through a link on this page.)

Department of Interior Manual, Part 485 Safety and Occupational Health Program: <http://www.nps.gov/riskmgmt/act_man.htm>.

AIC Health and Safety Guides: <http://palimpsest.stanford.edu/aic/health/>.

Conservation OnLine, Health and Safety Links: <http://palimpsest.stanford.edu/bytopic/health/>.

Environmental Protection Agency: <http://www.epa.gov/>.

ErgoWeb: <http://ergoweb.com/Pub/ewhome.html>.

National Institute for Occupational Safety and Health: <http://www.cdc.gov/niosh/homepage.html>.

Occupational Safety and Health Organization (OSHA), Department of Labor: <http://www.osha.gov/>.

OSHA information on respiratory protection: <http://www.osha-slc.gov/SLTC/respiratoryprotection/index.html.>.

The Physical and Theoretical Chemistry Laboratory, Oxford University, Guide to Gloves: <http://physchem.ox.ac.uk/MSDS/glovesbychemical.html>.

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K. List of Figures

Dilution Ventilation	
Advantages	***Disadvantages***
• low equipment and installation costs	• does not eliminate exposure to contaminated area
• effective control for small amounts of low and medium toxicity solvents	• should not be used for high toxicity vapors and gases
• effective control for flammable and combustible gases and vapors	• should not be used for large amounts of gases and vapors
• requires little maintenance	• ineffective for particulates (dust, metal particles, metal fumes)
	• requires large volumes of heated or cooled make-up air
	• not effective for handling surges of gases or irregular emissions
	• people working close to contaminant source can still have large exposures

Local Exhaust Ventilation	
Advantages	***Disadvantages***
• captures contaminants at source and removes them from workplace	• system design and installation can be expensive
• can handle all types of contaminates, including dusts, metal fumes, etc.	• requires regular cleaning, inspection and maintenance
• requires small amounts of make-up air since uses low exhaust volumes	
• low on-going energy costs because of low amounts of make-up air	
• only alternative for high toxicity airborne materials	

Figure 11.1. Comparison of Dilution and Local Exhaust Ventilation (after Clark, et. al., 1984).

Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communication Standard,
29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(As Used on Label and List)*	Emergency Telephone Number

Section I

Manufacturer's Name	Emergency Telephone Number
Address *(Number, Street, City, State, and ZIP Code)*	Telephone Number for Information
	Date Prepared
	Signature of Preparer *(optional)*

Section II - Hazard Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Names(s))	OSHA PEL	ACGIH TLV	Other limits Recommended	% (*optional*)

Section III – Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H_2O = 1)	
Vapor Pressure (mm Hg.)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	
Solubility in Water			
Appearance and Odor			

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
Extinguishing Media			
Special Fire Fighting Procedures			
Unusual Fire and Explosion Hazards			

(Reproduce locally) OSHA 174, Sept. 1985

Figure 11.2. Sample Material Safety Data Sheet

Section V - Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable		
Incompatibility *(Materials to Avoid)*			
Hazardous Decomposition or Byproducts			
Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur		

Section VI – Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?
Health Hazards *(Acute and Chronic)*			
Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?
Signs and Symptoms of Exposure			
Medical Conditions Generally Aggravated by Exposure			
Emergency and First Aid Procedures			

Section VII - Precautions for Safe Handling and Use

Respiratory Protection *(Specify Type)*			
Ventilation	Local Exhaust		Special
	Mechanical *(General)*		Other
Protective Gloves		Eye Protection	
Other Protective Clothing or Equipment			
Work/Hygienic Practices			

Page 2 * U.S.G.P.O.: 1986 - 491 - 529/45775

Figure 11.2. Sample Material Safety Data Sheet (cont.)

Material Safety Data Sheet
Formaldehyde Solution 37%

ACC# 50002

Section 1 - Chemical Product and Company Identification

MSDS Name: Formaldehyde Solution 37%
Catalog Numbers: S74337, S74338, S80018-2, BP530-25, BP530-500, BP53025, BP531-25, BP531-500, F75P20, F75P4, F77 20, F77 200, F7720, F77200, F77200LC, F7720LC, F77P 20, F77P 4, F77P20, F77P4, F79 1, F79 20, F79 200, F79 4, F79 500, F791, F7920, F79200, F794, F79500, F79J4, F79P 20, F79P 4, F79P20, F79P4, NC9475399, S74337MF, S74338MF
Synonyms: None.
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
50-00-0	Formaldehyde	37	200-001-8
67-56-1	Methyl alcohol	15	200-659-6
7732-18-5	Water	48	231-791-2
Not avail.	Odor mask	0.0-1.1	unlisted

Hazard Symbols: T
Risk Phrases: 10 23/24/25 34 40 43

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: not available. Flash Point: 50 deg C. **Danger! Flammable liquid.** May cause allergic skin reaction. This substance has caused adverse reproductive and fetal effects in animals. May cause central nervous system depression. Cannot be made non-poisonous. May cause liver and kidney damage. Causes eye and skin irritation. Causes digestive and respiratory tract irritation. May be fatal or cause blindness if swallowed. Contains formaldehye. Respiratory sensitizer. Potential cancer hazard. Vapor harmful.
Target Organs: Kidneys, central nervous system, liver.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (Reproduced by permission of Fisher Scientific.)

Potential Health Effects

Eye: Causes eye irritation. May cause chemical conjunctivitis and corneal damage.
Skin: Causes skin irritation. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material. May cause cyanosis of the extremities.
Ingestion: May be fatal or cause blindness if swallowed. Causes gastrointestinal irritation with nausea, vomiting and diarrhea. May cause liver and kidney damage. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. May cause central nervous system depression.
Inhalation: Inhalation of high concentrations may cause central nervous system effects characterized by headache, dizziness, unconsciousness and coma. Causes respiratory tract irritation. May cause asthmatic attacks due to allergic sensitization of the respiratory tract. Aspiration may lead to pulmonary edema. Vapors may cause dizziness or suffocation. May cause burning sensation in the chest.
Chronic: Repeated exposure may cause skin discoloration and thickening and nail decay. Repeated inhalation is associated with nasal and nasopharyngeal cancer.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed.
Skin: Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse. Destroy contaminated shoes.
Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Firefighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. Vapors may form an explosive mixture with air. Vapors can travel to a source of ignition and flash back. Will burn if involved in a fire. Use water spray to keep fire-exposed containers cool. Containers may explode in the heat of a fire. Flammable Liquid.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. Use water spray to cool fire-exposed containers. Water may be ineffective. Do NOT use straight streams of water.

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Avoid runoff into storm sewers and ditches, which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Remove all sources of ignition. Use a spark-proof tool. Provide ventilation. A vapor suppressing foam may be used to reduce vapors.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Avoid contact with heat, sparks and flame. Avoid ingestion and inhalation. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.
Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area. Keep containers tightly closed.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Formaldehyde	C 0.3 ppm	0.016 ppm TWA; NIOSH Potential Occupational Carcinogen - see Appendix A Potential NIOSH carcinogen.	0.75 ppm TWA PEL; 2 ppm STEL; 0.5 ppm TWA action leve
Methyl alcohol	200 ppm; 250 ppm STEL; skin - potential for cutaneous absorption	200 ppm TWA; 260 mg/m3 TWA 6000 ppm IDLH	200 ppm TWA; 260 mg/m3 TWA
Water	none listed	none listed	none listed

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

OSHA Vacated PELs: Formaldehyde: 3 ppm TWA (unless specified in 1910.1048) Methyl alcohol: 200 ppm TWA; 260 mg/m3 TWA Water: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: not available
Odor: None reported
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: >1.0
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 212 deg F
Freezing/Melting Point:32 deg F
Decomposition Temperature: Not available.
Autoignition Temperature: Not applicable.
Flash Point: 50 deg C (122.00 deg F)
NFPA Rating: Not published.
Explosion Limits, Lower: Not available.
Upper: Not available.
Solubility: soluble in water
Specific Gravity/Density: Not available.
Molecular Formula: Mixture
Molecular Weight: Not available

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, ignition sources, excess heat, oxidizers.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, oxides of phosphorus, irritating and toxic fumes and gases, carbon dioxide, toxic fumes of sodium oxide.
Hazardous Polymerization: Has not been reported.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

Section 11 - Toxicological Information

RTECS#:
CAS# 50-00-0: LP8925000
CAS# 67-56-1: PC1400000
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 50-00-0:
Inhalation, mouse: LC50 =400 mg/m3/2H;
Inhalation, rat: LC50 =203 mg/m3;
Oral, mouse: LD50 = 42 mg/kg;
Oral, rat: LD50 = 100 mg/kg;
Skin, rabbit: LD50 = 270 mg/kg;<BR.

CAS# 67-56-1:
Inhalation, rat: LC50 =64000 ppm/4H;
Oral, mouse: LD50 = 7300 mg/kg;
Oral, rabbit: LD50 = 14200 mg/kg;
Oral, rat: LD50 = 5628 mg/kg;
Skin, rabbit: LD50 = 15800 mg/kg;<BR.

CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;<BR.

Carcinogenicity:
CAS# 50-00-0:
ACGIH: A2 - suspected human carcinogen
California: carcinogen; initial date 1/1/88
NIOSH: occupational carcinogen
NTP: Suspect carcinogen
OSHA: Possible Select carcinogen
IARC: Group 2A carcinogen CAS# 67-56-1: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 7732-18-5: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.
Neurotoxicity: No data available.
Mutagenicity: No data available.
Other Studies: No data available.

Section 12 - Ecological Information

Ecotoxicity: Not available.
Environmental Fate: Not available.
Physical/Chemical: Not available.
Other: Not available.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: CAS# 50-00-0: waste number U122. CAS# 67-56-1: waste number U154; (Ignitable waste).

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	FORMALDEHYDE, SOLUTIONS, FLAMMABLE				No information available.
Hazard Class:	3				
UN Number:	UN1198				
Packing Group:	III				

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 50-00-0 is listed on the TSCA inventory.
CAS# 67-56-1 is listed on the TSCA inventory.
CAS# 7732-18-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
CAS# 50-00-0: final RQ = 100 pounds (45.4 kg) CAS# 67-56-1: final RQ = 5000 pounds (2270 kg)
Section 302 (TPQ)
CAS# 50-00-0: TPQ = 500 pounds; RQ = 100 pounds (does not meet toxicity criteria but because of high production volume and recognized toxicity is considered a chemical of concern)

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

SARA Codes
CAS # 50-00-0: acute, chronic. CAS # 67-56-1: acute, flammable.
Section 313
This material contains Formaldehyde (CAS# 50-00-0, 37%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373. This material contains Methyl alcohol (CAS# 67-56-1, 15%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
CAS# 50-00-0 is listed as a hazardous air pollutant (HAP). CAS# 67-56-1 is listed as a hazardous air pollutant (HAP). This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 50-00-0 is listed as a Hazardous Substance under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
CAS# 50-00-0 is considered highly hazardous by OSHA.
STATE
CAS# 50-00-0 can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
CAS# 67-56-1 can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act: WARNING: This product contains Formaldehyde, a chemical known to the state of California to cause cancer. California No Significant Risk Level: CAS# 50-00-0: no significant risk level = 40 ug/day

European / International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
T
Risk Phrases:
R 10 Flammable. R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed. R 34 Causes burns. R 40 Possible risks of irreversible effects. R 43 May cause sensitization by skin contact.
Safety Phrases:
S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S 36/37 Wear suitable protective clothing and gloves. S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S 51 Use only in well-ventilated areas.
WGK (Water Danger/Protection)
CAS# 50-00-0: 2
CAS# 67-56-1: 1
CAS# 7732-18-5: No information available.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

Canada
CAS# 50-00-0 is listed on Canada's DSL/NDSL List.
CAS# 67-56-1 is listed on Canada's DSL/NDSL List.
CAS# 7732-18-5 is listed on Canada's DSL/NDSL List.
This product has a WHMIS classification of B2, D1A, D2B.
CAS# 50-00-0 is not listed on Canada's Ingredient Disclosure List.
CAS# 67-56-1 is not listed on Canada's Ingredient Disclosure List.
CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

Exposure Limits

CAS# 50-00-0: OEL-ARAB Republic of Egypt:TWA 2 ppm (3 mg/m3) OEL-AUSTRALIA:TWA 1 ppm (1.5 mg/m3);STEL 2 ppm (3 mg/m3);CAR OEL-BELGIUM: TWA 1 ppm (1.2 mg/m3);STEL 2 ppm (2.5 mg/m3);CAR OEL-CZECHOSLOVAKIA: TWA 0.5 mg/m3;STEL 1 mg/m3 OEL-DENMARK:STEL 0.3 ppm (0.4 mg/m3); Carcinogen OEL-FINLAND:STEL 1 ppm (1.3 mg/m3);Skin OEL-FRANCE:STEL 2 ppm (3 mg/m3) OEL-GERMANY:TWA 0.5 ppm (0.6 mg/m3); Carcinogen OEL-HUNGARY: STEL 0.6 mg/m3;Carcinogen OEL-JAPAN:TWA 0.5 ppm (0.61 mg/m3);Carcinogen OEL-THE NETHERLANDS:TWA 1 ppm (1.5 mg/m3);STEL 2 ppm (3 mg/m3) OEL-THE PHILIPPINES:TWA 5 ppm (6 mg/m3) OEL-POLAND:TWA 2 mg/m3 OEL-RUSSIA: TWA 0.5 ppm;STEL 0.5 mg/m3;Skin OEL-SWEDEN:TWA 0.5 ppm (0.6 mg/m3); STEL 1 ppm (1. mg/m3) OEL-SWITZERLAND:TWA 0.5 ppm (0.6 mg/m3);STEL 1 pp (1.2 mg/m3) OEL-THAILAND:TWA 3 ppm;STEL 5 ppm OEL-TURKEY:TWA 5 ppm (6 mg/m3) OEL-UNITED KINGDOM:TWA 2 ppm (2.5 mg/m3);STEL 2 ppm (2.5 mg/m3) OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

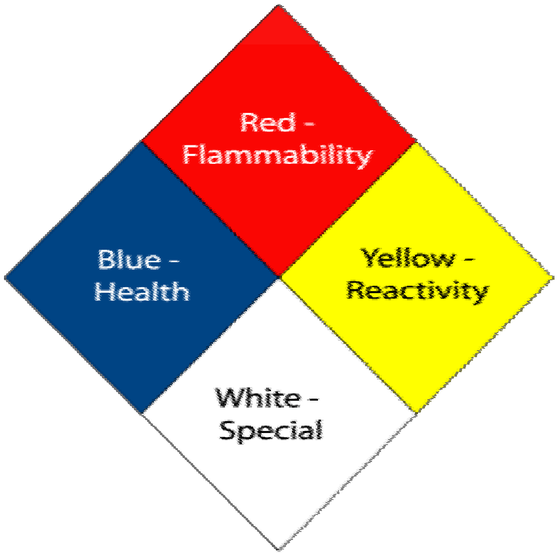
CAS# 67-56-1: OEL-ARAB Republic of Egypt:TWA 200 ppm (260 mg/m3);Skin OEL-AUSTRALIA:TWA 200 ppm (260 mg/m3);STEL 250 ppm;Skin OEL-BELGIUM:TWA 200 ppm (262 mg/m3);STEL 250 ppm;Skin OEL-CZECHOSLOVAKIA:TWA 100 mg/m3;STEL 500 mg/m3 OEL-DENMARK:TWA 200 ppm (260 mg/m3);Skin OEL-FINLAND:TWA 200 ppm (260 mg/m3);STEL 250 ppm;Skin OEL-FRANCE:TWA 200 ppm (260 mg/m3);STEL 1000 ppm (1300 mg/m3) OEL-GERMANY:TWA 200 ppm (260 mg/m3);Skin OEL-HUNGARY:TWA 50 mg/m3;STEL 100 mg/m3;Skin JAN9 OEL-JAPAN:TWA 200 ppm (260 mg/m3);Skin OEL-THE NETHERLANDS:TWA 200 ppm (260 mg/m3);Skin OEL-THE PHILIPPINES:TWA 200 ppm (260 mg/m3) OEL-POLAND: TWA 100 mg/m3 OEL-RUSSIA:TWA 200 ppm;STEL 5 mg/m3;Skin OEL-SWEDEN: TWA 200 ppm (250 mg/m3);STEL 250 ppm (350 mg/m3);Skin OEL-SWITZERLAND: TWA 200 ppm (260 mg/m3);STEL 400 ppm;Skin OEL-THAILAND:TWA 200 ppm (260 mg/m3) OEL-TURKEY:TWA 200 ppm (260 mg/m3) OEL-UNITED KINGDOM:TWA 200 ppm (260 mg/m3);STEL 250 ppm;Skin OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

Section 16 - Additional Information

MSDS Creation Date: 7/12/1999
Revision #6 Date: 8/02/2000

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the pos

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)



General Rating Summary

Health (Blue)

4	**Danger**	May be fatal on short exposure. Specialized protective equipment required.
3	**Warning**	Corrosive or toxic. Avoid skin contact or inhalation.
2	**Warning**	May be harmful if inhaled or absorbed.
1	**Caution**	May be irritating.
0		No unusual hazard.

Flammability (Red)

4	**Danger**	Flammable gas or extremely flammable liquid.
3	**Warning**	Flammable liquid flash point below 100° F.
2	**Caution**	Combustible liquid flash point of 100° to 200° F.
1		Combustible if heated.
0		Not combustible.

Reactivity (Yellow)

4	**Danger**	Explosive material at room temperature.
3	**Danger**	May be explosive if shocked, heated under confinement, or mixed with water.
2	**Warning**	Unstable or may react violently if mixed with water.
1	**Caution**	May react if heated or mixed with water but not violently.
0	**Stable**	Not reactive when mixed with water.

Special Notice Key (White)

W	Water Reactive
OX	Oxidizing Agent

Figure 11.4. The NFPA Hazard Symbol and Key to Color Code and Numbering System

Chapter 12: Curatorial Funding, Staffing, and Reporting

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CHAPTER 12: CURATORIAL FUNDING, STAFFING, AND REPORTING

A. Overview

This chapter will introduce you to:

- **Program** documents required to obtain funding
- **Funding** categories available to pay for preservation, protection, and documentation needs
- **Staffing** requirements for collections care activities
- **Reporting** requirements related to strategic planning

Museum program management requires careful planning. For additional information on NPS museum management planning, see:

- Director's Order #2: Park Planning
- Director's Order #24: NPS Museum Collections Management
- Director's Order #28: Cultural Resource Management and *Cultural Resource Management Guideline* (1997)

B. Basic Museum Program Management Issues

1. *How do I determine my park's museum collections management needs?*

- Become familiar with the park's museum collection. Determine the following:
  - present size and scope, as well as potential growth
  - status of accountability and documentation (accession and catalog records, inventories, and similar materials)
  - security and environment of storage and exhibit spaces
  - use of the collection
  - condition of the collection

  Two effective ways to get to know your collection are to:

  - conduct a 100% inventory
  - refer to the Introduction section of your park's Scope of Collection Statement (SOCS) for information concerning the significance of your collection

- Update the NPS Checklist for Preservation and Protection of Museum

Collections (Museum Checklist). The Museum Checklist is a facility report that rates all museum areas (exhibit, storage, administrative) at a park according to Servicewide preservation and protection standards. Director's Order #24: NPS Museum Collections Management, requires that all parks with museum collections have an up-to-date Museum Checklist.

Having an up-to-date Museum Checklist will help you to:

- better understand the museum conditions at your park
- identify preservation and protection deficiencies
- set priorities to address preservation and protection needs

Project funding for preservation is tied to deficiencies reported on the Museum Checklist. Be sure that your Checklist is as complete and accurate as possible. Include detailed information concerning:

- the nature of each deficiency
- the action needed to address the deficiency
- accurate cost estimates (see Appendix F, Figure 1, Cost Estimates)
- cross-referencing of applicable project proposals
- any additional comments

See Appendix F: NPS Museum Collections Management Checklists, and the *ANCS User Manual*, Appendix G: Automated Checklist Program, for additional information.

- Refer to your park's Collections Management Report (CMR) to determine estimated backlogs and cataloging needs.
- Prepare a list of projects for correcting deficiencies. Divide the list into two categories:
  - needs that can be met by existing park funds and staff (such as revising the Scope of Collection Statement, obtaining pest traps for monitoring, cataloging new accessions, key control and rekeying cabinets)
  - needs that require additional funds and staff (such as building a new collections storage area, assistance with an Emergency Operations Plan, conservation treatments, installing fire and security systems, cataloging the backlog of uncataloged items)
- Prioritize both lists. Begin working on those projects that can be accomplished with existing resources.

2. *What should my next steps be?*

Refine the list of needs that require additional resources to accomplish:

- Develop accurate cost estimates. See Appendix F, Figure 1, Cost

Estimates. Consult your regional/SO curator and park maintenance staff for additional information.

- Integrate these needs into appropriate park planning documents, such as Project Management Information System (PMIS) Project Statements, Resource Management Plan (RMP), General Management Plan (GMP), Exhibit Plans, and Long-Range Interpretive Plan (LRIP).

- Ensure that collections management project statements are included in the park's Strategic and Performance Plans. Include such project statements in PMIS. Additional information may be contained in the park RMP if that document is being used (see B.5 below). Examples of project statements are:

  - Assess and Catalog Park Archival Holdings
  - Catalog Museum Objects
  - Complete Conservation Treatments
  - Conduct an Appraisal of Museum Property
  - Conduct Collection Condition Survey
  - Conduct Curatorial Training
  - Construct a New Museum Storage Facility
  - Perform Conservation Treatment
  - Prepare Collections Management Plan
  - Prepare/Implement a Historic Furnishings Report
  - Install Fire Detection and Suppression Systems
  - Install Intrusion Alarm System
  - Install Security Systems
  - Store Museum Collections
  - Upgrade Exhibits

  These are but a sampling of the many potential projects that your park may require. Contact your regional/SO curator for additional assistance preparing necessary project statements.

3. *What plans are useful to identify needs and justify funding requests?*

The results and recommendations of various plans and surveys provide justification for operational support and project funding needed to develop a professional museum management program. In addition to the Collections Management Report and Museum Checklist, the most common plans and surveys used to identify collection management needs are:

- Collection Management Plan (CMP)

- Collection Condition Survey (CCS)
- Collection Storage Plan (CSP)
- Emergency Operations Plan (EOP)
- Exhibit Plan
- Integrated Pest Management (IPM) Plan
- Historic Furnishings Plan (HFP)
- Housekeeping Plan
- Security and Fire Protection Survey
- Structural Fire Plan

You also may seek funding to support these plans and surveys if they are out-of-date or do not exist for your unit.

4. *Where do I document needs?*

Programming documents are the key to obtaining funds for a project. A well-prepared document results from good planning. At the park level, the GMP, Performance Plan, Strategic Plan and RMP serve as the foundation for park resources management programs. At the Servicewide level, staff document these needs using:

- Project Management Information System (PMIS)
- Operations Formulation System (OFS)

5. *What is a Resource Management Plan?*

The Resource Management Plan (RMP) is a planning document that contains the park's natural and cultural resource management actions. The RMP includes:

- a summary of the resource status evaluating the condition and documentation of the resources and major threats to them
- an action program based on legislative and executive mandates including:
  - NPS *Management Policies* (2001)
  - NPS Director's Orders (DO): DO #24: Museum Collections Management, DO #28: Cultural Resource Management, and DO #77: Natural Resources Management
  - management zoning and provisions of related planning documents
- individual project statements

6. *What is the Project Management Information System?*

The Project Management Information System (PMIS) is a Servicewide Intranet-based database. Parks and offices use the program to manage information about requests for project funding. With PMIS, you can submit project proposals to be reviewed, approved and prioritized at park, regional, and Washington Office (WASO) levels.

Project funding is "one-time" money used to support park management goals. Some projects (design projects and others taking more than one year) can be phased, though all project funds have finite time limits.

PMIS allows staff to identify project funding needs and report accomplishments. All NPS employees can search the system. Only designated persons in each park and office can make changes and set priorities. Your regional/SO curator and your park's administrative and maintenance staff will be familiar with PMIS and can probably answer any questions that you may have.

7. *How can I learn more about museum management programming using PMIS?*

The PMIS program is a good place to see how other parks are managing similar projects and to get ideas to enhance your proposals. After you access the system, you can use keywords within the search function to view a variety of projects. You can search any of the various funding sources, such as Backlog Cataloging, Museum Collection Preservation and Protection, or others. You can also search by park, region, state, or a variety of other criteria. The search function allows you to access project narratives, cost estimates, and information on whether projects have been funded and completed.

Another resource is your regional office staff. Each regional office has subject matter experts in various program areas who are available to assist with planning projects, writing and reviewing PMIS project statements, estimating costs, and identifying targeted funding sources. These individuals will be familiar with program criteria, and the funding process particular to your region. Your regional/SO curator will be able to assist you with your collection management projects and help direct you toward other program managers if your project is interdisciplinary.

Access PMIS on the web at: <http://www.nps.gov/pmis>.

8. *What is the Operations Formulation System?*

The Operations Formula System (OFS) is an Intranet-based system designed to meet the needs of parks, regions, and WASO in the development and identification of operating increases needed to support the mission and strategic plan of the NPS.

The OFS system contains all unfounded budgetary requirements of the Service for ongoing or operational needs for the next five fiscal years. OFS does not contain requests for funding of individual projects; PMIS contains all the unfounded project requirements. Both systems contain a limited amount of historical information on funded requests.

The system is interactive and normally available 24 hours a day, seven days a week. After reviews are complete, parks and other program managers should be able to prepare new requests and revise most of the existing requests on their own timetables.

All needs or requests for funding should be represented in either the OFS or PMIS system. The information contained in OFS and PMIS serves as the sole source for formulating the three formal NPS budget requests (to the Department of the Interior, the Office of Management and Budget, and the Congress). In addition, the information will serve as the official NPS response to all internal and external inquiries about unfounded budgetary needs and strategies for addressing these needs.

The superintendent, in consultation with the management staff, generally develops OFS submissions. Ask your administrative staff when the OFS call comes out, and take the opportunity to advocate for your programs if you need more staff.

You can search OFS at <http://www.nps.gov/ofs>.

> ***Don't wait until the OFS call comes out to begin advocating for curatorial needs. Be sure to keep your superintendent, division chief, and administrative staff up-to-date at all times concerning museum programming needs.***

9. *How does the budget process work?*

The budget process can last 21 months or more. At any given time, the NPS is engaged in activities related to three separate fiscal year budgets; one enacted by Congress and those proposed for the next two fiscal years. The proposed budgets include the next fiscal year's Appropriations Bill (not yet enacted) and the following fiscal year's NPS budget proposal.

Each fall the NPS issues a Servicewide Comprehensive Call (SCC) for project and operating increase requests. Parks, regions, and offices enter their requests through the PMIS and OFS systems. They tie their requests to their Government Performance Results Act (GPRA) goals, strategic plans, and business plans. Although requests can be added to the systems at any time, review, approval and prioritization occur in response to the schedule set by the SCC.

The WASO budget office coordinates the entire process for the NPS. Procedures vary from region to region, but the general process from the park perspective is as follows:

- Superintendents and division chiefs identify additional resources needed to operate and maintain the park. They set priorities based on recommendations from park staff.

- Regional associate directors, the regional budget office, and the regional director review the park requests (with assistance from program managers and subject matter experts). They add requests for region-wide programs and regional office staff, and then set regional priorities.

- WASO associate directors and program managers submit projects and increase requests for their office and Servicewide programs.

- The Department and Office of Management and Budget (OMB) provide initial guidance and review of the NPS budget and pass back required changes.

- The President submits the budget to Congress.

- At the Congressional level, House and Senate Sub-Committees and Committees hold hearings to determine what will be included in the appropriations. Votes of the House and Senate result in an appropriations bill that is sent to the President for signature.

> ***Background and current information on the NPS budget process can be found on the Web at: <http://www.nps.gov/budget>.***

C. Developing Funding Requests

1. *What are the characteristics of a good funding request?*

A well-written request (project statement) should provide a concise description and justification, and identify expected results. Conduct research to determine how much time the project will take. Contact colleagues in other parks who have conducted similar projects, or contact your regional/SO curator and regional program specialists to help with costs estimates. When writing a project statement, answer the following questions:

- What is the project?

- Why is the project important?

- What problems, needs, or deficiencies will the project address?

- How much will the project cost?

- How will the funds be spent?

- What is the schedule for completion?

Make sure to do the following:

- Be certain that project statements address all criteria outlined in the SCC, the regional budget call and related guidance from Washington associate directors.

- Enter the eligible funding source(s) for each project in PMIS.

- Plan ahead to allow time for internal and external review of your project statement.

- Link desired results to your annual GPRA goals (see Section E. below).

See Figure 12.2 for a sample PMIS project statement and Figure 12.3 for a sample OFS statement.

> ***Remember: The person reviewing these documents won't be familiar with the problem. Submit clear and detailed project statement to have a better chance of being approved.***

2. *How do I prioritize short-term and long-term collection management needs?*

Short-term and long-term priorities depend on your park's mission, existing resources (staffing and funding), and resource management goals. Your Collection Management Plan, Museum Checklist, and Collections Management Report will help you start to identify and prioritize short-term and long-term funding needs.

Review the following park reports, surveys, and planning documents to help set priorities:

- General Management Plan (GMP)
- Development Concept Plan (DCP)

Museum Plans:

- Archival Assessments (see the *Museum Handbook*, Part II, Appendix D)
- Collection Condition Surveys (see *Museum Handbook*, Part I [*MH-I*], Chapter 3)
- Collection Storage Plans (see *MH-I,* Chapter 7)
- Environmental Surveys (see *MH-I*, Chapter 4)
- Emergency Operations Plan (see *MH-I,* Chapter 10)
- Fire Protection Surveys (see *MH-I*, Chapter 9, and Appendix G)
- Historic Furnishing Reports (see *Museum Handbook*, Part III, Chapter 8 [forthcoming]).
- Housekeeping Plans (see *MH-I*, Chapter 13)
- Integrated Pest Management Plan (see *MH-I*, Chapter 5)
- Security Surveys (see *MH-I*, Chapter 9, and Appendix G)
- Structural Fire Plans (see Director's Order #58: Structural Fire Management, *MH-I*, Chapter 9, and *MH-I*, Appendix G)

These reports generally provide a list of priorities in their recommendations. You can probably accomplish some of these recommendations using base funds (see Section D., below). Others will require special funding. When contracting for these reports and plans, include a requirement for a list of prioritized recommendations with funding estimates in the project Scope of Work.

Planning documents developed in other park divisions, such as Interpretation, History, and Maintenance will often have an impact on collections management. Examples are:

- Archeological Overview and Assessment
- Long-Range Interpretive Plan
- Historic Resource Studies
- Historic Structures Reports

Review these documents to ensure that applicable collections management needs are addressed. Also, be sure to brief these same divisions on museum activities that may affect their operations, or if you require their assistance in implementing your programs.

3. *How do I prioritize specific projects?*

You may want to ask your regional/SO curator to help you identify priorities for your park. In some cases, projects need to take place in a specific progression. For example, a condition assessment is needed prior to conservation treatment, and a security survey is needed prior to the installation of a security system. For additional information concerning the relationships among the various planning documents see Chapter 3: Preservation: Getting Started, Chapter 9: Museum Collections Security and Fire Protection, Chapter 10: Emergency Planning, Chapter 13: Museum Housekeeping, Appendix F: NPS Collections Management Checklists, and Appendix G: Protection of National Park Service Museum Collections.

4. *How do I determine which curatorial activities can be accomplished with current staff and funding?*

Parks with museum collections have a curator, museum specialist, museum technician, archivist, archives technician, or a person assigned collection management responsibilities as a collateral duty. Ongoing tasks should be conducted by park staff with base funds. Examples include:

- routine housekeeping in exhibit and storage areas
- monitoring for pest activity
- monitoring environmental conditions
- accessioning newly acquired objects
- cataloging objects in ANCS+
  - new acquisitions
  - backlog acquired since 1987 (pre-1987 backlog items are eligible for Backlog Cataloging funds)
  - re-cataloging
- completing and updating the Museum Checklist and Collections Management Report
- answering research requests

- developing project statements for improvements to the park's collections management program
- providing access to collections, such as mounting new exhibits (including Web-based) or assisting researchers

Document the ongoing curatorial workload, accomplishments, and related costs as follows:

- identify the major museum collections management work activities that need to be done
- maintain a general accounting of the hours spent on each major activity
- assess whether the work was fully, partially, or not completed
- keep a record of the costs of curatorial supplies and materials

Use these data annually to help identify any funding needed to fully complete the major work activities. This information supports OFS requests for increased park base funding.

5. *What kinds of activities require project funding?*

Additional funds are often required to prepare planning documents, surveys, or reports. Other special projects requiring funding include:

- designing and constructing new storage facilities
- improving existing storage
- contracting for exhibit design and fabrication
- contracting for Web-based exhibit design, production, and launch
- obtaining conservation treatment
- installing environmental systems
- contracting for cataloging

6. *What resources are available to assist in preparing funding requests?*

Obtain assistance in preparing documents by:

- researching successfully funded projects in the PMIS and OFS databases
- requesting assistance from your regional/SO curator
- contacting colleagues who have completed similar park projects

D. Sources of Funding for Collections Management

1. *What are the funding sources for NPS collections management?*

NPS funding is divided into two categories:

- Park Operations (also called Park Base)
- Project Funds

2. *How are base funds used?*

Base funds should support ongoing requirements for collection management, including curatorial staff, clerical support, curatorial supplies and equipment, and travel to training courses and professional conferences. The park's collection management program should have a sufficient funding base to complete all major curatorial activities. Ongoing operations should not be financed with project funds.

The size, nature, and complexity of a park's museum collection are major factors in determining workload. Base funds should be directed at:

- program accountability, documentation, and record keeping
- preventive conservation for objects in storage and on exhibit
- maintenance of security and fire protection systems
- providing for access and use of the collections

Submit requests for base increases in OFS (see Section B.8).

3. *What cultural resource project funds are available for museum collections?*

Project funding is available for cultural resource projects that support the *NPS Strategic Plan* long-term goals and address museum collections. Specific funding programs are:

- **Cultural Cyclic Maintenance.** Projects include repair of a historic property, when its condition warrants, with the least degree of intervention including replacement in-kind, or replacing an entire feature in-kind when the level of deterioration or damage of materials precludes repair. For archeological sites it includes work to moderate, prevent, or arrest erosion. For museum objects it includes actions to prevent damage and to minimize deterioration by practicing preventive conservation or by performing suitable treatments on objects themselves. Such work is performed less than once a year.
- **CRPP—Cultural Resources Preservation Program Base.** Projects include inventory, evaluation, documentation, research, stabilization, and conservation of park resources, including completion of the systemwide resources databases and preparation and publication of professional reports not addressed under other funding sources. Preferred projects include those that provide basic inventory and evaluation data for planning, treatment, protection, management, and interpretation needs; provide National Register documentation; address common resource needs of multiple parks; and respond to accepted findings of the General Accounting Office (GAO) and Inspector General (IG). Projects produce archival material and sometimes

objects that must be cataloged into the museum collections and properly stored. Review cultural resource projects to ensure that these costs are included.

- **CRPP—Museum Collections Backlog Cataloging. (For Post-1987 Collections).** Projects are to catalog previously uncataloged collections. The backlog must be identified on the previous year's Collections Management Report on file with Museum Management Program (MMP), National Center for Cultural Resources. Costs should be consistent with the range of costs in the *Museum Handbook*, Part II, Appendix B. Costs at variance should be explained in the PMIS statement. This activity supports the *NPS Strategic Plan* long-term goal Ib2D. Regions should give priority to projects that commit to mounting the resulting catalog data on the *Web Catalog* and projects that catalog nitrate film that must be cataloged prior to reformatting. **Note:** These funds address the needs of the post-1987 collections acquisitions.

- **Museum Collections Backlog Cataloging. (For Pre-1987 Collections).** Projects include the cataloging of the backlog of uncataloged objects acquired prior to January 1, 1987. Projects include activities essential to cataloging, such as completing catalog worksheets, entering catalog data in the Automated National Catalog System (ANCS+), photographing objects as part of the cataloging process, and purchasing computer equipment to accomplish these tasks. The backlog must be identified on the previous year's Collections Management Report on file with the MMP. Costs should be consistent with the range of costs in the *Museum Handbook,* Part II, Appendix B. Costs at variance should be explained in the PMIS statement. This activity supports the *NPS Strategic Plan* long-term goal Ib2D.

- **CRPP—Systemwide Archeological Resources Inventory (SAIP).** Projects include archeological overviews and assessments, identification and evaluation studies, database documentation using the Archeological Sites Management Information System (ASMIS), National Register nominations and other activities consistent with program requirements, standards and priorities set forth in the *National Park Service's Systemwide Archeological Inventory Program* publication (October 1992), and the priorities established in each region's archeological inventory plan. Projects produce archival material and sometimes objects that must be cataloged into the museum collections and properly stored. Review cultural resource projects to ensure that these costs are included.

- **Museum Collections Preservation and Protection.** Projects include correcting preservation and protection deficiencies identified in each park's and center's Checklist for Preservation and Protection of Museum Collections. Parks and centers must have an up-to-date Museum Checklist on file with MMP. Costs should be consistent with the range of costs in the *Museum Handbook,* Part I, Figure F.1. Costs at variance should be explained in the PMIS statement. This activity supports the *NPS Strategic Plan* and long-term goal Ia6.

- **Park Native American Graves Protection Projects.** Projects include cultural affiliation and lineal descendent studies; consultations related to inadvertent discoveries, repatriation, planned excavations, modifications in the Summary and Inventory, and development of Memoranda of Understanding and preparation of Written Plans of Action regarding planned excavations and inadvertent discoveries per 43 CFR 10.5 (e); updating of related ANCS+ records. For additional information see *Museum Handbook*, Part II (*MH-II*), Chapter 6: Deaccessioning, Section N, Native American Graves Protection and Repatriation Act and *Cultural Resource Management Guideline*, Appendix R, NAGPRA Compliance.

Access the current National Park Service Strategic Plan on the web at: <http:// www.nps.gov/performance>.

4. *What natural resources funding programs directly support museum collections?*

There are no natural resource management funds that support the curation or long-term care and maintenance of existing natural history collections. However, in accordance with Director's Order #24: NPS Museum Collections Management, you must ensure that all project budgets include funding for the basic management of any project-generated collections. Basic collections management includes cataloging, labeling, conservation, examination, treatment, specimen preparation, initial storage of objects and specimens, and organization and storage of project documentation.

5. *Are there any collections management requirements for projects that generate collections?*

Yes, as noted above, Director's Order #24 requires all project budgets to include funding for the basic management of any project-generated collections. Archeological projects generate field records (archives) [see *MH-II*, Appendix D for additional information] and often recover objects that must be accessioned as museum collections. These field records and objects must be cataloged and stored properly for long-term preservation and access. Likewise, other resource management projects such as fire effects projects, inventorying and monitoring projects, Historic Landscape Reports, Ethnobotanical Studies, Historic Resource Studies, oral histories, Ethnographic Overview and Assessments, National Register nominations, and Historic Structure Reports generate archival collections (and may also generate objects and specimens) that must be accessioned and curated in an appropriate facility. Be sure to include adequate funding for cataloging and curation in all project cost estimates.

6. *What other NPS fund sources can be used to support museum projects?*

Additional funding programs that you can use to support museum projects include:

- **Challenge Cost-Share.** This program provides a maximum of 50% cost-share grant to expedite and complete mutually beneficial projects with outside sources. The purpose is to increase awareness and participation by both neighboring communities and the public at large in the preservation and improvement of NPS recreational, cultural, and natural resources. Park partners include individuals, groups, companies, corporations, state and local agencies, and other non-federal entities that will donate funds, equipment, supplies, or in-kind labor to complete a park project. Projects are generally intended to be small, able to be completed in one year, and consistent with park planning documents.

- **Concessions Franchise Fees.** Fees for concessioner activities are retained entirely by the NPS (80% by the collecting park) for training, the repair and rehabilitation of facilities (including historic structures used by concessioners and NPS exhibits within concession buildings), roads, and utility systems, and other concessions-related projects.

- **Donations.** Although parks cannot solicit donations, they are authorized to accept and use donated funds to meet the purposes of the National Park Service. Use of these funds is strictly controlled, must be consistent with legislative authority, and must meet with the approval of the grantor. Individual park accounts are established for specific-purpose donations (such as a museum management account). A general donation account, not specific-purpose in nature, is also available.

Director's Order #21: Donations and Fundraising, Section 3.1 states that "…neither the NPS nor its employees has authority to solicit donations."

- **National Parks Pass.** Fees collected from the sale of the National Parks Pass (minus administrative costs) are retained by the NPS (70% by the collecting park) and are available to fund various park projects, including museum and other cultural resource management projects. Funds not retained by the collecting parks (30% of the total) are available to finance various projects at other parks that do not sell the National Parks Pass.

- **Exhibit Rehabilitation and Preservation.** Projects include the repair, rehabilitation or replacement of films, videos, and equipment and visitor center or wayside exhibits. Funding also provides for the preservation of artifacts and museum specimens, and the acquisition of historic furnishings.

- **Recreational Fee Demonstration Program.** Fees collected at participating parks are retained by the NPS (80% by the collecting park) and are immediately available to fund various park projects, including museum and other resource management projects. Funds not retained by the collecting parks (20% of the total) are available to finance various projects at other parks not involved in the Recreational Fee Demonstration Program.

- **Regular Cyclic Maintenance.** Funds are used to maintain park roads, trails, buildings, utility systems, and other facilities on a fixed periodic basis as long as the cycle is longer than one year but no longer than ten years. Budget submissions for the cyclic maintenance program are extracted from the park's ten-year cyclic maintenance program. The work may require the preparation of simple designs and specifications and is performed by contract or day labor. Funding may not be used for new construction without clearance from the regional office and WASO.

- **Repair and Rehabilitation.** Funding is used to cover the cost of repair and rehabilitation of existing facilities, roads, trails, and utility systems.

Funding may not be used for new construction without approval from the regional office and WASO.

- **Save America's Treasures.** Grants are available for preservation and/or conservation work on nationally significant intellectual and cultural artifacts and nationally significant historic structures and sites. A grant requires a dollar-for-dollar non-Federal match. The minimum grant request for collections projects is $50,000 Federal share; the minimum grant request for historic property projects is $250,000 Federal share. The maximum grant request for all projects is $1 million Federal share.

- **Volunteers-in-Parks (VIP).** Funding is available for incidental expenses such as uniforms, period clothing, local travel, supplies, lodging, meals, and other direct costs chargeable to the Volunteers-in-Parks Program. **This fund also provides for the training of volunteers.**

Contact your park and regional/SO budget staff for additional information concerning project eligibility standards, criteria, and funding sources that you may utilize in support of museum projects.

7. *Are there any other sources of funding for park museum programs?*

Yes. Additional sources of potential funding include:

- Cooperating Associations
- Friends Groups
- Park Partners
- Grants

Contact your regional/SO curator for help identifying additional sources of funding.

Support, donations, and other assistance provided to the Service by cooperating associations, friends groups, park partners, and others must comply with the policies contained in Director's Order #21: Donations and Fundraising and Director's Order #32: Cooperating Associations.

8. *How does the construction program address collections management needs?*

There are several categories of facilities maintenance and construction funds that can be used to address collections management needs:

- Repair of a failing fire alarm and/or existing sprinkler system is a ***Critical Health and Safety Deferred Maintenance Need*** (a facility deferred maintenance need that poses a serious threat to public or employee safety or both).

- Installation of a fire alarm system in a public building where one did not previously exist is a ***Critical Health and Safety Capital Improvement Need*** (a condition that poses a serious threat to public or employee safety or health and can only be reasonably abated by the construction of some capital improvement).

- Repairs to a building housing a museum collection that is threatened because of the poor building condition is a ***Critical Resource Protection Deferred Maintenance Need*** (a facility deferred maintenance that poses a serious threat to natural or cultural resources).

- Installation of a fire sprinkler system for the protection of a building or its contents is a ***Critical Resource Protection Capital Improvement Need*** (a condition that poses a serious threat to natural or cultural resources).

All construction projects must be entered in the PMIS system. Consult with regional construction professionals to develop an appropriate project statement. Estimate costs carefully and refer to cost information provided on the Construction Program Management Intranet site at: <construction.den.nps.gov/html/BenchmarkCosting.htm>.

E. Documenting Results and Performance

1. *What is performance management?*

Performance management ensures that established goals guide daily actions. Performance measures help us know both how effective we are in fulfilling our mission, and how efficient we are in using the least input (time, materials, dollars, and staffing) to achieve the greatest outcome (intended consequences and effects resulting from our activities). Your park will develop a mission statement and long-term and annual performance goals for all major programs, then measure and report on the actual park performance.

The Government Performance and Results Act of 1993 (GPRA) (31 USC 1115) requires federal employees to use performance management in all aspects of daily operations. The strategic planning process is the heart of performance management.

> ***Performance management focuses on the results of efforts rather than the efforts themselves.***

2. *What is strategic planning?*

Strategic planning sets goals to achieve an institution's mission. The *National Park Service Strategic Plan* implements performance management, a business system that:

- provides a Servicewide performance agreement with the public

- sets measurable goals that directly support the NPS mission

- aligns activities and human resources to accomplish the goals

- shows where the NPS can fulfill its mission with current resources and where it cannot

The *National Park Service Strategic Plan* defines success for the Service and provides Servicewide direction. The NPS developed its strategic plan with public meetings and questionnaires, in consultation with the Office of Management and Budget, Congress, and the Department of the Interior. Each park, program, and central office also has its own strategic plan.

3. *How does GPRA relate to NPS collection management programs?*

The Servicewide Strategic Plan includes two mission goals and long-term goals that are specific to NPS museum management. Long-term goals stem from mission goals and include a date by which to achieve the goal.

- **Mission Goal Ia** states, "natural and cultural resources and associated values are protected, restored and maintained in good condition and managed with their broader ecosystem and cultural context."

  Long-term goal Ia6 states that a certain percentage of preservation and protection standards for park museum collections will be met. (For example, *By September 30, 2005, 73.4% of preservation and protection standards for park museum collections are met.*)

- **Mission Goal Ib** states, "the National Park Service contributes to knowledge about natural and cultural resources and associated values; management decisions about resources and visitors are based on adequate scholarly and scientific information."

  Long-term goal Ib2D states that the number of museum objects cataloged increases by a certain percent. (For example, *By September 30, 2005, museum objects cataloged are increased by 35.9% from 37.3 million to 50.7 million*)

4. *Are there any other mission goals relevant to museum management?*

Yes. They include:

- **Mission Goal IIa**, which states, "Visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services, and appropriate recreational opportunities."

- **Mission Goal IIb**, which states, "Park visitors and the general public understand and appreciate the preservation of parks and their resources for this and future generations."

5. *How do parks estimate Ia6 annual and long-term goal and performance targets?*

This goal corresponds directly to the number of standards met on the Museum Checklist. This number is reported as a percentage of standards met as compared to the number of applicable standards. You can use the Automated Checklist Program deficiency report (see the *ANCS+ User Manual*, Appendix G) to get your current status. To estimate a target, use the sum in the standards met column, and then decide which additional standards you think that you can meet. An example of a goal would be, "By September 30, 2005, 76% of applicable preservation and protection standards are met for the park's museum collections."

6. *How do parks estimate Ib2D annual and long-term goal and performance targets?*

This goal corresponds directly to the Collections Management Report (CMR). In your most recent CMR, check the "Objects Cataloged" total under the "Total Collection Summary for All Years." This is how many cataloged objects you currently have. Calculate how many objects you want to catalog by the end of the current fiscal year (annual goal), subsequent years (annual goals), and at the end of five years (long-term goal).

7. *What is the Performance Management Data System?*

The Performance Management Data System (PMDS) is an Intranet database that identifies all of the agency's performance management efforts. Performance management requires that you depict the work you do in terms of measurable outcomes. PMDS records data to measure performance relative to Servicewide and park and/or program-specific long-term goals.

Parks use the Museum Checklist (ACP) and CMR in ANCS+ to submit required electronic reports to the Museum Management Program by November 1 each year. The MMP certifies the data to the Strategic Planning Office, which incorporates it into PMDS.

> ***For more information, access the PMDS website at: <http://www.nps.gov/performance/>.***

8. *How do I get GPRA credit for long-term goal Ia6 and Ib2D accomplishments?*

Your park PMDS coordinator will report your accomplishments in relation to Goals Ia6 and Ib2D in PMDS. You need to provide the park PMDS coordinator with a copy of your **defrpt.frx** report from the ACP and a copy of your CMR so that person can enter the correct data. In PMDS, the park's data and the certified data entered in Washington should be identical since they come from the same ACP and CMR reports.

F. Staffing

1. *What are the discipline tracks in NPS museum management programs?*

There are four discipline tracks:

- Collections Management
- Curation
- Archives
- Conservation

2. *What are the different occupational titles within the career tracks?*

NPS museum management career tracks include the following nine occupational groups:

- Museum Technician (GS-1016)
- Museum Specialist (GS-1016)
- Museum Registrar (GS-1001)
- Collections Manager (GS-1015)
- Museum Curator (GS-1015)
- Archives Technician (GS-1421)
- Archives Specialist (GS-1421)

- Archivist (GS-1420)
- Museum Conservator (GS-1001)

3. *What are the qualifications for these positions?*

Refer to the list of the principal occupational series in the OPM *Qualification Standards for General Schedule Positions*, available on the web at: < http://www.opm.gov/qualifications/sec-iii/a/num-ndx.htm>.

4. *What are the typical duties in each career area?*

Collections Manager: Collections managers provide front-line management of collections at parks and centers. Collections managers often begin their careers as museum technicians, and may eventually move on to the:

- curator track
- conservator track

Occasionally, this path can lead to the archivist track. Typically, the collections manager will have an academic degree in museum studies, museology, archeology, natural science, or a related field.

Curator: Curators are responsible for the acquisition, documentation, preservation, and use of collections. Typically, the support office, regional, or center curator will provide technical assistance to field staff in carrying out their responsibilities. Within this track there are three separate sub-tracks or specializations:

- program management
- exhibit development
- subject matter expert

Typically, the curator will have an academic background in American studies, anthropology, history, a natural science discipline, museum studies, or a related field. Experience in addition to education is necessary at the developmental level. As their careers progress, curators should obtain additional education and experience in museum management, exhibit development, or their subject matter specialization.

Archivist: Archivists evaluate, survey, acquire, preserve, arrange, describe, use, and manage archival and manuscript collections. Such collections can include audio-visual, electronic, and textual records. Typically, archivists at the entry or developmental level have a masters degree in library science or history with a specialization in archives management. Archivists gain extra training through a combination of education and experience. They also will have considerable additional experience under the tutelage of another professional. The Society of American Archivists (SAA) and the Academy of Certified Archivists (ACA) both formally endorse archival certification and the hiring of certified archivists.

Conservator: Conservators provide specialized experience in preventive conservation and treatment of collections. Typically, conservators have graduated from a recognized conservation training program. At the entry level, conservators will have both academic training and considerable experience in either a broad range of conservation issues or a narrowly focused group of materials

5. *How do I know what staffing or career goals are needed at my park?*

Review planning documents and work with your regional/SO curator to develop guidelines for determining the appropriate staff mix for your collection. Consider your collection's size, complexity, and uses. Be sure to build a trained museum staff adequate to your needs in order to comply with museum management requirements.

In general, for museum-related jobs such as curator (1015), museum specialist (1016), registrar (1001), and archivist (1420), the grade at which the individual acts independently is the GS-11 level. At lower grades, the incumbent requires guidance from a higher graded individual in the same series (or another museum-related classification). It's best if this higher graded person is located in the same park, but they may work in a nearby park or center, or in the regional or support office.

The classifier determines the appropriate classification and grade for a position by:

- working with the supervisor and the description of duties
- following Office of Personnel Management classification standards

Use the Resources Careers Benchmark Position Descriptions (available on the web at **<http://www1.nrintra.nps.gov/careers>**) to facilitate this process.

> ***Communication is essential!** Be sure that your superintendent is aware of the value and potential uses of the archival and museum collections. Stress the concept of highly visible and unique natural and cultural resources collections and documentation associated with the site's history and resources to support staffing needs. Collections should be used as a powerful outreach and public relations tool (as well as being resources themselves) while preserving the history and resources of the park.*

6. *Are there alternative sources for staffing?*

Many parks use alternative sources for staffing their museum management programs. Full time museum staff may not be necessary in a park with a small collection; however, all collections require ongoing documentation, preservation, protection, and access. Alternative sources of staffing for museum management include:

- using collateral duty staff (see below)
- contracting specialized tasks or projects that can be accomplished in a given fiscal year
- establishing cooperative agreements with universities or local museums for collections storage and curatorial staffing
- recruiting volunteers and mentors

- offering internships and fellowships

Generally, cooperative agreements are formed to maintain a portion of a museum collection (e.g. archeology or entomology) that provides mutual benefit to the park and the agency or institution where the collection is housed.

Other sources of staffing include volunteers from the community and student interns. Volunteers and interns can provide assistance with:

- identifying objects and specimens
- cataloging
- photographing
- organizing storage spaces
- museum housekeeping
- assisting researchers and park staff
- conducting collections research

> ***For volunteer programs to work effectively, park staff must provide all volunteers with proper training, supervision, and support.***

7. *What is collateral duty?*

Collateral duty is a term used when a person has multiple and highly varied responsibilities in his/her official position description. A collateral duty is secondary to the primary duties that determine the job classification. Often collateral duties for museum management are assigned to a park ranger or a resources management specialist, such as a biologist, historian, or archeologist. Many collateral duty staff bring prior training in museum management to their positions, while others are trained on the job. Collateral duty museum staff should be trained by a full-time curator or museum specialist (GS-1015 or GS-1016), and receive ongoing guidance from a nearby park curator (at GS-11 or above) and/or the regional/SO curator.

G. Training and Development

The NPS is committed to the professional growth and continuous learning of all its employees. It provides them with a comprehensive, competency-based, and mission focused training and development program. The strength of competency-based training is that it is ***outcome-based*** and ***learner-driven***.

The NPS Training and Development Program develops and delivers learning opportunities that provide the knowledge and skills needed by employees to better perform their jobs. These opportunities include:

- formal education

- life experiences
- traditional classroom courses and workshops
- seminars and conferences
- on-the-job experience and training
- technological enhanced learning (TEL), including:
  - self-paced computer courses
  - satellite broadcast courses

For more information on the NPS Training and Development Program, see the NPS "Learning Place" at: <http://www.nps.gov/training>.

1. *How is competency defined?*

Note: At present, the competencies are to be used only for training and development purposes. They should not be used for hiring and promoting employees. OPM must validate the competencies before the NPS decides how to integrate them into the full NPS Human Resources Performance Process.

The NPS Training and Development Program defines competency as follows:

- **Competency**—"a combination of knowledge, skills, and abilities in a particular career field, which, when acquired, allows a person to perform a task or function at a specifically defined level of proficiency."
- **Essential Competency**—"a competency that forms part of the vital knowledge, skills, and abilities for an individual career field. An essential competency is critical for an employee to perform effectively at his or her level in a Career Field."

Eight essential competencies are common to all employees in and associated with the Cultural Resources Stewardship Career Field. They are:

- Professional Discipline
- Preservation Law, Philosophy, and Practice
- Research and Inventory
- Preservation, Treatment, and Maintenance
- Program and Project Management
- Writing and Communications

- Training
- Safety

Knowledge, skills, and abilities (KSAs) are identified for each competency.

For more information on NPS museum management competencies, see the Cultural Resources Stewardship Career Field Web site: <http:www.nps.gov/training/crs/crs.home.htm>.

2. How do I find out about training in museum management?

There are a number of sources of museum management training, including:

- **Training and Development Program** develops and delivers Servicewide training and development opportunities. For further information, see the Learning Place website at: **<http://www.nps.gov/training>.**
- **Museum Management Program** works with the Training and Development Program to develop training related to new policies and procedures concerning NPS museum collections management, such as ANCS+ training.
- **Regional offices** offer training in museum management basics and ongoing professional training, including training in NPS procedures. Contact your regional employee development officer and regional/SO curator for further information.

Other museum training opportunities are presented by various local, state, and national organizations. To learn more, refer to:

- the MMP Web site at: **<http://www.cr.nps.gov/museum>** to access a monthly list of museum conferences, courses, seminars, and other opportunities.
- Appendix C: Professional Organizations
- your regional/SO curator

H. Resources

Most of the important NPS resource documents referenced in this chapter are on the Internet. See *Conserve O Gram* 1/7, Useful World Wide Web Resources.

NPS Web Resources

Cultural Resources <http://www.cr.nps.gov>.

The Learning Place <http://www.nps.gov/training/npsonly/npsescom.htm>.

Museum Management Program <http://www.cr.nps.gov/museum>.

National Park Service Strategic Plan <http://www.nps.gov/planning/NPS_strategic_plan.pdf>.

Project Management Data System <http://www.nps.gov/performance/ >.

Project Management Information System <http://www.nps.gov/pmis/>.

Resources Careers <http://www1.nrintra.nps.gov/careers/index.htm>.

Other Web Resources

American Association of Museums <http://www.aam-us.org/>.

American Association of State and Local History <http://www.aaslh.org>.

American Institute for Conservation of Historic and Artistic Works <http://aic.stanford.edu>.

Campbell Center for Historic Preservation Studies <http://www.campbellcenter.org>.

Canadian Conservation Institute <http://www.cci-icc.gc.ca/main_e.shtml>.

Society of American Archivists <http://www.archivists.org>.

Special Libraries Association <http://www.sla.org>.

Texas Historical Commission’s Winedale Museum Seminar <http://www.thc.state.tx.us/museums/muswinedale1.html>.

I. Figures

General	DOC	Division of Conservation
	DSC	Denver Service Center
	HFC	Harpers Ferry Center
	MMP	Museum Management Program
	MMPC	Museum Management Program Council
Contracting	IDIQ	Indefinite Delivery Indefinite Quantity
	RFP	Request for Proposal
	RFQ	Request for Quotation
	SOW	Scope of Work
Funding Sources	BACAT	Backlog Cataloging
	CR-MAP	Cultural Resources Management Assessment Program
	CRPP	Cultural Resource Preservation Program
	CYCC	Cultural Cyclic
	MCPP	Museum Collection Preservation and Protection
Planning and Budget	GPRA	Government Performance and Results Act
	OFS	Operations Formulation System
	PMDS	Project Management Data System
	PMIS	Project Management Information System
Recurring Museum Management Reports	ACP	Automated Checklist Program (Museum Checklist)
	AIP	Automated Inventory Program
	CMR	Collections Management Report
Program Planning	CBA	Choosing By Advantage
	CCS	Collection Condition Survey
	CIP	Comprehensive Interpretive Plan
	CLR	Cultural Landscape Report
	CMP	Collection Management Plan
	CSP	Collection Storage Plan
	DCP	Development Concept Plan
	EPD	Exhibit Plan and Design
	EIS	Environmental Impact Statement
	GMP	General Management Plan
	HFR	Historic Furnishings Report
	HRS	Historic Resource Study
	HSR	Historic Structure Report
	IPM	Integrated Pest Management
	LRIP	Long Range Interpretive Plan
	RMP	Resource Management Plan
	SOCS	Scope of Collection Statement
	VA	Value Analysis

Figure 12.1. NPS Acronyms Related to Servicewide Funding, Programs, and Planning for Museum Collections

Project Identification - PMIS 50283	
Project Title: Purchase Museum Storage Equipment (region-wide)	**Project Total Cost:** $114,300.00
Park/Unit: Alaska Regional Office	**Region:** Alaska
States: AK	**Congressional District:** 01
Old Package Number:	**Reference Number:**
Project Type: Non-facility	**Financial System Package Number:** AKRO 050283
Contact Person: Betty Knight	**Contact Phone:** 907-257-2656

Project Status - PMIS 50283	
Date Created: 08/09/99	**Review Status:** Region-Reviewed on 11/30/2001
Date of Last Update: 05/29/03	**Updated By:** Stephanie Stephens (SStephens)

Project Narratives - PMIS 50283

Description

This combines PMIS 50287 with this project (50283).

Purchase and install museum cabinets, shelving units, media safes, fireproof filing cabinets and other specialized curatorial storage units throughout the region. Museum quality supplies, as well as the personnel to perform the upgrade are included in these projects.

This will be an annually recurring account of up to $63,000 through 2005.

Justifications

Alaska parks' collections are experiencing major growth, improvement of storage facilities, decompression of objects with improvements of storage conditions. Concurrently management is recognizing the wealth of unique cultural and natural history collections we manage. As the storage facilities are improved and expanded, at last there is room for more of the specialized equipment required. Additionally, we have been assessing archival resource and anticipate major expansion in that area as well as collections resulting from a resource initiative to inventory and monitor paleontological resources.

Measurable Results

Collection storage equipment is available in sufficient quantity and condition to meet standards at 10 collection storage facilities. As a result, GPRA Goal Ib2D will show an increasing percentage of standards met on a regional basis.

Figure 12.2 Sample PMIS Project Statement

Project Activities, Assets, Emphasis Areas and GPRA Goals - PMIS 50283	
Activities • Maintain or Treat Cultural Resources • Resource Protection	**Assets** • Museum Object and Specimen
Emphasis Areas • Cultural Resource Protection • Museum Property • Natural Resource Protection • Seismic	**GPRA Goals and Percent Values** • Museum Collections (Servicewide), 0%

Project Prioritization Information - PMIS 50283	
Unit Priority: 7	**Unit Priority Band:** LOW

Project Funding Component - PMIS 50283A	
Funding Component Title: Purchase Museum Storage Equipment (region-wide)	**Funding Component Request Amount:** $114,300.00
Funding Component ID: 50283A	**Funding Component Type:** Non-recurring , Deferred Status Confirmed
Funding Component Description:	
Initial Planned FY: 2000	**Requested Funding FY:** 2003
Review Status: Region-reviewed on 11/30/2001	**Funded Amount:** $63,000.00
Date of Park Submission:	**Submitted By:**
Upper-level Review Status:	**Fee-demo Submission Number:**
Formulated FY: 2004	**Funded FY:** 2003
Formulated Program: Other Program	**Funded PWE Accounts:** 9791-0304-UOC, 9865-0311-UOC, 9922-0302-UOC
Formulated Funding Source: Museum Collections Preservation and Protection	**Funded Funding Source:** Museum Collections Preservation and Protection

Component Cost Estimates

Estimated By: Ruth Poff - AKRO	**Date of Estimate:** 03/28/2001
Estimate Good Until: 09/30/2001	**Class of Estimate:** A

Figure 12.2 Sample PMIS Project Statement (continued)

Item	Description	Qty	Unit	Unit Cost	Item Cost
supplies	[ITEM DESCRIPTION]	1	Lump	$35,300.00	$35,300.00
museum quality supplies	Yearly need for supplies within region.	1	Lump	$7,000.00	$7,000.00
Museum quality supplies	Yearly need for supplies within region.	1	Lump	$7,000.00	$7,000.00
museum quality supplies	Yearly need for museum supplies for repositories in region.	1	Lump	$7,000.00	$7,000.00
Storage upgrades throughout region in FY03	Correct deficiencies identified in the Automated Checklist at ARCC, KEFJ, WRST, WEAR and KATM.	1	Lump	$58,000.00	$58,000.00
Component Funding Request					**$114,300.00**

Eligible Funding Sources and Funding Priorities

Funding Source	Unit Priority at Formulation	Regional Priority	National Priority	Year Unit-Prioritized
CRPP - Cultural Resources Preservation Program Base	7			2003
Museum Collections Preservation and Protection	7	1		2003
NRPP - Natural Resource Management	7			2003

Component Start Date: 10/01/2003	**Component Completion Date:**
Completion Status: Project Started	**Accomplishment Reported By:** Stephanie Stephens (Sstephens)

Figure 12.2 Sample PMIS Project Statement (continued)

Operations Formulation System
Request Detail Sheet

Contact: Susan Hurst

Unit/Office: Golden Gate National Recreation Area	Region/Directorate: Pacific West

Title of Funding Request: Manage Cultural Resources and Museum Collections

Total $ Requested: 500,000	**Recent Budget: FY** 2003 - $13,882,000	**Last Operational Increase: FY** 2002 - **$**750,000
Total FTE Requested: 7	**Recent FTE: FY** 2002 - 210	**Request Type:** Park Base
OFS Number: 7356A	Date Created: 05/01/1999	
Servicewide Initiative:		
Park Priority: 21.0	**Date Last Modified:** 02/18/2003	**Budget Driver(s):** 100% Threats to Resources
Regional Priority: 416.0	**Earliest Year of Funding:** 2003	**Status:** WASO Locked Approved By Region 03/18/2003

Funding Component	PWE	FTE	Pers.	Other	Total	Recur.	Priority	GPRA Goal/Results
Provide Historical Architecture Services	CZS	1.0	85,000	3,000	88,000	Yes	1.0	Ia5 / 50
Research-Historical Significance	CZH	1.0	85,000	3,000	88,000	Yes	2.0	Ia5 / 50
Manage Cultural Landscapes	CZL	1.0	85,000	3,000	88,000	Yes	3.0	Ia7 / 3
Manage Museum Collection	CZC	3.0	185,000	9,000	194,000	Yes	4.0	Ia6 / 57
Provide Clerical Support	CZS	1.0	40,000	2,000	42,000	Yes	5.0	Ia5 / 50

Figure 12. 3. Sample OFS Statement

GPRA Goal	Measurable Results	Performance Measure
Ia5	50	Each structure
Ia5	50	Each structure
Ia5	50	Each structure
Ia6	57	Each applicable standard
Ia7	3	Each landscape

Concise Description and Justification:

Golden Gate contains a nationally significant collection of cultural resources including over 1,250 historic structures, 7 cultural landscapes, 4 National Historic Landmark Districts and 6 National Register Districts. Professional expertise is required to manage all aspects of these resources including providing technical direction to maintenance and park partners to guide the repair and rehabilitations of structures and maintenance of cultural landscapes, managing A/E projects and processing compliance actions. In addition, Golden Gate's museum and archival collection of over 4.9 million items, including historic, archival, archeological and biological objects and specimens is the second largest such collection in the NPS. Insufficient resources exist to properly manage and care for this large, significant collection. Funds would provide for an enhanced level of professional management and protection of these irreplaceable cultural resources.

Supporting Information: None

Figure 12. 3. Sample OFS Statement (continued)

Chapter 13: Museum Housekeeping

CHAPTER 13: MUSEUM HOUSEKEEPING

A. Overview

1. *What information will I find in this chapter?*

Information in this chapter will help you to:

- understand the importance of museum housekeeping
- identify the elements of museum housekeeping
- write a Museum Housekeeping Plan
- find additional sources of information

The chapter includes sample formats for a Museum Housekeeping Plan. This format is not required. You can contact your Support Office curator for other sample housekeeping plans that parks have used.

This chapter will not tell you how to clean objects. That specific information is available from a variety of other sources listed in the references. You can also contact your Support Office curator for help.

2. *What is a Museum Housekeeping Plan?*

In the National Park Service, a written housekeeping plan is required for every space that houses museum collections, such as storage spaces, furnished rooms in a historic structure, indoor and outdoor exhibit spaces, curatorial offices, and work and reference spaces. See Cultural Resource Management Guideline (formerly NPS-28), 1997, Chapter 9, D.2.a, Preventive Conservation. Museum objects and historic spaces are cleaned in a different way than modern buildings and equipment that may house museum objects.

A staff curator, collateral duty curator, or contractor who has expertise in the preventive care of museum objects should write the housekeeping plan. The production of the plan should include all staff who will have housekeeping responsibilities. If the plan is written by someone other than the curator, the plan should be reviewed and recommended by the curator before approval by the superintendent. You can use the sample format presented here or contact your Support Office curator for other formats that have been used successfully in parks.

The Museum Housekeeping Plan sets up a schedule for preventive treatments. It serves as a reminder of what needs to be done and, generally, how often it needs to be done. The Museum Housekeeping Plan:

- considers the nature and condition of museum collections
- identifies the location of museum collections
- identifies both routine housekeeping tasks and special housekeeping projects
- identifies equipment, materials, and techniques for carrying out housekeeping tasks

- identifies staff persons responsible for carrying out housekeeping tasks
- establishes a schedule for completing the tasks
- records completed tasks

An approved Museum Housekeeping Plan provides a framework for consistent care of museum objects. It institutionalizes a preventive conservation program. The preservation of the museum collection depends on adherence to the plan by the entire park staff over time. No single employee is responsible for care of the objects. The plan is based on the idea that preventive conservation is an ongoing process—not a product.

A well-written Museum Housekeeping Plan is the basis for your park's preventive conservation program.

3. *Why is museum housekeeping important?*

Preventive conservation, the *primary goal of housekeeping*, aims to prevent damage to museum collections. See Chapter 3, Preservation: Getting Started, for a discussion of preventive conservation. Housekeeping is essential to your preventive conservation program.

From the moment an object is created, it begins to deteriorate as a result of its interaction with the environment. At certain points in its life, a museum object may require the knowledge and skills of a conservator to stabilize its condition. You can minimize the need for conservation treatment by implementing a museum housekeeping program in all spaces that house museum objects, such as:

- exhibit spaces
- historic furnished rooms
- storage spaces
- curatorial offices
- research services spaces
- other work spaces

Each space will require a slightly different approach to cleaning that takes into account how objects are stored and used. For example, exhibit spaces with closed cases may require only annual dusting of objects. Historic furnished rooms, with objects on display in the open air, will require daily or biweekly cleaning.

Preventive Conservation	
Curator/Collateral Duty Curator	Other Park Staff
• Monitors and assesses the condition of objects • Monitors and evaluates the museum environment • Practices proper methods and techniques for storing, exhibiting, handling, packing and shipping of objects • Develops and carries out an ongoing housekeeping program for collection spaces • Prepares an emergency management plan for the museum collection • Prepares an Integrated Pest Management program for the museum collection • Coordinates park's Museum Housekeeping Plan	• Provide guidance, in their area of expertise, on effective means of achieving preservation standards for museum objects • Alert curator to impending activities that may impact museum collections but are not addressed in the Museum Housekeeping Plan • Prepare parkwide emergency management plan • Prepare the parkwide Integrated Pest Management plan • Assist in development and annual review of the Museum Housekeeping Plan • Implement the actions of the Museum Housekeeping Plan for which they are responsible

Figure 13.1. Curator and Other Park Staff Roles in Preserving Museum Collections

4. *Who is responsible for museum housekeeping?*

The park superintendent delegates responsibility for the day-to-day management of museum objects to a permanent full-time, part-time, or collateral duty curator. Non-curatorial staff may also play significant roles in preserving museum objects. For example, keeping air filters clean in a heating, ventilation, air conditioning (HVAC) unit is a preventive conservation action that may be carried out by non-curatorial staff, but that task has significant impact on the long-term preservation of museum objects. This shared responsibility requires close cooperation and open communication between the curatorial and maintenance staff. Although the superintendent may delegate duties, housekeeping must be a primary concern of site management; sound housekeeping practices are significant for the visitor experience and visitor safety, as well as for resource preservation.

Good museum housekeeping needs the contributions of all park staff including maintenance personnel, interpreters, historians, architects, and other cultural resources staff. Individual parks will divide these responsibilities differently. Curatorial staff must keep close watch over the effects of cleaning, informing maintenance when methods or frequency seem harmful. Maintenance and other staff have a reciprocal obligation to consult the curator and take advice or work out acceptable alternatives. See Figure 13.1 for shared roles in preserving museum collections.

5. *What is museum housekeeping?*

In the context of museum collections management, the term "housekeeping" is defined as all of the ongoing actions (tasks) to preserve museum objects, archives, and museum records. Housekeeping is planning and monitoring, as much as it is hands-on collections care. Housekeeping requires *looking* as much as *doing*. Knowing when *not* to clean is as important as knowing when and how to clean. Housekeeping involves such tasks as:

- building and site care
- monitoring the effectiveness of environmental controls
- monitoring and recording light, temperature, and relative humidity levels
- monitoring for pests
- cleaning or replacing filters in air handling units
- monitoring the condition of museum objects
- dusting
- vacuuming
- applying protective waxes

Housekeeping is a major, and very challenging, part of a collections management program.

- It will greatly increase or greatly decrease the life of museum objects.
- It requires direct contact with museum objects.
- It is time consuming.

6. *What is the goal of museum housekeeping?*

Good museum housekeeping minimizes deterioration of objects by focusing on preventive care. Housekeeping relies on blocking the agents that deteriorate artifacts, such as pests, pollutants, and UV light, and monitoring to be sure that preventive actions are working. It enables you to inspect your collection on a routine basis so that deterioration can be detected early. Only when preventive techniques have failed, will cleaning need to be carried out.

If you approach housekeeping with this preventive approach in mind, instead of as a series of hands-on tasks, you will minimize damage to artifacts. In the long run you will also save a lot of time.

For example:

You can place floor mats at the entrance into historic houses where objects are exhibited, limiting the amount of dirt brought into the space that can be kicked up as dust. If you use a HEPA (high efficiency particulate air) filter vacuum when you clean, you minimize the amount of dust blown out into the air. Making sure doors and windows are tight limits the amount of dust blown in from outside. If all these preventive measures are taken, then the amount of dust that collects on objects and the amount of time and energy needed for cleaning will be minimized. With less cleaning and handling the chance that an object will be damaged is curbed.

You must work with and educate other park staff to improve preventive care and limit the amount of cleaning you must do. Effective care requires the cooperation of all staff members that work with and around collections.

7. *What is the goal of cleaning?*

The goal of cleaning is to preserve museum collections. Most of the traditional housekeeping tasks, such as dusting and vacuuming, are tasks also done at home. As a museum professional, you also dust and vacuum in museum exhibits, storage rooms, and furnished structures.

However, you should keep in mind that the significant difference between housekeeping at home and housekeeping in museums is the goal of preservation. Approach cleaning spaces that house museum collections from a different point of view. Consider:

- the nature and condition of objects
- cleaning materials and methods appropriate to object preservation
- signs of object deterioration
- interpretive effects in exhibits and furnished historic rooms

8. *How does museum housekeeping differ from housekeeping at home?*

Think about and understand why you are undertaking a certain housekeeping task. At home, the primary concern is usually aesthetics. You may want home furnishings and fixtures to look clean and shiny with the least amount of effort, so scrubbing and polishing may be done in haste. At a museum, these tasks are undertaken primarily to preserve collections. Cleaning must be careful, gentle, and thorough. If you simply clean for appearance, as you may do at home, then damage to collections will inevitably occur.

Express your museum housekeeping attitude through careful, thoughtful, and gentle actions.

"Clean" in museums means that enough collected dirt has been removed so that deterioration will not take place. It does not mean spotless or "white glove" or "squeaky" clean. Evaluate the situation each time cleaning is done and decide first, if it is necessary and second, how far you must clean. Careful museum housekeeping requires using the correct supplies and equipment with proper techniques for the preservation of a museum collection. For example:

- When *dusting*, apply minimum pressure, move carefully, and frequently change to a clean dust cloth.
- When *vacuuming*, don't allow the vacuum cleaner, including cords and attachments other than the brush, to come into contact with museum objects.

See the references listed at the end of this chapter for more explanations of cleaning techniques and supplies for all types of materials.

Understand what each housekeeping task will accomplish. What are you doing and why you are doing it? A neat and clean museum will be the result of housekeeping, but it is not the only goal. Think of museum housekeeping as preventive conservation. You and your staff are trying to prevent damage to museum objects before it occurs.

Museum housekeeping requires an objective approach. Before beginning your daily tasks, ask yourself, “Am I prolonging the life of the object?” You need to *think preservation*.

9. *How often should I clean?*

There is no typical time period for cleaning. You might only have to vacuum a secure storage area that you monitor for pests once a month, or twice a year. However, you may need to vacuum the floor once a day in a poorly sealed log cabin that gets many visitors. Unnecessary and frequent cleaning can damage objects and may lead to their consumptive use.

To decide on how often to clean, think critically. Take into account how dirt, pests and other contaminants get into a space. Think about how many people go through an area. Walk through and carefully look at the space to see where dirt collects and how quickly.

A park can decide if cleaning should be done during operating hours when the public can see you care for the collections, or at times when spaces are closed to the public. Explaining housekeeping tasks can be a part of your resource preservation message.

10. *How do I find out the correct techniques for cleaning objects?*

There are a variety of information sources available that give overviews of housekeeping and describe specific techniques and materials. You should obtain books and videos listed in the bibliography and keep them available as references.

Watch the following NPS sources for new information and techniques:

- NPS *Conserve O Gram (COG)* series
- cc:Mail NPS *Museum Management Newsletter*
- NPS *Museum Handbook*, Part I, Curatorial Care Appendices

11. *Where can I get training to learn more about housekeeping?*

There are a variety of places you can find more information about housekeeping.

- The NPS Curatorial Bulletin Board lists advertisements for courses that are taught at various institutions around the country.
- A variety of written references and videos are available. See the bibliography for specific references.
- Contact your Support Office curator for more information.

B. The Museum Housekeeping Plan

1. *What are the components of a Museum Housekeeping Plan?*

There are a variety of ways to format a MHP. The format described here is one example. For other examples contact your Support Office curator.

The Museum Housekeeping Plan illustrated here includes:

- Title Page
- Narrative Section
- Reference File Sheets
- Task Sheets
- Schedules

2. *How do I prepare the title page?*

The title page includes the:

- title
- full name of park
- review and approval signature lines

A table of contents is helpful for people using the plan. You may add additional sign-off lines and circulate the plan through each appropriate division. This practice documents in writing each division's commitment to implement its part of the plan. The superintendent provides final approval. Figure 13.2 illustrates the proper format for the Title Page.

3. *How do I write the narrative section?*

State the purpose of the Museum Housekeeping Plan. Sample language for this section follows. Append additional park-specific language as needed.

> *Preventive conservation is the ongoing activity of non-invasive actions taken to prevent damage to and minimize deterioration of museum objects. Housekeeping, executed faithfully and with professional judgment, is a crucial component of preventive conservation. The park has developed this Museum Housekeeping Plan to ensure consistent, long-term care of its museum collections. The plan is the product of a cooperative effort between all involved divisions and has the support of the superintendent.*

The narrative outlines a cohesive program of care that the plan documents. You can include information on:

- the locations for museum housekeeping
- the tasks to be performed
- the appropriate techniques for accomplishing the tasks
- the frequency of each task
- the title and name of person(s) responsible for performing the tasks
- the appropriate supplies and equipment

4. *What are reference file sheets?*

Reference file sheets can help you collect all the information dispersed in a variety of documents on equipment and supplies and environmental concerns. Using the reference file sheets you collect all this information once, instead of having to find it repeatedly. Documents that contain information collected in reference file sheets include the Collection Management Plan, (CMP), Collection Condition Survey (CCS), historic furnishings reports, equipment handbooks, and environmental monitoring records.

Complete reference file sheets for:

- environmental concerns
- equipment to monitor and control the environment
- supplies to monitor and control the environment

Reference file sheets provide data necessary to complete the task sheets.

5. *How do I complete the reference file sheet for environmental concerns?*

The reference file sheet for environmental concerns identifies ongoing issues for maintaining environmental standards, and lists tasks necessary to maintain or work toward those standards for each location containing museum objects.

See Figure 13.3 for a suggested format for the reference file sheet.

- Under "Location," enter the park acronym and common name of structure.
- Summarize for each space the existing environmental factors (temperature, relative humidity, light, pest infestation, and dust/pollution).
- List sources from which data were derived.
- List all tasks relevant to the preservation of the museum objects.

6. *How do I complete the reference file sheet for equipment or supplies used to monitor and control the environment?*

Prepare a reference file sheet for equipment and supplies used to monitor and control the environment. Describe the equipment, give model numbers, and location of manuals and supplies. Also list tasks necessary to maintain the equipment.

See Figure 13.4 for a suggested format for a reference file sheet for equipment and supplies used to monitor or control the environment.

- Under "Location," enter the park acronym and the common name of the structure/space.
- List type, size, quantity, and brand of portable equipment (such as vacuum cleaners, humidifiers, dehumidifiers, hygrothermographs, dataloggers).
- State the location of the equipment in the space. You may want to attach a floor plan of the space that indicates the location.
- State the location of operational and maintenance manuals, warranties and additional supplies.

- List all sources for the information on the reference file sheet.

- List all tasks relevant to maintaining the equipment or supply described. Include tasks such as changing vacuum filters and reconditioning silica gel.

Record the quantity of supplies used throughout the year. Keep extra vacuum cleaner bags and cleaning supplies in stock. Track and quantify the expenditure of supplies to ensure that you have sufficient quantities.

Mark or label supplies and equipment used for preventive conservation. Use them only for that purpose. Limiting use prevents the unintentional introduction of dirt and residues into spaces that house museum collections.

7. *What are housekeeping plan task sheets?*

Complete task sheets for all tasks listed on reference file sheets (see no. 4 above). When preparing the sheets, you need to involve discipline and job specialists, as appropriate, from all divisions. Working with other staff members to develop the tasks will identify all the aspects of care that must be addressed. A cooperative approach to preventive care will begin to develop when you work with all staff members involved in caring for collections.

Task sheets and schedules provide a mechanism for tracking the costs of preserving and protecting museum objects. Task sheets can also be used to support the need for additional staff or funding to carry out necessary housekeeping tasks. The task sheets:

- provide detailed procedures to be followed such as specialized handling techniques

- identify appropriate equipment and supplies for each task

- determine the frequency of performance, which must be critically evaluated each time the task is performed

The objectives of the task sheets and schedules are to ensure that no task is overlooked, and to avoid duplication of effort through:

- efficient dove-tailing of divisional responsibilities

- judicious use of limited resources

Review and revise the task sheets at least once a year and whenever other park planning or operational documents (such as the Emergency Operations Plan) are updated.

8. *How do I prepare a task sheet?*

See Figures 13.5-8 for samples of task sheets. You may use this suggested format or design your own reports. Adjust time and cost estimates based on staff experience.

See Section E for a list of MH-I, Curatorial Care Appendices that provide guidance on preventive care and cleaning techniques for specific material and object types.

For each task sheet:

- List the location.

  Include the park acronym and common name of structure.

- Identify the task.

  Option 1: For each task, object, or piece of equipment, use one task sheet. Vacuuming in a historic house could have one task sheet. If one table has an unstable veneer and requires special handling techniques, it should have its own task sheet. Include a task sheet to maintain the equipment. For example, mops and dust cloths must be washed, dried, and put away carefully.

  Option 2: Use one task sheet for several identical objects. For example, all the upholstered furniture may be cared for using the same procedures and techniques.

- State how often a task should be performed (frequency). Be sure to include statements on how to evaluate whether the task needs to be performed. Your observations and experience will influence the frequency for each task. Each time the task is performed, it should be reevaluated. The frequency may also be affected by the interpretive goal of an exhibit or furnished historic structure.

- Describe procedures.

  Describe how the task will be accomplished safely, appropriately, and effectively. **Consult conservators and discipline specialists and refer to professional publications to confirm that procedures are appropriate and current.**

- State cautions.

  Identify any physical hazards associated with the task (such as heavy lifting). When chemicals (even detergents) are used for cleaning, attach a copy of the applicable Material Safety Data Sheet (MSDS) to the task sheet, or state where it may be obtained elsewhere in the park.

- Provide current staff assignment(s). List the name and title of the staff member currently responsible for completing the task.

- Identify skills and training needed.

  Describe the skills or training required to perform the task. Staff should practice only those preventive conservation techniques and procedures for which they are trained. For example, only staff who have been trained by a conservator may undertake treatments such as removing or re-applying wax or lacquers. See Chapter 3 for a discussion of the roles of the curator and conservator.

The hands-on care of collections, including activities that occur near museum objects (such as vacuuming), requires special care and aptitude. If you are involved in such activities, you need to demonstrate sensitivity for the objects as well as the physical coordination needed to handle objects safely. Training and re-training are important elements in developing and improving these skills, and should be addressed in a separate task sheet.

- Identify supplies and equipment needed for each task.

  Provide a common descriptive name that distinguishes between similar pieces of equipment (such as a double filter vacuum or wet-vac). List identification numbers if necessary. See NPS *Tools of the Trade* for information on obtaining museum supplies and equipment.

- State sources used to develop each task sheet. Include published works and personal communications.

- Provide information on who prepared tasks sheets and when.

9. *What is a housekeeping schedule?*

Museum housekeeping schedules are an important part of the plan. The schedules are guides that:

- remind you when to do tasks (Season and visitation variations may affect the frequency of tasks.)

- chart the progress and provide a means of tracking the status of the housekeeping program

- prevent tasks from being crowded out or forgotten

10. How do I prepare a housekeeping schedule?

Combine information on specific tasks and procedures (identified on task sheets) into a schedule for each responsible staff member.

- Allot each task adequate time at the proper intervals. (Refer to frequencies compiled in the task sheets.)

- Organize tasks on the schedule as follows:

  – daily

  – weekly

  – monthly

  – quarterly

  – semi-annually

  – cyclically (less or more often than annually)

  – as needed

- List all tasks concisely.
- Use a chart to format your schedule.
- File all completed charts for future reference.

Provide a space for initials or check-off and dates to document each time a task on the schedule is carried out. You may wish to add other useful information such as cost for the task and account numbers to be charged.

See Figures 13.9-12 for sample formats. You can use these formats as is, or adapt them to your particular park needs as you write your housekeeping plan.

11. *Will ANCS+ help me develop my Museum Housekeeping Plan?*

The task sheets and schedules described in this chapter can be generated using the Maintenance associated module and Maintenance supplemental record in ANCS+. You can find information on using the Maintenance associated module in Chapter 4 and the Maintenance supplemental record in Chapter 3 in the ANCS+ User Manual (1998).

C. Selected Bibliography

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______. *Preventive Conservation in Museums*, series of 19 videocassettes. Available from Université du Québec à Montrèal, Audiovisual Department, Production Services, Box 8888, Station Centre-Ville, Montrèal, QC H3C 3P8, Tel. (514) 987-6195.

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National Park Service. *Museum Handbook,* Part I, Museum Collections. Washington, D.C.: National Park Service, Museum Management Program, 1990.
Appendix I: "Curatorial Care of Archeological Objects"
Appendix J: "Curatorial Care of Paper Objects"
Appendix K: "Curatorial Care of Textile Objects"
Appendix L: "Curatorial Care of Paintings"
Appendix M: "Curatorial Care of Cellulose Nitrate Negatives"
Appendix N: "Curatorial Care of Wooden Objects"
Appendix O: "Curatorial Care of Metal Objects"
Appendix P: "Curatorial Care of Ceramic, Glass, and Stone Objects"
Appendix R: "Curatorial Care of Photographic Collections" (1996)
Appendix S: "Curatorial Care of Objects Made from Leather and Skin Products" (1996)

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Simonson, Kaye Ellen, compiler. *Maintaining Historic Buildings: An Annotated Bibliography*. Washington, D.C.: U.S. Department of the Interior, National Park Service, Preservation Assistance Division, 1990.

D. List of Figures

Figures 2-12 illustrate sample formats for writing your Museum Housekeeping Plan.

You can use these Sample plans as is or adapt them when preparing your own Museum Housekeeping Plan. MHP Task Sheets, and MHP Daily, Weekly, and Quarterly Schedules can be produced using the Automated National Catalog System (ANCS+). Using ANCS+ to generate your plans will help you track maintenance treatments on individual objects.

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

PARK NAME

STRUCTURE NAME

MUSEUM HOUSEKEEPING PLAN

Prepared by:	Title	Date
Recommended by:	Park Curator	Date
Approved by:	Superintendent	Date

Figure 13.2. Sample MHP Title Page

NATIONAL PARK SERVICE
MHP REFERENCE FILE SHEET
ENVIRONMENTAL CONCERNS

Location: CHDO, Visitor Center, Exhibit Space

Temperature: Gradual fluctuations occur seasonally within a 5° - 10°C range (60°-70°F). Maintenance staff makes adjustments to climate control equipment only after consultation with curatorial staff.

Relative Humidity: Relative humidity is poorly controlled. Front entrance doors provide immediate access to the outdoors, allowing air and humidity to flood the exhibit area whenever visitors enter. Microclimates in exhibit cases must be maintained to compensate for unacceptable levels of RH. Construction of a separate entrance alcove is planned for FY1999 (refer to Resources Management Plan Project Statement #14 and Development/Study Package Proposal Form 10-238 #93-1).

Light: Applied light tint solar control film to exterior windows in June 1990. Filters remove 96% of UV, and 30-40% of visible light.

Pest Infestations: With the exception of an annual influx of yellow jackets, no insect infestations have been recorded to date. Park curatorial staff arranges for removal of these insects from collection areas.

Dust/pollution: Dust levels are relatively low because concrete sidewalks provide access to the structure. Interpreters bring walking tours from the historic trace road, which is dirt, into the Visitor Center through the side door and across a dust mat.

Source: Environmental monitoring records, curator's office, Cabinet 4, Drawer 3.
CHDO IPM Plan, 1991, p. 44.

Tasks:

- Monitor temperature and relative humidity. Weekly.
- Monitor sticky traps for pests. Weekly.
- Monitor silica gel tiles in cases, and recondition regularly. Monthly.
- Monitor condition of objects, especially those located nearest the entrance. Weekly.
- Monitor progress of Development/Study Package Proposal (Form 10-238) #93-1. Quarterly.
- Monitor condition of UV filters and replace when needed. Quarterly.
- Inspect case seals. Annually.
- Inform interpretive staff of rationale and procedures for following established tour routes at seasonal and permanent staff training sessions. Annually in May.

Prepared by: Nathan Santiago
Title: Museum Curator
Date: June 17, 1992

Figure 13.3. Sample MHP Reference File Sheet: Environmental Concerns
Information provided for specific tasks on these samples should not be regarded as standards.
See Section A above for a discussion of the decision-making process that goes into developing these sheets.

NATIONAL PARK SERVICE
MHP REFERENCE FILE SHEET
EQUIPMENT/SUPPLIES USED TO CONTROL THE ENVIRONMENT

Location: CHDO, Visitor Center, Storage Space

Type of Equipment/Supplies: HEPA vacuum

Size: Medium, 16" x 12" x 12"

Quantity: 1

Brand: Nilfisk GS80I

Location in Space: See attached floor plan.

Location of Manuals: Operational and repair manual is in Curator's Office, File Cabinet 1, Drawer 2, File "Equipment." Note: The curator's manual is the only copy on site.

Location of Supplies: Replacement bags and filters are in Storage Cabinet 4, Shelf B in the curatorial supplies storage area. Order one year's supply of bags (12) and one HEPA exhaust filter annually in January.

Sources: Nilfisk product information. Duplicates available from Nilfisk (610) 647-6420.

Tasks:

- Purchase replacement bags and filters. January.
- Change bags. Monthly, and more often if necessary.
- Change HEPA filter. January.

Prepared by: Betty Ann Kinitz
Title: Museum Tech
Date: April 1, 1988

Figure 13.4. Sample MHP Reference File Sheet: Equipment/Supplies Used to Control the Environment
You may create a separate sheet for each piece of equipment or combine all equipment on one reference sheet if appropriate.

NATIONAL PARK SERVICE
MHP TASK SHEET
DUSTING

Location: CHDO, LCS#101, Room 101, Wall Cabinet (Chris Doe Homeplace, Front Parlor)

Task: Clean wall cabinet, dust objects in cabinet

Frequency: Monthly. Before dusting, carefully inspect objects and cupboard to decide if cleaning is necessary.

Procedure:
- ☐ Prepare space on table to receive objects.
- ☐ Remove objects from cupboard.
- ☐ Check pest trap on lower shelf. Replace with new trap.
- ☐ Dust wooden cupboard with soft dust cloth. Give special attention to molding, using a soft artist's brush to dust. Dust ceramics and glass with brush.
- ☐ Replace items using sketch from HFR (attached).
- ☐ Incorporate pest trap findings into IPM records. (Forward to Curator.)
- ☐ Wash dust clothes and brushes in non-ionic soap at first sign of darkening.

Cautions:
- ☐ **Lid on stein is not attached; handle top and base separately.**
- ☐ Use surgical gloves when handling china.

Currently Assigned to: Adam Karlson, Museum Technician

Special Skills/Training: Watch curatorial handling video.

Supplies/Equipment:
- ☐ Soft artist's brush
- ☐ Soft dust cloth
- ☐ Pest trap
- ☐ Surgical gloves

Sources:
- Chris Doe House, Historic Furnishings Report, Harpers Ferry Center, 1997.
- Museum Handbook, Part I, Appendix P, "Curatorial Care of Ceramic, Glass, and Stone Objects"

Prepared by: Nathan Santiago
Title: Museum Curator
Date: July 16, 1992

Figure 13.5. Sample MHP Task Sheet: Dusting
You can prepare one sheet for all dusting tasks or divide them as needed for your park. The Maintenance associated module in ANCS+ can help you generate these task sheets.

NATIONAL PARK SERVICE
MHP TASK SHEET
PEST MONITORING

Location: CHDO, Visitor Center, Exhibit Space

Task: Monitor for pests

Frequency: Weekly

Procedure:
- ☐ Prepare new pest traps; write the location and number on each trap. Where necessary for clarity, draw a rough sketch of the room or wall.
- ☐ Collect traps from previous week. Place carefully inside plastic bags and seal.
- ☐ Put new traps into position.
- ☐ In work area (outside of storage room), count numbers of each specimen type and record data on data sheets or enter into database.
- ☐ If action thresholds have been exceeded, take appropriate action. Report action to PCM Coordinator and park IPM Coordinator (Marc Johnson, Resources Management Specialist). Action thresholds listed in CHDO IPM Plan.
- ☐ Incorporate new specimens into the IPM reference collection.
- ☐ Initial and date schedule.

Cautions:
- ☐ Mouse traps were placed in the southwest corner of the Visitor Center on May 31. If a mouse has been caught, discard trap and mouse, and replace trap, notify IPM Coordinator.

Currently Assigned to: Dr. Joachim Kapp, Volunteer

Special Skills/Training: ☐ Identify insects and rodents.

Supplies/Equipment:
- ☐ Pest traps
- ☐ Microscope
- ☐ Record sheets and/or database access

Sources: CHDO IPM Plan

Prepared by: Marc Johnson
Title: Resources Management Specialist
Date: June 3, 1991

Figure 13.6. Sample MHP Task Sheet: Pest Monitoring
The Maintenance associated module in ANCS+ can help you generate these task sheets.

NATIONAL PARK SERVICE
MHP TASK SHEET
REVIEW HOUSEKEEPING PLAN

Location: FOLA, Officer's Quarter #14

Task: Review Housekeeping Plan

Frequency: Annually (January)

Procedure:

- ☐ Assess currency of plan. If changes, based on observation and experience with plan, are needed to improve implementation, circulate the revised plan to appropriate reviewers on-site.
- ☐ If necessary, revise to keep plan current with changes in technology and procedure. Make copies for formal review. Reviewers may include: Curator, Park Architect, Building and Utilities Foreman, Conservator, Volunteers involved in implementing the plan, Support Office Curator, Interpretive Staff.
- ☐ Distribute plan for review. Allow a minimum of six weeks for review.
- ☐ Incorporate comments as appropriate into plan.
- ☐ Route for formal signature.
- ☐ Distribute copies of revised plan.
- ☐ Initial and date schedule.

Cautions:

- ☐ A memo reminding staff of impending review is recommended as a courtesy to staff.

Currently Assigned to: Team: Lenore O'Doul, IPM Coordinator and Nathan Santiago, Museum Curator

Special Skills/Training: ☐ Familiarity with museum objects and the structure and their respective requirements.

Supplies/Equipment: ☐ None

Sources: Housekeeping Plan for Officer's Quarters #14

Prepared by: Nathan Santiago
Title: Museum Curator
Date: October 19, 1992

Figure 13.7. Sample MHP Task Sheet: Review Housekeeping Plan
The Maintenance associated module in ANCS+ can help you generate these task sheets.

NATIONAL PARK SERVICE
MHP TASK SHEET
SPECIAL USES

Location: CHDO, LCS #101, Chris Doe Homeplace

Task: Plan evening tours of Homeplace, CHDO Birthday Weekend

Frequency: Annually in September-October

Procedure:

- ☐ Review interpretive plans. **Consumptive use of original furnishings as part of the tours is specifically prohibited (e.g., sitting on chairs or using tables as writing surfaces).** If reproductions are substituted, schedule staff and time to move furnishings and to restore rooms to their normal arrangement. No less than one month before event.
- ☐ Review security plan for event with Law Enforcement and Interpretive staff supervisors. Give special attention to opening and closing procedures. Two weeks before event.
- ☐ Consult Interpretive Supervisor. Schedule an adequate number of staff/VIPs to protect objects. No less than two people per floor. Curator and Museum Technician to be stationed at Homeplace during the event. Two pay periods before event.
- ☐ Review security plan with staff and volunteers assigned to homeplace tours no more than one week before event.
- ☐ Install VARDA motion detection units in each room. See attached sheet for locating units out of visitors' sight.
- ☐ Ensure special event supplies and equipment are in homeplace and operational.
- ☐ Clean-up.
- ☐ Conduct visual inventory each evening after tours.
- ☐ Implement weekly housekeeping procedures each day of event, as needed.

Cautions:

- ☐ Attendance at tours has averaged 1500 visitors per night.
- ☐ **Use of lighted candles inside the building is specifically prohibited.**

Currently Assigned to: Lenore O'Doul, IPM Coordinator

Special Skills/Training:

- ☐ Familiarity with security plan.
- ☐ Training in park radio procedures.
- ☐ Training in crowd control/observation in special events.

Supplies/Equipment:

- ☐ 3 Flashlights, extra batteries.
- ☐ Park radio.
- ☐ 8 VARDA units.

Sources: Chris Doe NP Interpretive Prospectus, (revision in progress).

Prepared by: Nathan Santiago
Title: Museum Curator
Date: June 12, 1987

Figure 13.8. Sample MHP Task Sheet: Special Uses
The Maintenance associated module in ANCS+ can help you generate these task sheets.

CHRIS DOE HOMEPLACE — **FEBRUARY 1991** — **JOHN ENGLAND**

Location — Month - Year — Staff Name

Daily	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Dust mop entrance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																			
Clean ext. exhibit cases	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																			
Vacuum doormats	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																			
Clean restrooms	✓	✓	✓	✓	✓			✓	✓	✓																			
Remove trash/food	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																			

Comments: Restrooms flooded on the 6th and 7th.

Figure 13.9. Sample MHP Tracking Schedule: Daily

The Maintenance associated module in ANCS+ can help you generate schedules.

CHRIS DOE HOMEPLACE **1997 1ST** **NATHAN SANTIAGO** Location
Year Quarter Staff Name

Weekly	1	2	3	4	5	6	7	8	9	10	11	12	13
Change hygrothermograph charts	✓	✓											
Check pest traps	✓	✓											
Dust objects in historic rooms	✓	✓											
Buff waxed floors	✓	✓											

Comments:

Figure 13.10. Sample MHP Tracking Schedule: Weekly
The Maintenance associated module in ANCS+ can help you generate schedules.

CHRIS DOE HOMEPLACE — Location

NATHAN SANTIAGO — Staff Name

Quarterly	1997 1st Qtr.	1997 2nd Qtr.	1997 3rd Qtr.	1997 4th Qtr.	1998 1st Qtr.	1998 2nd Qtr.	1998 3rd Qtr.	1998 4th Qtr.	1999 1st Qtr.	1999 2nd Qtr.	1999 3rd Qtr.	1999 4th Qtr.
Vacuum silk sofa	✓											
Dust lamp shades	✓											
Measure visible light readings	✓											
Measure UV light readings	✓											
Vacuum beneath beds	✓											
Turn open book pages	✓											
Dust lighting fixtures	✓											

Comments:

Figure 13.11. Sample MHP Tracking Schedule: Quarterly
The Maintenance associated module in ANCS+ can help you generate schedules.

SUMMER

5-DAY SCHEDULE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
V.C. EXHIBIT Clean floor Damp wipe door knobs Dust Pest check Clean glass on cases	Clean floor Vacuum all floors & baseboards Clean glass on cases Change hygrother-mograph chart	Clean floor Damp wipe door knobs Clean glass on cases Clean window sills, ledges, tops of door	Clean floor Clean text & graphics Clean doormats Dust Clean glass on cases	Clean floor Vacuum flies Vacuum all floors & baseboards Damp wipe door knobs Clean glass
WORKSHOP Clean floor Damp wipe door knobs Clean glass on cases Record thermo-hygrometer	Clean floor Dust Pest check Clean glass on cases Record thermo-hygrometer	Clean floor Clean window sills, ledges, tops of door Damp wipe door knobs Clean glass Record thermo-hygrometer	Clean floor Clean text, graphics & railings Clean glass Record thermo-hygrometer	Clean floor Dust exhibit cases & furniture Clean glass Damp wipe door knobs Record thermo-hygrometer
STORAGE Inspection Pest Check	Change hygrother-mograph charts			Sweep floors Straighten
HOMEPLACE Dust mop entrance Clean exterior exhibit cases Vacuum doormats Clean restrooms Remove trash/food	Change hygrother-mograph charts Dust mop entrance Clean exhibit cases Vacuum doormats Clean restrooms Remove trash/food	Check pest traps Dust mop entrance Clean exhibit cases Vacuum doormats Clean restrooms Remove trash/food	Dust objects in historic rooms Dust mop entrance Clean exhibit cases Vacuum doormats Clean restrooms Remove trash/food	Buff waxed floors Dust mop entrance Clean exhibit cases Vacuum doormats Clean restrooms Remove trash/food

Figure 13.12. Sample MHP 5-Day Schedule

Chapter 14: Museum Collections Security

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CHAPTER 14: MUSEUM COLLECTIONS SECURITY

A. Overview

As hard as we try, nothing lasts forever. Still, an effective preservation program can delay the inevitable. Preventive conservation can slow the rate of loss to natural, expected causes, while a comprehensive security system can help limit losses from unexpected causes, such as fire, theft, natural disasters, and accidental damage. Security and fire protection are as important to the long-term survival of a collection as proper curation, storage, and conservation and must be an integral part of the day-to-day care of the collection.

1. *What is a comprehensive security system?*

A comprehensive security system combines policies, procedures, personnel, and hardware to protect museum collections from unexpected losses caused by crime, negligence, fire, or other catastrophic events. Four concepts are implicit in such a system:

- The park itself is a system, and security is one of its subsystems.
- Identifying objectives precisely and clearly is the most important step you can take in designing an effective system. A security system for museum collections, for example, has two principal objectives: to protect museum collections and associated records from catastrophic loss, and to protect the documentation related to objects in the collection, such as accession records, catalog records, conservation reports, and photographs.
- No single subsystem or component can achieve a security system's overall objectives. Subsystems must complement each other to make the system efficient and ultimately successful.
- Subsystems and components are interdependent within a system. Changes in one part affect the whole system and may have unexpected consequences. For example, placing an air handler in a museum collection storage area might be an efficient use of space, but it complicates access control, adds a potential source of ignition, and increases the risk of accidental damage to museum objects.

2. *How should I design an effective security system?*

There are no cookbook solutions for security problems, and no single recipe will turn out a perfect security system every time. Each park must develop its own system. Every park is unique, faces different threats, has different short-term objectives, and has different resources available. While security concepts are mostly common sense, applying them effectively requires care, consideration, and experience.

One way you might think about a comprehensive security system is to visualize a series of concentric circles that form a bull's-eye (see Figure 9.1). Simply stated, you should add more and tighter security precautions as you get physically closer to a high value object, like the rings on the bull's-eye diagram. The more valuable the protected object, the more protection rings there should be, and the more they should focus on the object. The figure also shows the overlapping and complementary roles played by park boundaries, policies, procedures, the building shell, cases, electronic systems, and personnel.

Figure 9.1. Security Bull's-Eye

3. Who is responsible for security?

Overall responsibility for protecting the park's museum collection rests with the superintendent, while museum and law enforcement staff share direct day-to-day responsibility. Nevertheless, you and all of your fellow park employees—permanent, seasonal, salaried, or volunteer—are part of the park's security system and have security responsibilities that should be reflected in the park's standard operating procedures (SOPs).

4. *What information will I find in this chapter?*

Information in this chapter will help you:

- identify threats to your collections
- assess the risk of loss
- select and implement appropriate countermeasures
- measure the effectiveness of those countermeasures

See NPS Museum Handbook, Part I, Appendix G: Protection of

National Park Service Museum Collections, for NPS security and fire protection standards, glossary of terms, and sample statements of work, standard operating procedures, and agreements.

B. Legal, Regulatory and Policy Requirements

Protection of museum collections is basic to the mission of the National Park Service. The following digest of statutes and policies provides a starting point for a park's protection program. In essence, they require you to use the most effective means available to protect museum collections against fire, theft, and other threats without compromising their integrity.

1. *What laws and regulations do I need to know?*

Title 40 United States Code (USC), *Public Buildings, Property, and Works* Paragraph 486(c) provides statutory authority for the head of each executive agency to issue orders and directives necessary to manage the Government's property.

Code of Federal Regulations (CFR) 41 *Federal Property Management Regulations* Part 101, Subpart 20.5 "Physical Protection", prescribes policies and methods for physically protecting buildings and grounds operated by GSA and other Federal Executive agencies. The Department of the Interior's property management regulations are in Part 114 of CFR 41.

2. *Which parts of the Department of the Interior's Manual address protecting museum collections?*

Part 411, Chapters 1-3, sets standards and requirements for protecting museum property.

Part 444, Chapter 1, tells you how to safeguard personnel, prevent unauthorized access to Federal property and records, and safeguard against espionage, sabotage, vandalism, and theft.

3. *What sections of NPS Management Policies refer to protecting museum collections?*

Section 5.3, Stewardship concerns the protection and preservation of cultural resources. It states the National Park Service will employ the most effective concepts, techniques and equipment to protect cultural resources against theft, fire, vandalism, overuse, deterioration, environmental impacts, and other threats, without compromising the integrity of the resources. It also states that:

- Measures to protect or rescue cultural resources in the event of an emergency, disaster, or fire will be developed as part of a park’s emergency operations and fire management planning processes. Designated personnel will be trained to respond to all emergencies in a manner that maximizes visitor and employee safety and the protection of resources and property.

- In the preservation of historic structures and museum and library collections, every attempt will be made to comply with national building and fire codes. When these cannot be met without significantly impairing a structure’s integrity and character, the management and use of the structure will be modified to minimize potential hazards, rather than modifying the structure itself.
- When warranted by the significance of a historic structure or a

museum or library collection, adequate fire detection, warning, and suppression systems will be installed. "Pre-fire plans" will be developed for historic structures and buildings housing museum or library collections, designed to identify the floor plan, utilities, hazards, and areas and objects requiring special protection. This information will be kept current and made available to local and park fire personnel.

- Park and local fire personnel will be advised of the locations and characteristics of cultural resources threatened by fire, and of any priorities for protecting them during any planned or unplanned fire incident. At parks with cultural resources, park fire personnel will receive cultural resource protection training. At parks that have wildland or structural fire programs, cultural resource management specialists will receive fire prevention and suppression training and, where appropriate, will be certified for incident management positions commensurate with their individual qualifications.

- Smoking will not be permitted in spaces housing museum or library collections, or in historic structures (except those used as residences in which smoking is permitted by the park superintendent).

4. *Which Director's Orders address protecting museum collections?*

Several Director's Orders contain instructions related to protecting museum collections.

Director's Order #9: Law Enforcement Program, vests considerable authority and responsibility in law enforcement staff for protecting park resources, including museum collections. It tells you to inventory your resources and prioritize protection needs after you assess their significance and vulnerability. It also discusses crime prevention and physical security programs in parks.

Director's Order #28: Cultural Resource Management and Cultural Resource Management Guideline, Release No. 5 (1997), which implements Director's Order #28, addresses protecting and managing all cultural resources, including museum objects.

- *Chapter 4* provides overall guidance on protecting cultural resources. The sections on physical security and structural fire relate to protecting museum objects.

- *Chapter 9* says a systematic approach to protecting museum objects involves:

  – identifying and evaluating threats and risks

  – conducting and reconciling annual inventories of collections

  – developing and implementing good operational procedures and practices, such as key control, access control, and opening and closing procedures

– evaluating the physical security of spaces housing collections, with attention to barriers, cases, locks, doors, and windows

– installing intrusion detection systems and fire detection and suppression systems that are appropriate to the nature of collections and the structures housing them

– incorporating the special needs of collections in physical security plans, structural fire plans, and emergency operations plans

– ensuring that all incidents involving collections are reported

Director's Order #44: Personal Property Management and Personal Property Management Handbook #44, Section 9.3 governs firearms and ammunition that are part of a museum collection.

Director's Order #50B and Reference Manual #50B, Occupational Safety and Health Program state the installation, inspection, and maintenance of fire sprinkler systems, fire alarm systems, life safety systems, smoke detectors, fire extinguishers, and other fire protection features will be in accordance with National Fire Protection Association (NFPA) requirements.

Director's Order #58 and Reference Manual #58, Structural Fire Management tell you how to manage a structural fire program. Structural fire management is defined as the protection of people, content, structures, resources, and the landscape surrounding the structure from the effects of fire.

C. Measuring the Effectiveness of a Security System

Past experience is an important element. Complete and accurate loss records, such as Case Incident Reports, are vital. Nevertheless, past history does not tell the whole story. You also must:

- analyze the risk comprehensively
- evaluate the effectiveness of the countermeasures intended to reduce the risk
- determine how well the security system fits the operational needs of your park

All the elements are important. And remember, a system that reduces risk but paralyzes operations is not effective.

1. *What are the threats to museum collections?*

Figure 9.2 lists the threats to museum collections.

General Category	Specific Threat	
Crime	Burglary Robbery Vandalism	Larceny Bombing Arson
Civil Disturbances and Warfare		
Natural Catastrophes	Earthquake Landslide Hurricane Tidal wave Volcanic eruption	Flood Fire Tornado Lightning Wildlife
Industrial Disasters	Explosion Structural collapse Hazardous materials release Fire Serious employee or visitor accident Nuclear incident Power outage Loss of water, sewer, or gas service	
Other Threats	Accidental damage Acts by disturbed persons Transportation accidents	

Figure 9.2. Threats to Museum Collections

2. *What is risk assessment?*

In assessing risk, you must analyze a threat's probability of occurrence and the severity of its consequences. You'll need to identify the possible ways losses can occur, what the impact of the losses would be, and how you prevent or reduce the losses.

Probability

While the number of potential threats is unlimited, some are more likely than others. In general, the more ways something can happen, the higher the probability it will happen. For example, consider a park with an extensive collection of Native American artifacts--pots, baskets, and other easily sold items. If the threat is theft, any of the following conditions, or some combination, increase the probability of a loss:

- Pots and archeological fragments on exhibit are not in locked exhibit cases.
- Objects on display are not routinely inventoried.
- There are no procedures for temporarily removing objects from exhibit cases.
- Exhibit cases have plain glass and standard fasteners.

- Exhibit spaces have large windows close to the ground.
- Door locks are not strong enough to prevent forcible entry.
- The building is not protected by an intrusion detection system.

Some threats are unlikely in some parks. For example, a park in New Mexico doesn't need to plan for a tidal wave. Some threats just seem unlikely. For example, a 500-year flood may seem to be a remote threat. But if we remember that the objective of the NPS preservation program is to preserve museum objects and historically significant structures for as long as possible, a 500-year flood is a threat that deserves thoughtful planning.

Severity

Highly probable threats may not require much in the way of preventive measures if the net loss or damage they would cause is small. On the other hand, moderately probable or greater threats demand greater attention if the impact would be great. For example, it is highly probable that someone will take the ball point pen from a visitor registration desk, but it is more cost-effective to use cheap pens, and replace them, than to prevent the loss. On the other hand, a low to moderate probability of arson in an historic structure demands full protective measures because the impact could be significant.

You can measure the impact of a loss by the direct cost, or dollar value, of the lost or damaged property and the cost of its repair or replacement. Direct cost is quantifiable and can be used to evaluate the cost-effectiveness of potential countermeasures. However, it may not be the most important measure, because the indirect costs may have a more severe impact on the park's mission. Indirect costs could include:

- effects on employee morale and reputations
- effects on public relations
- loss of donations to parks that do not protect their assets
- adverse impacts on the park's interpretive program

For example, a soldier's diary may have little dollar value, but it can play a significant part in telling the story of how the soldier lived and how soldiers in general took part in the development of the country. The diary serves both as an information resource and as a tangible point of reference to help visitors relate to the story. The fact that the diary is an original object enhances the relationship. If the diary is stolen, the interpretive story suffers in ways that cannot be translated into dollars.

3. *How do I conduct a risk assessment?*

First, you need to identify the potential threats or hazards that have the greatest probability of occurring and those with the greatest adverse impact on the museum collection.

Then look for irreplaceable, valuable and particularly sensitive objects, especially those on exhibit, such as historic firearms and paintings.

Finally, analyze the nature and effectiveness of the protection currently given such objects. For example, if you want to assess how well an object is protected from theft, try to think like a thief.

- A thief has to touch an object with something--hand, stick, wire hook, an accomplice--to steal it. Look at obvious ways first. In one theft from a park, the thief removed a diary from a case by tilting up the unsecured vitrine cover.

- If the case is small or poorly mounted, the thief might take both the case and the object in it. Look carefully at how cases are mounted. The case may be strong, but the wall mounting may be weak so the thief can pull the case off the wall, or remove it by taking out a few fasteners. So ask yourself:

  – Are doors and cases locked?

  – Are cases structurally sound?

  – Are fasteners firmly in place?

- After checking the obvious, be creative. A thief is not restricted by our concept of what someone might do, only by what it is possible to do. In one incident, a thief boosted a small child over a Plexiglas™ barrier that covered all but a small space at the top of a door into a period room. The child gathered objects and escaped through another door.

4. *How can I limit the risk?*

If possible, eliminate threats; if not, reduce them by:

- ***Risk Assumption*** is the process of using existing resources to absorb losses as and when they occur. It may be appropriate under the following conditions:

  The impact of a loss is small. For example, it is advisable to assume the risk of some forms of vandalism.

  The likelihood of damage is small. For example, it takes considerable effort to damage a stone-grinding wheel. Even if the grinding wheel is original to the site it may not make sense to exhibit it in a case, or even in a building, when it is easier to see outside and the wheel's size and composition make it nearly indestructible.

- ***Risk Transfer*** is the process of transferring a risk to another entity for a fee. It is usually not appropriate because the NPS generally insures property only when it is borrowed from someone outside the government or another government agency.

See the Museum Handbook, Part II, (MH-II) Museum Records, Chapter

4, Inventory and Other Special Instructions for guidance on insuring borrowed objects.

5. *How often should I assess risk and what tools are available?*

Director's Order #24: NPS Museum Collections Management requires parks and centers to keep the NPS Checklist for Preservation and Protection of Museum Collections (Checklist) up-to-date in the Automated Checklist Program (ACP) in ANCS+. The Checklist records information on preservation and protection conditions (including fire and security protection) in parks and centers, identifies deficiencies, and provides estimated costs to correct deficiencies. You can use the checklist to conduct a self-assessment of your park's level of museum security and fire protection. See Appendix F: NPS Museum Collections Management Checklists, and the *Automated National Catalog User Manual*, Appendix G: Automated Checklist Program, for guidance on the checklist.

6. *How do I conduct a self-assessment?*

Conduct a ***Basic Security Inspection*** by using the checklist as a guide to inspect museum collection spaces. There are three steps in this inspection.

- Describe the nature of the museum collection, to include:
  - types of materials used, such as paper, wood, or stone
  - value of objects (for example, monetary, research, interpretation)
  - most significant objects in the collection (for example, letter signed by President Truman)

See the NPS Museum Handbook, Part II, (MH-II) Chapter 4: Inventory and Other Special Instructions, Section IX, Determining the Monetary Value of Museum Objects, for guidance in establishing value.

- Identify the areas where the collection is kept (such as visitor center exhibit, storage), especially the most valuable and most vulnerable objects.
- Inspect for deficiencies using the NPS Checklist for Preservation and Protection of Museum Collections.

7. *What is a security survey?*

Use a ***security survey*** in the on-site phase of preparing a Collection Management Plan or as a specific need in a self-assessment inspection. Do not forget to include fire protection.

A comprehensive security survey will cover:

- perimeter security
- structures housing the collection
- policies and procedures

- emergency plans
- individual object protection
- fire prevention
- personnel training programs
- structural and procedural fire hazards
- maintenance of protective systems

Either you or a contractor can conduct the survey. Whoever does so must have the following qualifications:

- experience and expertise in protecting museums and historic sites
- sensitivity to the special protection requirements in museum operations
- practical experience in applying the requirements in parks and historic sites

8. *How should I prepare for a survey?*

Write a detailed scope of work (SOW) that serves as a blueprint for the survey and as a standard against which to measure the surveyor's work. See *MH-I*, Appendix G: Protection of National Park Service Museum Collections, for a sample SOW. The scope of work should specify what the surveyor is expected to do, and when, and how to report results.

Make sure all facilities with museum collections will be available during the survey. Brief park staff on the importance of the survey and ask everyone to answer questions candidly.

Prepare the following documents for the surveyor:

- most recently-completed NPS Checklist for Preservation and Protection of Museum Collections
- reports from any earlier security surveys
- plans and drawings of all facilities that house museum collections on which the surveyor will record observations to be included with the final report
- information on installation, operation and maintenance of the existing intrusion, fire detection, and fire suppression systems

Schedule meetings with the superintendent and key security, fire protection, and museum staff at the beginning of the survey to discuss its scope and at the end to discuss findings and recommendations. Also, schedule blocks of time for key staff members to spend with the surveyor during the site visit.

9. *What should the survey*

From the site visit, the surveyor will:

report include?

- identify potential threats
- perform a risk analysis
- determine which losses are most likely and which would have the greatest impact
- establish priorities for correcting deficiencies

The final report should include:

- recommended improvements
- countermeasures that correct more than one problem
- alternatives for correcting deficiencies
- estimated cost for each recommended action

10. *What is the final and most important step?*

The last and most important part of your security survey will be the corrective action plan you will develop and implement afterwards. Take corrective actions that do not require funds, such as changing operating policies or procedures, immediately. Changes that can be made at a small cost also should be made relatively soon, while changes that require significant funding must be programmed. See *MH-I*, Chapter 12: Curatorial Programming, Funding, and Staffing, for guidance on programming. Naturally, if money is available, the most serious deficiencies should be corrected first. If funding is a problem, many corrective actions can be implemented in stages, or you may want to use the funds that are available to correct several less severe risks. The combined improvement from correcting several small problems can often outweigh the effect of correcting one large one.

If you discovered weaknesses in your security system, your corrective action plan should have taken care of them. If on the other hand, your security system works, stick with it, make minor improvements on the margin, and continue to self-assess on a regular basis.

But what if you need a new security system, in whole or part? The sections that follow in this chapter will help you design effective fire protection and security systems.

D. Fire Protection

See Chapter 9: Museum Fire Protection.

E. Operational Security

When designing a new security system, or redesigning your existing one, you will want to reduce or remove the risks you have identified. Then you can develop and implement your day-to-day operating procedures, as well as your emergency procedures. Finally, you will need to train the staff on the new or revised system.

1. *What are some of the*

The value of cooperation in security planning is never more apparent than *design issues I should consider?*

in the design phase of a new project--a new exhibit, a new storage facility, or refurnishing and restoring a historic structure. Working together, curators, security specialists, architects, engineers, exhibit designers, historic preservation specialists, interpreters, maintenance personnel, and fire safety professionals often can resolve security issues before they become a problem. Before you start work, prepare a written list of minimum security standards to include:

- proximity of staff to the exhibit area
- tours--size, type (self-guided versus staff-guided) and tour route
- proximity of exhibit objects to the tour path
- features that limit public access to exhibits

> ***The Architectural Barriers Act of 1968, Section 504, and the Americans with Disabilities Act of 1990 require museums to be as accessible as practicable, both architecturally and programmatically. The NPS has installed equipment to make structures accessible to the mobility-impaired. In some historic structures, for example, access equipment is located out of public view to minimize the visual intrusion, and disabled visitors are routed through otherwise closed spaces. In the rare instances where an alternative access route goes through exhibit spaces, the planning team must consider the impact on the security of exhibit objects and their vulnerability to accidental damage.***

- security issues raised by making exhibits accessible for people with disabilities
- vulnerability of exhibit objects to theft, vandalism, touching and accidental damage

You should resolve these and any other security issues before the design is approved to avoid the need to make costly corrections later.

Be aware that technology is developing so fast in some areas (such as computers and detection systems) that it may make sense to select the technology as close as possible to completion of the project, provided this does not require significant changes in the structure.

Finally, document **all** decisions.

2. *What should I cover in our day-to-day operational policies and procedures?*

The need for these detailed, day-to-day policies and procedures is to control access to vulnerable objects, a key element in your security program. The key in protecting museum collections is to allow reasonable access without creating undue risk. How? By controlling legitimate access while preventing unauthorized or unnecessary access.

Security programs depend on trusted agents, such as our Park Service employees, but even so, one individual should not have the freedom to care for and account for museum collections without routine oversight by someone who understands the system well enough to spot discrepancies. Your access control policy must include inspection, oversight, and audit safeguards to reduce the risk.

3. *What should I include in an access policy?*

When writing an access policy, include the following elements:

- statement of purpose
- general access procedures
- general guidelines for employees, scholars, researchers, visitors, service vendors, emergency response personnel, and others who are eligible for access to the museum collections
- conditions that justify access
- superintendent's signature

See *MH-I*, Appendix G: Protection of National Park Service Museum Collections, and *MH-II*, Appendix D: Museum Archives and Manuscript Collections, for sample access policy and procedures.

4. *What else should I do regarding access?*

- Know the people who have access to the collection. The more access someone has, the more you should know about him or her.
- Look for other ways for the person to accomplish his or her objective without allowing access to original pieces.
- Specify how someone receives authorization for access to collections:
  - Who is authorized to grant access?
  - How much access can they grant (i.e., escorted, unescorted)?
  - What justifies granting access?
  - When are escorts required?
- Keep access lists up-to-date and make sure they are used routinely.
- Specify minimum parcel control procedures:
  - Limit the size of parcels visitors are allowed to carry into collection areas (anything larger than 11" X 15" can be a problem).
  - Search parcels larger than 11" X 15" if they are taken into research or non-public areas by non-employee researchers.
  - Use property passes to identify personal property taken out of the building by employees.

5. *Why should I be concerned about key control?*

Barriers and locks are the most common tools used to accomplish the objectives of your access control policy. While keys are a symbol of trust, as well as a way of controlling access, the key as status symbol sometimes overrides the importance of the key as a tool for access control.

The fewer keys there are, the better.

- Keys multiply over time, particularly at the master and grand master levels. Unchecked, this quickly compromises the access control program.
- Good key control requires ongoing maintenance and cooperation by all staff.
- Lost or stolen keys to museum collection spaces, such as storage or exhibit cases, increase the risk of loss.
- Lack of accountability invites unauthorized possession and duplication of keys.

6. *How do I control keys?*

Ask your superintendent to sign written procedures that:

- Designate one person as responsible for controlling keys, including issuing or transferring keys, having keys made and inventorying keys annually.
- Designate, by name, those authorized to have keys to museum collections storage spaces and exhibit cases.
- List the responsibilities that go along with having park keys:
  - safeguarding keys
  - reporting lost keys
  - returning keys when they are no longer needed
- Require a signed and dated Receipt of Property Form, DI-105, or its equivalent, when keys are issued.

7. *What should I do to safeguard keys?*

First, decide where and how to store spare keys and operational keys that remain on-site; then, think about off-site concerns.

In an ideal world, no keys would leave the park, but this is almost never possible, therefore:

- Designate which keys employees can take off-site.
- Specify limitations on taking keys off-site (overnight versus a two week vacation).
- Restrict the number of keys that leave the park, and be sure that grand

master keys <u>never</u> leave the park (if lost or stolen the whole key system is compromised).

- Place keys to museum exhibit cases and specimen storage cabinets in a key cabinet (located in museum storage, where possible) or some other appropriate locked container at the end of each day.

- Limit access to the curatorial key cabinet to the curatorial staff.

- Keep other keys in a key cabinet in a protected space that is convenient for opening and closing.

- Lock up any keys that are not in use.

- Store spare removable cylinder cores and core removal keys in a safe, preferably separate from key blanks.

8. *What about access to keys in emergencies?*

Specify in your key control policy who may obtain keys in an emergency, how to get them, and where they are kept.

9. *How do I ensure accountability?*

- Develop audit and inventory procedures.

- Report results of the inventory to the superintendent.

- Review key control records annually to make sure they are current.

- Make sure all museum keys are returned by transferring museum employees.

10. *What should I do if a key is lost or stolen?*

When a key is lost or stolen, the only sure way you can protect the facility is to rekey every lock it opens. If the missing key is a master, or grand master, then you should rekey all the locks.

11. *Are combination locks better than keyed locks?*

Combination locks have many applications. File cabinets and secure areas used by a large number of employees often have combination locks. The gate to a vehicle storage area is an example. Other applications include very high security areas, such as safes and vaults, where the physical existence of the key poses a threat because of its vulnerability to loss, theft, or unauthorized use.

Combination locks have advantages and drawbacks. For example, while it is easier and less costly to change a combination than to rekey a lock, these locks can also be greater security risks. Why? Because many find it difficult to remember random number combinations. They:

- write down the combination (a quick look around a safe or file cabinet often turns up the combination written on something close by),

- use number combinations that are easy to defeat, or

- use birth dates or other number combinations easily associated with the safe's custodian.

Because of such security concerns, be sure that you change combinations annually, or when anyone with the combination transfers or quits, or whenever evidence suggests the combination has been compromised.

Also, you will want to seal a written record of the combination in an envelope designed to show evidence of tampering and keep it in another safe. Finally, do not forget to protect change keys/wrenches and the instructions for changing combinations from unauthorized use.

12. *What should I include in opening and closing procedures?*

The best access and key control programs in the world are of no value if you do not open or close the facility properly. Written opening and closing procedures provide a checklist for transitioning from one condition to the other and, at a minimum should:

- Identify who may open or close.

  If you designate who has authority to open a building or controlled area, you establish both the responsibility and the authority to control access.

- Specify locking and unlocking sequences and paths.

  There should be a clearly defined entry and exit procedure. The person opening the building should enter at a designated point, and the person closing the building should leave the same way.

- Require checking for stay-behinds.

  Don't forget to inspect the building for someone trying to stay behind after closing.

  – Buildings often have places someone can hide (closets, stairways), so the first step to prevent a stay-behind is to keep potential hiding places locked while visitors are in the building.

  – For potential hiding places that cannot be locked, consider local daytime intrusion detectors to alert staff when someone enters them.

  – When closing the building it is important to search it in a systematic way--start at the top, work down and out.

  – Where possible, lock areas of the building as they are inspected to prevent someone moving back into a space after it is inspected.

  – Written procedures should highlight vulnerable areas for special attention.

  – It may be possible in a large building to activate the intrusion detection system by areas to detect someone trying to get back into an inspected area.

See *MH-I*, Appendix G: Protection of National Park Service Museum

Collections, for sample opening and closing procedures.

13. *What else should I include in the opening and closing procedures?*

Opening and closing procedures should include:

- Alarm system information--include arming and disarming sequences.

Don't include alarm codes in the written procedures.

- Doors and windows to be opened and closed.
- Mechanical system information--how to activate and secure, systems that should be on when the building is open and off when it is closed, location of controls, and how to operate them.
- Potential fire hazards--locations of coffee pots, hot plates, and other heat producing devices (<u>all</u> of which should be turned off and unplugged at the end of the day).
- Opening procedures, such as the need to:
  - look for signs of unauthorized entry or theft
  - inventory particularly valuable or sensitive objects
  - check for unusual conditions (e.g., leaks in roof)
  - make sure all objects on exhibit are in place
  - make sure cases are locked
- Other site-specific conditions that require attention.

14. *What about the park's crime prevention and physical security plans?*

The park's crime prevention program should include:

- leadership and participation by management in developing and operating the security program
- regular security surveys by qualified personnel and provisions for corrective actions
- orientating and training all employees (permanent, temporary, seasonal, and volunteers) in security awareness, with emphasis on each employee's security responsibilities
- an appropriate level of security for all park property-- including museum collections, capital equipment, supplies, buildings, money, firearms, and historic sites, monuments, and ruins
- procedures for guides, reception desk personnel, and cashiers to surreptitiously summon help in an emergency or when a visitor becomes unruly

- an annual review of the park's crime and security problems followed by implementing preventive measures
- appointing a full time or collateral duty Physical Security Coordinator

15. *What should I include in the Emergency Operations Plan?*

Be sure that protecting the museum collection is in the park's Emergency Operations Plan (EOP). See *MH-I*, Chapter 10: Emergency Planning, for guidance on museum collections emergency planning. Staff should be trained to act promptly in an emergency and should be prepared to remove museum collections after seeing to the safety of visitors and other staff.

The Emergency Operation Plan should include specific information regarding:

- command and control
- controlling access in an emergency
- location of emergency keys
- inventory and location of emergency supplies
- location and operating instructions for fire extinguishers, fire alarm equipment and other fire suppression and emergency response equipment
- emergency telephone numbers for assistance--both on-site (curators, conservators) and off-site (regional/SO personnel, other cooperating agencies and institutions, commercial recovery firms, and emergency response personnel)

16. *What should I include in staff training?*

The final and most important element in your operational security program is staff training. Written policies and procedures are valuable only if all employees know what they are and how to implement them. Staff training should be specific and cover all basic security practices. Hold mandatory training sessions regularly.

Be sure to include these topics in the training:

- importance of routine security measures, such as locking doors and windows when the building is unattended
- importance of routine inventories of objects on exhibit and in storage
- reminder that theft is preventable
- reminder that most thefts are spontaneous events that occur because of simple oversights
- importance of maintaining the integrity of non-public spaces by challenging those who are not members of the staff when they are in

these areas without an escort

- fire safety
- routine and emergency operations
- use and maintenance of equipment

17. *Where can I get help?*

For additional information, contact your park or regional/SO protection staff and regional/SO curator. You can also consult:

- The security or protection services departments in most large museums, such as the Smithsonian Institution, for advice and answers to specific questions.
- The American Society for Industrial Security's (ASIS) Standing Committee on Museum, Library and Archive Security. Members of the Standing Committee will give advice on specific problems. Call ASIS headquarters at (703) 519-6200, or visit their website at <http://www.asisonline.org>. You can also order their publication *Suggested Guidelines in Museum Security.*

F. Physical Security

While the previous section of this chapter discussed the concept of designing for security, this section examines the specific physical security elements you can use to satisfy your security standards. You can also incorporate these elements into existing facilities to help remove or reduce threats.

1. *What is physical security?*

Physical security includes all measures intended to prevent acts of violence against persons and destructive or unauthorized access to or removal of property. Physical security elements deny, delay, or discourage criminal acts, and are the means for achieving the objectives of the access control policy.

Physical security is a **crime prevention** tool. Three factors have to be present for a crime to occur:

MEANS + MOTIVE + OPPORTUNITY = CRIME

The criminal brings **MEANS** and **MOTIVE** to the crime. There is little we can do to remove them from the equation. We can use physical security measures, however, to remove or limit **OPPORTUNITY**.

2. *What are the tools of physical security?*

There are many, but the primary ones are:

- barriers
- locks
- lights

3. *Why do I need barriers?*

Barriers limit access by delaying the intruder, by making the intruder visible, or both. Given enough time a determined person can breach the most elaborate barrier, but you can discourage entry by increasing the time it takes and the chances of being seen, and by encouraging the thief to look for an easier target elsewhere.

Typical barriers might include:

- Park boundaries
  - natural barriers (e.g., ravines, mountains, water)
  - fences
  - well lighted open spaces
- Building structure
  - walls
  - foundations
  - roof
  - doors
  - windows
- Interior barriers
  - storage rooms
  - cabinets
  - vaults and safes
  - cases
  - temporary or permanent exhibit barriers

4. *How many barriers are enough?*

Figure 9.1 illustrates how you can use barriers to protect valuable objects:

- Add barriers, like the rings of the bull's-eye, to protect high value objects.
- The more valuable the object, the more rings you need.
- There have to be enough barriers to delay entry until the responder arrives.

5. *Why do I need locks?*

Properly designed and installed locks are one of the first lines of defense in a museum protection program. The locking system should not rely on

- warded locks
- spring latches
- deadbolts less than ¾" long
- key-in-knob locks
- locks installed with screws ½" or less in length

> ***A lock is no better than the door it is on or the strike and jam the bolt fits into, and even the best quality lock is of little value without an active key control program.***

Most historic structures have old style locks on exterior doors. Authenticity considerations do not allow changing to modern locks in most cases. Where this is true, the park should include additional protection features, such as alarms, to supplement the locks.

6. *What criteria should I use in selecting locks?*

An effective locking system must fit the needs of the park and of the space it protects. Many types of locks are available, but they are not all equally effective in all circumstances. Isolated spaces and high security areas need heavy-duty locks.

7. *What is required for museum storage spaces?*

Museum storage spaces should have <u>metal</u> or <u>solid-core</u> wood doors. Each door should have:

- a dead bolt lock
  - 1" or longer bolt
  - exclusive non-mastered key code
- hinges located with pins are on the secured side of the door (When this is not possible, spot-weld the hinge pins so they cannot be removed, or replace the existing hinges with hinges that have non-removable pins.)

You may want to use a proprietary or regionally propriety keyway--a lock system with a keyway the manufacturer guarantees not to sell to anyone else within a specified area. Keys for a proprietary keyway must be made by the manufacturer, or the park must purchase specialized key cutting equipment. The advantage is that the local hardware store cannot duplicate the park's keys.

8. *Why is an effective lighting system important?*

Good lighting makes criminals nervous because it increases the chances of detection and identification. It has the opposite effect on employees and the public. Light increases the public's perception of the safety of an area and lets law enforcement patrols see what's going on and detect the physical signs of a break-in.

It is not the intensity of the lighting as much as the evenness of the illumination that makes a lighting system effective. The area should be free of glare and shadows. Lights close to structures should illuminate toward the structure, not out and away from the structure. A properly designed

lighting system eliminates hiding places and facilitates the ability of security patrols to observe.

9. *Is lighting always necessary?*

Under some conditions lighting may attract unwanted attention to the site. In isolated rural areas, for example, a well-lighted building in an otherwise dark landscape makes an attractive target. Some parks have found that lighting remote parking lots also can bring unwanted visitors, making the lots a local hangout. In both cases, you may want to use time-clocks so the grounds or parking lots are lighted when legitimate visitors are using them, but dark afterward.

10. *What about light for closed circuit television (CCTV)?*

Exhibit areas and visitor centers may use closed circuit television (CCTV) as a protection and control tool. A video recorder makes CCTV useful for after-hours protection by visually documenting unusual conditions. CCTV is also useful to those responding to intrusion or fire alarms. The cameras provide a quick way to survey a large building.

If exhibit objects could be damaged by light, cameras are available that need little background illumination. Infrared illuminators also are available to boost the efficiency of CCTV cameras where visible light levels must remain low.

Where CCTV is part of the protection system, after-hours lighting is an important consideration.

- Motion detectors can turn on lights and the VCR.

- In a large building, you may want to have central light controls, so specific areas, or the whole building, can be illuminated at once. Low voltage remote control switches are well suited to that purpose.

11. *What is the value of human presence?*

A human presence or response is a critical element in any physical security system. The mere presence of a person on the site is a deterrent. Of more importance, however, is a prompt response by a trained person when an attempt is made to breach the physical security of the site.

12. *Where can I get help?*

Refer to the following resources for additional information:

- NPS law enforcement and physical security specialists.

- Your regional/SO curator.

- The security or protection services departments in most large museums, such as the Smithsonian Institution, for advice and answers to specific questions.

- The American Society for Industrial Security's (ASIS) Standing Committee on Museum, Library, and Archive Security. Members of the Standing Committee will give advice on specific problems. Call the ASIS Headquarters at (703) 519-6200, or visit their website at <http://www.asisonline.org>. You can also order their publication *Suggested Guidelines in Museum Security*.

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G. Electronic Security Systems

Electronic systems (e.g., CCTV, alarm systems) are only extensions of staff eyes and ears; they only provide information. There are four important questions you should answer before selecting an electronic security system to protect museum collections.

- What is the threat?
- How vulnerable is the collection?
- Are there restrictions on the installation?
- What should the system do?

1. *What is the threat?*

Learn as much past history as possible about thefts, acts of vandalism, accidental damage, and wear and tear on furnishings.

2. *How vulnerable is the collection?*

Go through room by room and identify museum objects that are vulnerable to theft, accidental damage, and wear and tear from visitor touching (whether purposeful or inadvertent).

3. *Are there restrictions on the installation?*

With the range of technology available, devices in period rooms do not have to be intrusive. Some security specialists argue that making detectors visible acts as a deterrent. Others make the case that visible detectors give away valuable information a thief can use to defeat the system and allow the potential burglar to spot weak points. Management has to make the final decision based on the level of the threat, the value and vulnerability of the collection, and the interpretive objectives. There is no completely right or wrong answer.

If you do use visible detectors, there are several things that can be done to minimize the information the potential thief can get while walking through the building.

- Mix visible and hidden devices. Visible detectors signal the would-be thief that there is a protection system, while the hidden devices provide back-up if the thief tries to exploit perceived weaknesses.

- Many parks leave the walk-test lights active on motion detectors. These lights are there so the installer can test the detector and measure the area it covers. Active walk-test lights give the same information to a would-be intruder. There are two schools of thought on how you might protect a space with motion detectors: position detectors to cover areas the intruder most likely will cross (creating traps), or install enough detectors so the intruder cannot move more than 6" undetected anywhere in the space.

  As an added deterrent, you can also leave walk-test lights active where there is 100% saturation coverage, although such coverage is expensive and more intrusive in a period room. Designers usually specify saturation coverage for vaults and other highly protected spaces.
  Where detectors create traps, the walk-test lights should be disabled. On most detectors this involves changing a switch or jumper wire inside the detector. Follow the instructions that accompany the detector. If all else fails, a piece of tape covering the light serves the same purpose.

- Damage to historic fabric

  - Be sensitive in placing security devices so as to prevent unnecessary damage and ensure that necessary damage is repairable.

  - Be aware of vertical and horizontal spaces where installers can run alarm wire.

  - Know if other work is planned that will open walls or ceilings. This may help with the placement of detectors.

  - Where physical or aesthetic considerations limit the ability to run wire, consider using wireless alarm devices so you don't have to penetrate surfaces. A combination of hard-wired and wireless devices may be optimum in many historic buildings.

- Placement of furnishings

  - The location of furniture in a room greatly influences the type and location of detectors that will be appropriate. Furniture can block a detector, making it ineffective, or, used properly, furniture can help disguise a well-placed detector.

4. *What should the system do?*

- If you install a **daytime alarm system**, is it more important to deter the act or catch the person who commits the act? If deterrence is preferred—as it normally should be—the design will include audible and visual indications that the act has triggered an alarm. If apprehension is preferred, audible and visual alarms may defeat the purpose.

- A **nighttime alarm system** has both deterrent and apprehension objectives. First, decide if a silent alarm, that summons law enforcement personnel, or a noisy one, that both summons law enforcement personnel and draws attention to the site, is the most effective.

  A silent intrusion detection system is more likely to lead to catching the intruder. And, in a populated area, an intrusion detection system sounding a loud horn or turning on lights may scare the intruder away empty handed. The determining factor should be a reasonable estimate of how much time the intruder needs versus the length of time before someone notices the alarm and takes action to stop the theft. If it only takes a few minutes, then doing everything reasonable to prevent the loss must take precedence over apprehension.

- **Personal Protection Alarms** allow people working in the building the ability to summon help quickly and silently, especially where assault, robbery, or harassment is a threat. (The reception desk in an urban park headquarters building located in a high crime area is a good example.)

  Personal protection alarm systems (duress or panic alarms) can use small push-button radio transmitters, worn either as a pendant around the neck or on a belt, for protection of staff members who must move around in the course of their work, or fixed position transmitters for personnel at fee collection or sales shop cash registers.

5. *What factors influence a system's design?*

- Know who the responders are, where they are located, and the resources they have.

- Know how long it will take the responders to get to the site at different times of the day. Many jurisdictions have more police on duty between 4:00 p.m. and midnight than other times, but they are busier during that period. Rural areas may have only one or two officers on duty, each covering many square miles of area.

  Where response time is long, the security system must include both electronic and physical security elements to be effective. If it takes the first responder 15 minutes to get to the site after the alarm sounds, then, to prevent the thief from taking an object it must be physically impossible to remove it in less than 15 minutes:

  – It must be large and heavy enough to delay removal.

  – It must be located in a room or vault that will withstand a determined attack for more than 15 minutes.

  – It must be in a case that can withstand attack until help arrives.

  – It must be some combination of the above.

Otherwise, the alarm only indicates someone entered the building and something may be gone.

- Think about what the responders know about the site. Consider access to the site, familiarity with the physical layout, and the responder's general level of training..

- Decide what information is needed by thinking about what will be done with it. Electronic systems provide all kinds of information. The more complex the system, the more costly it is to maintain, and the more important it is to maintain it regularly. Just as you would not under design an electronic security system, do not over design it.

- Determine the system's operating parameters. Some objects on display may need 24-hour individual protection. Value, replaceability, sensitivity to controversy, ease of sale, and vulnerability to damage. Precious metals, gems, firearms, edged weapons, currency, coins, jewelry, original documents, rare books, and stamps are all candidates for 24 hour protection systems.

- Identify how you will need to change operations. You can determine which changes are necessary by considering these issues:

  – Electronic systems complicate access, even for authorized personnel.

  – Electronic systems create the need for additional staff training.

  – Someone has to manage the electronic system.

  – Those operating, managing, and maintaining sophisticated electronic systems need different skills than those using less complicated systems. An electronic system may, in some cases, require more staff.

  – It is very expensive to contract out all routine maintenance and minor repairs. If no one in the maintenance division can take care of them, money must be programmed into the budget, or someone must be trained, or both.

- Consider the following park specific issues:

  – The schedule for opening and closing the structures when staff arrive and depart, and visitor hours.

  – The procedures and staffing needed for opening and closing the structure.

  – The number and location of people on duty at any given time governs the nature of the response to daytime alarms and influences where and how to display the alarms.

  – The visitor tour path and direction, the number of persons on a tour, and the number of staff with each tour group help determine daytime alarm needs.

When all visitors are in tour groups, closely monitored by staff at all times, there may be less reason to install sophisticated alarm devices. However, when visitors wander freely through a structure, and there are not enough staff to provide surveillance, electronic protection for objects becomes more important.

– You need to know the parts of the structure that are off-limits to visitors. Define the nature and level of access control needed in those places, and identify who is allowed in and under what circumstances. Provide information about physical access control measures, such as locks, and indicate whether to incorporate card readers, numeric keypads, or other devices into the overall alarm system.

- Study the environment. Where the components will be installed determines which technology you select. For example, if the building is reinforced concrete, or has a large amount of metal in the structure (including, perhaps, metal foil backed wall paper) then a wireless system may be a poor choice. Ambient temperature, humidity, and dust levels also are important considerations.

- Consider not only who responds, but also who monitors your system. With CCTV, for example, experience shows that someone can watch a monitor for about 30 minutes before it starts to become part of the visual background. This suggests the person assigned to monitor the system should be rotated every half hour. If not, then the system must include additional devices to identify potential threats and attract the operator's attention, such as a video motion detector.

- Observe the physical characteristics of the exhibit. For example, in a museum gallery where many people are present, color CCTV displays make it easier to distinguish and describe an individual. Where the camera is located in a little-used hallway, however, less expensive black and white monitors are usually sufficient.

6. *What are the types of intrusion detection devices?*

There is no cookbook way to design an effective intrusion detection system. Each protection problem is different, and the design of the intrusion detection system must reflect this. If not, the system will not provide effective protection, or the nuisance alarm rate will destroy confidence in it. Figure 9.5 describes commonly used intrusion detectors, how they detect, where to put them and common sources of nuisance alarms.

Each detector has strengths and weaknesses so an intrusion detection system that relies on one type has all the weaknesses of the detector selected. For example, using only contacts to protect doors, windows, and cases makes the building vulnerable if the intruder breaks the glass in a window and enters through the hole without raising the sash. Glass-break or motion detectors complement and provide back up for perimeter and case protection detectors.

TYPE	WHAT IT DETECTS	WHERE TO PUT IT	COMMON SOURCES OF NUISANCE ALARMS
Passive Infrared (PIR)	• Movement of an infrared heat source (in the range generated by the human body	• Best located so intruder's path of travel crosses the detection zone of the detector; least effective where intruder's path of travel is directly toward or away from the detector. • Aimed at a wall, floor or ceiling with a stable background temperature located within the design range of the detector.	• Heat sources (radiant heaters, hot water pipes, heat supply grills, etc.) • Surfaces heated quickly by the sun (metal doors, large areas of glass, etc.) • Aimed into open space, no stable background within detector range (for example, aiming a detector with a 50' range into a space 75' wide). Hot air moving at the detector's outer range can cause alarms. • Temperature extremes (below 32°F or above 100°F). • Small animals, such as cats, dogs, raccoons, large rats. Birds generally are not a problem. • Large amounts of dust. • Large electric motors, air compressors that cycle on and off.
Photoelectric Beam	• Movement of a solid object crossing the infrared light beam.	• Large open spaces • Out-door applications • Period rooms or other locations where an unobtrusive detector is desirable. The transmitter and receiver can be disguised or mounted inside a wall or other structure, although the transmitter must have a clear path to the receiver. If not hidden or disguised the intruder can step over or go under the beam.	• Birds or large insects. If used outside, set the beam far enough off the ground to let small animals cross the path, or the area must be fenced to keep them out. Stacked arrays or multiple beams can compensate for this. • Accumulations of dust, although more sophisticated devices compensate for gradual changes caused by environmental conditions.
Microwave Motion Detection	• Changes in microwave frequency. The detector transmits and receives electromagnetic energy in the microwave range (radar). Microwaves leave the transmitter, bounce off the target back to the receiver. The detector operates on the doppler effect (the frequency of the microwave energy changes as a target gets closer to or further away from the detector).	• Best located so intruder travels toward or away from the device. A target that stays exactly the same distance from the device, but moves laterally to it, may not be detected. • Can be mounted behind some solids (microwaves will penetrate 1" or more of wood. Useful where visual intrusion is a concern (place detector inside a piece of furniture, behind wainscoting, etc.) • Aimed at a solid structural feature (masonry wall, etc).	• Two devices in the same room operating on the same frequency. (One detects energy radiating from the other, causing unwanted alarms. Not a problem if detectors operate on different frequencies.) • Detector aimed at an outside wall fronting on a busy street, or a thin wall with foot traffic close to the building. • Aimed at a window or glass door. (Glass is invisible to microwave.) • Aimed at objects that move under normal conditions (curtains in the path of an air supply or draft from a door or window, for example).

Figure 9.5. Types of Intrusion Detection Devices

TYPE	WHAT IT DETECTS	WHERE TO PUT IT	COMMON SOURCES OF NUISANCE ALARMS
Ultrasonic Motion Detection	• Changes in high-frequency sound. Similar to microwave, except uses high frequency sound energy.	• Similar to microwave, but does not penetrate solids, including glass.	• Strong air movement. • Aimed at object that moves under normal conditions. Unwanted alarms make these devices unpopular except where used with another technology (PIR or microwave in dual technology devices). Stable when used inside vitrine cases (alarms if cover is removed or broken).
Dual Technology Detectors	• Detector combines two technologies (e.g., micro-wave and passive infrared or ultrasonic and passive infrared), Activation of both technologies needed for alarm. Fewer unwanted alarms when used properly.	• Same general considerations as other motion detectors.	• Environmental conditions or installation that voids one of the detection technologies (see above).
Sonic Sensors	• Sound in the frequency range associated with movement.	• Quiet locations such as inside a vault.	• Vibration, shock, and some ambient noise conditions.
Passive Audio Sensors	• Any sound in the protected space.	• Quiet locations such as inside of a vault.	• Ambient noise.
Contact Switches	• Opening or closing a mechanical switch—includes magnetic door and window contacts, plunger switches, and roller or ball switches. Magnetic contacts are in two parts: a magnet mounted on a movable surface and a switch mounted on a fixed surface. Moving the magnet away from the switch causes the device to go into alarm. Properly installed, they are stable with a low failure rate.	• Doors, windows, hatches, etc. • Exhibit cases, object protection (e.g., plunger switch under a object to detect movement of the object.) • If there is a large gap between the magnet and the contact switch (e.g., the door on an historic building is warped or fits loosely), a larger magnet may stabilize the alarm. If warping at the top and bottom of the door is extreme, install contacts near the latch. • Mount magnetic contacts on top or bottom of door about 6" from the latch edge. • Magnetic contacts mounted on the hinge edge of the door allow the door to open enough to enter without an alarm. Use roller or ball switches for this.	• Flimsy doors that rattle excessively in the wind • Doors that shrink or swell excessively as weather and the seasons change • Wide gaps between the magnet and the contact switch caused by settling of the building • Overhead doors with excess up and down movement when locked.

Figure 9.5. Types of Intrusion Detection Devices (continued)

TYPE	WHAT IT DETECTS	WHERE TO PUT IT	COMMON SOURCES OF NUISANCE ALARMS

TYPE	WHAT IT DETECTS	WHERE TO PUT IT	COMMON SOURCES OF NUISANCE ALARMS
Capacitance Motion Detection	• The device generates a capacitance field 4-6" from the protected object. Detects any electrical conductor that enters the field. • Most sound a local alarm to let the person know he or she is too close. Used to prevent touching--alarm sounds before person touches the protected object.	• Primarily used in museums to protect high value wall hangings or paintings from touching. • Must be used with physical barriers to prevent accidentally getting too close to the protected object.	• Lack of physical barriers to prevent visitors from accidentally getting too close to the object. • Requires frequent adjustment, and is sensitive to humidity and moisture.
Pressure Mats	• Pressure	• Usually placed under a rug or carpet to detect an intruder who steps into the protected space. • Period rooms with a rug or floor cloth.	• Lack of barriers to prevent visitors from stepping into protected area accidentally.
Vibration or Shock Detection	• Vibration or shock	• Attached directly to the protected object, an exhibit platform, or the structure of an exhibit case.	• Vibration from a train, trucks or cars on a busy highway, or an air handler that cycles on and off. Some have adjustments to screen out ambient vibration.
Glass Break Detection	• Frequency Discriminators: A sound detector activated by frequencies generated by breaking glass. • Metallic Foil or Wire: A ribbon of lead foil or small wire that acts as an electrical path. Attaches in a pattern around the outside of a window glass. Breaking the glass breaks the electrical circuit to activate an alarm.	• Frequency discriminators can be concealed near the protected glass. • Foil must be mounted directly to the protected glass (limiting its usefulness in historic houses with original glass).	• Frequency Discriminators: Clicking sounds, such as the sound of a heel tap on a tile floor, air moving through supply and return grills in the HVAC system, pipes heating and cooling, and some equipment noises. • Foil: Accidental damage and damage from water, sun, and temperature changes.
Strain Sensors	• Detects elongation of the under side of a joist, floor, or platform that occurs when weight is applied to the top surface.	• Underside of floors, stair treads, and other surfaces an intruder might walk over. • Under surfaces supporting high value objects to detect removal of the object. The sensor adjusts for weight normally on the surface. After it adjusts, the device alarms if the weight increases or decreases.	• Large animals with access to the protected area.

Figure 9.5. Types of Intrusion Detection Devices (continued)

7. *What are the most common causes of a false alarm?*

There is no such thing as a false alarm. An electronic detection system alarms because something approximates the conditions that one or more of the components of the system are designed to detect.

- If a rat runs in front of a microwave detector, it should alarm. The rat's movement has all the qualities that the detector was designed to detect. The alarm may be unwanted and a nuisance, but it is not false. To stop unwanted alarms like this, either select another type of detector that will not register the movement of the rat, or get rid of the rats!

- Power-induced alarms are unwanted, but power fluctuations can mimic the conditions the system is designed to register. The fix for this problem is to clean up the power supply.

The primary cause is human error. Someone either forgets to turn the system off, turns it on or off incorrectly, or accidentally triggers the system in some other way. The solution is either educating the users better or simplifying the system. Poor system design and lack of maintenance are other causes.

8. *What can I do to reduce the number of false alarms?*

Think about the conditions the system is designed to detect and then look for those conditions or conditions that mimic them. Look for patterns in the alarm records. For example, protection staff at a park noted a passive infrared detector in a loading dock often went into alarm between 6:30 a.m. and 8:00 a.m. Examining the area showed the device was aimed at a metal roll-up door facing east. As the sun came up and heated the door, infrared radiation inside the loading dock put the device into alarm. Repositioning the device cured the problem.

9. *What are other design considerations?*

Electronic access control systems can stand alone, or they can be computer controlled. Some use cards, some use keypads, and some use both. Some can be integrated with a CCTV system. The advantages are:

- You can customize a person's access to a particular area at a particular time. High security areas can be programmed to require two authorized people before entry is granted.

- A lost card can be programmed out of the system and does not have to be recovered (unlike a lock system where a lost key requires extensive and expensive rekeying).

- The system can provide a record of who entered a space and when.

Closed circuit television (CCTV) systems can improve the efficiency of the protection staff. With CCTV one person can monitor multiple and remote locations. CCTV does not replace personnel, however; someone always has to respond to prevent losses.

Lighting is also an important consideration in the design of a CCTV system. See the discussion on lighting in Section F.

Electronic exhibit and case protection systems require technical input from someone familiar with the design of exhibit and case protection systems. Many of the detectors discussed in Figure 9.5 are useful for protecting exhibits and cases. As with intrusion detection systems, there is no cookbook way to protect cases or exhibits.

Alarm response time is critical because exhibit and storage cases are the innermost rings of the bull's-eye. They directly house the objects we most need to protect. When the thief is inside the case or exhibit, the loss is imminent. At that point only the exhibit mounting stands between the thief and the object. If vandalism is the intent, the object will already be damaged.

Electronic system maintenance components are sensitive to heat, cold, dust, lightning, power fluctuations, power outages and mechanical damage, and must have regular routine maintenance to operate as designed.

System maintenance can be contracted out, although as a rule, standard maintenance agreements do not cover damage from electrical power problems, lightning, accidental or deliberate mechanical damage, or natural disasters. Repairs not covered by the maintenance agreement usually are made on a time and materials basis. The alternative is to train or hire in-house staff to maintain the systems.

10. *Where can I get help?*

You can obtain additional assistance from:

- Park or regional/SO protection staff.
- Your regional/SO curator.
- The security or protection services departments in most large museums, such as the Smithsonian Institution, for advice and answers to specific questions.
- The American Society for Industrial Security's (ASIS) Standing Committee on Museum, Library, and Archive Security. Members of the Standing Committee will give advice on specific problems. Call ASIS headquarters at (703) 519-6200, or visit their website at <http://www.asisonline.org>. You can also order their publication *Suggested Guidelines in Museum Security.*
- Barnard, Robert L. *Intrusion Detection Systems: Principles of Operation and Application* 2nd rev. ed. Boston: Butterworths, 1988.

H. Protecting Collections in Transit

Museum objects are at greatest risk when in transit from one place to another. Whether in the custody of a courier, a bonded mover, or the U.S. mail, the act of transporting objects exposes them to risks not encountered in the park. Deciding how to transport a museum object safely, how much protection to provide, and how much it will cost, demands a rigorous analysis of the risk. Consider the following issues before consigning museum objects to a mover.

1. *What are the object's characteristics?*

Consider the object's value (monetary, historic significance), its vulnerability to theft or damage, and its physical characteristics, that limit the appropriate means of transportation such as size, weight, and composition.

2. *What means of transportation should I select?*

Objects that are especially vulnerable to theft or damage or that have significant value should be carried by the most secure means possible. That may mean a courier, a contract carrier, or both.

The most significant threat to an object in transit is a transportation accident. Like a fire, an accident involving the transport vehicle can destroy everything in it. The prospective transporter's safety record should be a significant factor in selecting a carrier.

3. *How should objects be handled in transit?*

Discuss special handling considerations with the transporter. For example, mechanical lifting devices, such as forklifts, should not be used for most categories of museum objects. Spell out these requirements to the transporter in advance.

4. *Is chain of custody important?*

Yes! A courier is the optimum way to handle chain of custody. However, except for very important objects, a courier may not be practical because of the cost. Nevertheless, it is vital to define how accountability transfers from one person or organization to another.

- Establish inventory procedures that do not require the objects to be unpacked when custody changes.

- When the objects are transported by a bonded mover, the contract should state that the driver will not leave the truck unattended for breaks, meals, or any other reasons.

5. *What about intermediate stops?*

Long distance movers often route objects from one place to another by way of central collection points, much as an airline routes passengers to one city via a hub in another. Intermediate loading and unloading of museum objects increases the risk of damage significantly.

If possible, museum objects should be moved directly from point A to point B with no intermediate unloading and reloading. If the values do not justify the cost of direct, non-stop routing, try to keep intermediate stops to a minimum.

If objects are placed into temporary storage along the way, the warehouse should be bonded, and the park should review the warehouse's security procedures.

6. *What about delivery time?*

When the objects reach their destination, someone should be on site to receive them. Specify in the contract that the mover will schedule the arrival of the van at a time when the receiving facility is open or staffed.

7. *Where can I get help?*

- The Registrar's Committee and the Security Committee of the American Association of Museums (AAM) provide specialized publications and referrals. Call the AAM in Washington, D.C. (202-289-1818) for a contact.

I. Reporting and Recovering Stolen Museum Objects

Time is critical after a theft because after only a few hours the likelihood of recovery for most museum objects is very small. Success depends on:

- detecting the loss quickly
- notifying law enforcement agencies rapidly
- providing a detailed description of the objects and, if possible, a photograph

1. *What should I do if I suspect a theft?*

Before calling the police, make sure that a staff member has not moved the object to another location within the park. If you cannot locate the missing object within a reasonable time, call the park law enforcement specialist and the police.

- Secure the area and do not permit anyone to enter.
- Determine exactly what is missing, but do not handle or move anything, or allow anyone else to do so. Consider everything in the area of the theft as potential evidence.
- Locate the following records:
  - Museum Catalog Record (Form 10-254) for each missing object. Make photocopies for use during the investigation.
  - A clear photograph of the missing objects.
- The park's law enforcement officer must complete a Case Incident Record (Form 10-343), with a copy of each relevant museum catalog record attached to the report.

> ***See the NPS MH-II, Chapter 4, Inventory and Other Special Instructions, for guidance on reporting the loss of museum objects.***

2. *How do I report a theft to outside agencies?*

Theft of museum objects and library, archival and manuscript materials is a serious international problem, and only 10 to 15 percent of stolen museum objects are recovered. This is because it is difficult to alert law enforcement agencies outside the area where the theft occurred about the theft. The problem is especially acute when the thief takes the stolen object over a state or international boundary, a common occurrence with stolen museum objects.

You should notify other appropriate agencies and offices as soon as possible after notifying local law enforcement authorities and the NPS law enforcement specialist. It is vital to report <u>all</u> losses, because the more widely a loss is reported, the better the chance of recovery.

Depending on your arrangements with the local police, they may be the conduit for reporting crimes to the Federal Bureau of Investigation (FBI) and to the International Police Organization (INTERPOL). See NPS *MH-II*, Chapter 4, Inventory and Other Special Instructions, Section III, for a list of agencies to which you can report a theft.

3. *How should I handle the news media after a theft?*

Dealing successfully with the news media can help limit the public relations impact of a theft.

- Detail **one** person as the media spokesperson and coordinate **all** communication with the news media through that person.
- Do not discuss details of the theft with the public, news media, or other employees.
- Do not speculate about what happened, what was stolen, or the value of the missing objects.
- Prepare a statement for the news media with general information about the incident, and release it as soon as practical.

J. Museum Collection Records

Museum records are as valuable as any object in the collection and should be just as well protected.

1. *Why are the records important?*

Records, catalogs, and photographs of the park's museum collection are vital for security of the collection. For example, stolen objects are more likely to be recovered if they have been cataloged and if a full description and even a photograph of the object is available for law enforcement agencies.

2. *When should I use the camera?*

Photographs are better for describing and identifying objects than written records.

- Photograph the museum collection, or at least the more valuable or sensitive objects.
- Photograph exhibits, both as a record of the exhibit and as a quick way to inventory objects on exhibit when opening and closing for the day. Consider keeping photographs in a three ring binder as a quick reference for interpreters. Some museums and historic sites keep catalog information about specific objects in the binder as well to help interpreters answer visitor questions about the history of the objects on exhibit. See *MH-II*, Chapter 3: Cataloging, for procedures on cataloging, and Appendix K: Photography, for guidance on photographing museum objects.

3. *Should I review my museum records protection program?*

Yes. Records are vulnerable to a wide range of threats--human error, fire, theft, mildew, mold, pests, paper deterioration, water damage, disasters and electronic media deterioration--and require constant attention.

- Keep duplicates of all museum property records in a secure location off-site. Avoid a location that will be affected by an area-wide natural disaster, such as an earthquake, that would affect both the park and the off-site location.

- Restrict access. Catalog and accession records should not be accessible to visitors, researchers, or non-museum employees except under the close supervision of the curatorial staff. Theft of an object and its associated museum records makes it extremely difficult to trace the object or to prove its ownership.

- Check environmental conditions and make sure there is an active pest management program.

- Keep records away from pipes and out of basements or flood plains. Use water or leak detection alarms where water damage is a potential threat.

- Make sure records are included in disaster and recovery plans.

- Train personnel in proper record maintenance techniques, and check work for accuracy.

- Keep important records on high quality paper (high rag content with alkaline deterioration buffer).

- Make sure electronic media are backed-up, stored properly, and access is controlled.

- Store paper records in a locking, approved UL-Rated Class C or D, as appropriate) insulated filing cabinet.

4. *Where can I get help?*

Consult the following resources for additional information:

- For detailed descriptions and applications guidelines, see the *CRM Bulletin Supplement* by John E. Hunter cited in Section K.

- Your park's fire safety officer, a local fire marshal or an NPS archivist or collection manager.

- NPS *Tools of the Trade* for sources of approved insulated files.

- *MH-II*, Chapter 2: Accessioning, for guidance on protecting museum records.

K. World Wide Web Resources

College and Research Library News (C&RL News): <http://www.rbms.ne.edu/> Includes:

ACRL Standards for Ethical Conduct for Rare Book, Manuscript, and Special Collections Libraries and Librarians, with Guidelines for Institutional Practice in Support of the Standards.
ACRL/SAA Joint Statement on Access to Original Research Materials.
ACRL Guidelines for the Security of Rare Books, Manuscripts, and Other Special Collections.

Museum Security: <http://museum-security.org/>

Fire Safety: <http://www.nfpa.org/>

ExLibris (list serve). Send blank message without signature with the following in the subject line:
subscribe ExLibris Your Name to <listproc@library.berkeley.edu>

Archives (list serve). Send blank message without signature with the following in the subject line:
subscribe Archives Your Name to <listserv@miamiu.acs.muohio.edu>

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NFPA 25: *Inspection, Testing and Maintenance of Water-Based*

Fire Protection Systems, 1998
NFPA 70: *National Electrical Code*, 1998
NFPA 72: *National Fire Alarm Code*, 1999
NFPA 110: *Emergency and Standby Power Systems*, 1993
NFPA 909: *Protection of Cultural Resources*, 2001
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M. Endnotes

1. NFPA 909: *Code for the Protection of Cultural Resources*. Quincy, MA: National Fire Protection Association, 2001, p.909-31, Table A.8.1, "Causes of Structural Fires in Museums or Art Galleries (1980-1997 Annual Averages)."

2. NFPA 909: *Code for the Protection of Cultural Resources*. Quincy, MA: National Fire Protection Association, 2001, Appendix A, A-8.1, p909-31.

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See also *Museum Handbook*, Part I, Chapter 9: Museum Fire Protection (2019) and Chapter 10: Emergency Planning (2019) for additional information.

FORMER APPENDIX G: PROTECTION OF NATIONAL PARK SERVICE MUSEUM COLLECTIONS

A. Overview

This appendix contains information that supports the guidance provided in NPS *Museum Handbook*, Part I, Chapter 14: Museum Security. In this appendix you will find:

- NPS standards for security
- Definitions of security terms
- Sample statements of work for a security survey
- Sample standard operating procedures and agreements

B. NPS Standards for Security

1. *What general standards do I need to meet?*

- Identify all threats that may affect the museum collection and take steps to counter those threats.
- Ensure that the park's museum protection program applies to everyone on the staff.
- Ensure that systems for detecting and controlling access meet Underwriters Laboratories (UL) standards.
- Establish a process for evaluating plans for building and exhibit construction and rehabilitation to ensure that security objectives will be met.

The NPS Checklist for Preservation and Protection of Museum Collections (1996) includes mandatory standards for museum security. See *MH-I*, Appendix F: NPS Museum Collections Management Checklists, Section A for guidance.

2. *What security standards do I need to meet?*

- Issue keys to storage rooms and exhibit cases only to those employees who have a frequently (at least daily) recurring need for direct, unaccompanied access to collections.
- Control the issuing of keys strictly by using signed hand receipts (Form DI-105, "Receipt for Property" or its equivalent).
- Write and implement procedures for access to museum collections.
- Ensure that researchers or qualified visitors entering a space housing museum objects are accompanied at all times by someone on the park museum staff.
- Maintain a visitor log to record non-museum staff entries into museum storage and work areas.
- Write and implement opening and closing procedures for museum exhibit, storage, research and work spaces.

- Equip museum storage rooms with secure metal or solid-core wooden doors in substantial frames. Equip those doors with deadbolt locks and other appropriate security hardware, such as non-removable pin hinges.

- Install and maintain intrusion detection systems appropriate to the nature of the facility, the nature and value of the collection, and to the known threats.

- Ensure that intrusion detection systems are inspected and maintained on a regular schedule.

- House highly sensitive and valuable objects (such as firearms) in storage cabinets of an appropriate design with keyed or combination locks.

- Protect irreplaceable or particularly sensitive or valuable objects on exhibit by using appropriate mounts, cases, or security electronics (or some combination of the three) or by other means that will protect them from theft or vandalism without making curatorial access or visitor viewing impractical or difficult.

- Give museum objects, especially those on exhibit, additional protection at times of high risk, such as during special events or when exhibit galleries are particularly crowded, or when uniquely threatened, such as by terrorist threats or attack or during times of civil unrest.

C. Museum Security Survey

1. *What are the subjects that I need to address in a security survey?*

The outline below lists subjects that may be addressed during a protection survey.

- The Park or Facility
  - Name or other identifier
  - Function or purpose
  - Location (including proximity to other facilities and communities)
  - Physical nature of the facility and its surroundings
  - Climate
  - Staffing (including nature and size of staff, hours, seasonal variations)
  - Visitor access (including visitor use characteristics, numbers of visitors, hours, seasonal variations)
  - The law enforcement situation (including type of jurisdiction, reaction/response times)
  - Site loss history (including nature/impact of past criminal

activity, nature/impact of other loss events, subsequent mitigating/preventive actions, current loss control policies, programs, procedures)

- Perimeter Security (External)

  - Perimeter barriers and access points: nature and effectiveness (including fences, natural barriers, clear zones, underground passages)

  - Cover (such as vegetation) for possible illegal activity

  - Lighting (including nature, location and areas of coverage, maintenance and testing, power supply, circuit, and switching reliability, tamper resistance, operation)

  - Access points (including controls such as gates, locks, and surveillance)

  - Patrols (including nature, frequency, and seasonal variations)

  - Intrusion detection system (including type of system, power supply, tamper resistance, signal transmission method(s) and supervision)

  - Inspection, testing, and maintenance, operating procedures and instructions, and monitoring of alarms

- The Structure Housing Museum Collections

  - Perimeter security (such as doors, windows, loading docks, walls, roofs, floors, basements, attics, and underground tunnels)

  - Interior security (such as connecting doors and pass-throughs, walls and interior windows, ceilings and spaces above them, floors and crawl spaces, duct work, storerooms, closets, utility rooms, vaults, storage cabinets, elevators and stairwells, and hiding places)

  - Locks and related hardware (including types, mounting, and cylinders and keys)

  - Interior lighting (including security, emergency types, mounting, and cylinders and keys, lighting reliability)

  - Intrusion detection system (including detectors, controls, tamper resistance of wiring and components, alarm transmission methods and supervision, inspection, testing, and maintenance, operating procedures and instructions, monitoring of alarms)

  - Safes, vaults, and media containers (including type, location, capacity, and use)

- Procedures

  - Key and combination control (including policies and procedures, documentation/records, and security of keys and cores)

  – Building opening and closing (including policies and procedures, checklists, and monitoring by management)

  – Housekeeping practices

  – Employee screening, investigation, and identification

  – Package and material control

  – Visitor control (including control of visitors to staff-only areas, passes, records of visits, and ID's for contractors, tradesmen, utility workers)

  – Visitor surveillance and inspection

  – Protection of administrative records

  – Security of cash and valuables

  – Control of access to restricted areas or facilities (including museum and non-museum staff)

  – Property inventory and control

  – Security communications (including methods, reliability, back-up power, employee operation, and efficiency and speed)

  – Incident reporting (including timeliness, accuracy, and records creation and maintenance)

- Individual Object Protection

  – Storage spaces (including physical construction, access control, housekeeping practices, storage cabinets and shelves, inventory and material movement, and intrusion detection systems)

  – Exhibit spaces (including case construction and object mounting, lighting of space and cases, surveillance by the staff, intrusion and tamper detection systems, inventory, and object removal/movement procedures)

  – Furnished rooms (including access control, intrusion detection systems, housekeeping practices, and inventory)

2. *Where can I obtain a sample scope of work for a security survey?*

Figures G.1 and G.2 provide suggested language for a scope of work (SOW) statement for a security survey. When contracting for a combined security and fire protection survey, the two documents can be merged and redundant language eliminated. In the sample SOWs, the square brackets [ ] denote alternative words or phrases, one of which must be chosen and the other deleted, depending upon the situation. Square brackets also mark off optional words and phrases that may be applicable.

D. Park Museum Protection Standard Operating Procedures and Agreements

1. *How do I organize museum standard operating procedures?*

In preparing park-level policy statements and procedures, it is important to distinguish between policies and procedures. Policies express what is allowed and not allowed. Procedures express how to carry out the policies (how, when, by whom, and under what circumstances you put the policies into effect.)

Museum facility standard operating procedures (SOPs) share certain common elements with all standard operating procedures. They all include the following information:

- ***Why*** the required actions should be performed. When the purposes for having the SOP are made clear, and when the responsible staff fully understand why they must do certain things, the procedures become more valuable.

- ***Who*** is to perform the required actions. Depending on the circumstances, the SOP may indicate responsibility by name or by position title. The SOP will say that the procedures are to be followed by staff who have the duty by virtue of some roster or work schedule (which you must identify in the SOP). Regardless of how it is done, it is essential that the SOP assign specific responsibility.

- ***When*** the required actions are to be performed. Usually, specific times are given for either initiating or completing the procedures. The times may vary seasonally or according to the day of the week. It may not be necessary to set a specific time for initiating each action. Simply setting a time to begin the procedures or a time by which they are to be completed will suffice.

- ***Where*** the required actions are to be performed. For example, an opening SOP might designate which building entrance is to be opened first, indicate where the intrusion detection system keypad and light switches are located, direct the sequential unlocking of specific emergency exit or other doors, specify where items needed during the procedure, such as flags, are to be found, and indicate which exhibit cases are to be checked.

- ***How*** the required actions must be performed or, as appropriate, may be performed. Unless there is a clear need for an action to be performed in a certain way, however, it is best to allow the responsible persons flexibility in how they carry out their tasks. When an action must be performed in a certain way, as with operating an intrusion detection system or certain high-security locks, the SOP then should be as specific and detailed as necessary to ensure that it is done that way.

- ***What*** the results of the actions should be. For example, it is not sufficient to say something like "Check all exhibit cases." Instead, the SOP should say "Visually examine exhibit cases 4-13 for evidence of burglary or tampering during the night and for objects and graphics that might have fallen or come loose from their mounts. Inspect exhibit case access doors to ensure that they are still locked and that the locks are in good condition."

2. *Where do I find sample museum standard operating procedures and agreements?*

Figures G.3 through G.8 provide suggested format and language for park collection opening and closing procedures, access policies and procedures, and an agreement with a fire department. The sample documents are designed to cover all elements that normally need to be considered in most parks. You generally should follow the sample formats. However, the language may vary depending on your park's specific requirements and problems. Contact parks for copies of their SOPs.

3. *Where do I find additional help with preparing access policies and procedures?*

- MH-II, Appendix D, Museum Archives and Manuscript Collections
  - Section U. Access.
  - Section W. Use-Reference
  - Figure D.8. Researcher Registration Form (Sample)
- MH-III: Museum Collection Use

4. *Where do I find a sample visitor log?*

See Figure G.6 for a sample visitor log. An unpunched, full size visitor log accompanies this appendix. Keep the full size visitor log as a master and make copies for your use.

5. *Where do I find conditions for access to museum collections?*

See Figure G.7 for conditions for access to museum collections. An unpunched full size conditions for access to museum collections accompanies this appendix. Keep the full size document as a master and make copies for your use.

E. Glossary

- **Barriers:** Tools for physical security designed to prevent, restrict, or delay access to a protected area or object.
- **Burglary:** Breaking and entering with the intent to commit a felony, usually theft, although vandalism also is common.
- **Capacitance Motion Detector:** A motion detector designed to detect motion close to a protected object, generally used to detect and discourage touching of high value exhibits, such as wall hangings or paintings. The device generates a capacitance field 4-6" from the protected object that detects any electrical conductor that enters the field.
- **Central Station:** A privately owned alarm monitoring system monitored by personnel who will report alarms to the police or fire department and to designated members of the staff of the protected site. A central station may be owned by the protected site (proprietary) or by a commercial business (commercial central station).
- **Civil Disturbances:** Disturbance of civil order and the peace. This activity may be organized or spontaneous; may be indiscriminate, involving the park as a consequence of its location, or discriminate, involving the park as a planned target; and may be a prelude to other criminal activity, especially vandalism and larceny and possibly robbery and assault.
- **Contact Switch:** A normally open or normally closed electrical switch that triggers an alarm when the switch changes position. Examples include magnetic door and window contacts, plunger switches, and roller or ball switches.
- **Crime Prevention:** Anticipating, recognizing, and appraising the risk of a crime and initiating actions to remove or reduce the risk.

- **Dual Technology Motion Detector:** A motion detector that combines two detection technologies (such as microwave/passive infrared or ultrasonic/passive infrared) to minimize unwanted alarms. Both technologies must detect motion before the device signals an alarm.
- **Duress Alarm:** A personal protection device (also known as a panic or hold-up alarm) consisting of a manually operated switch that triggers a local or remotely monitored alarm to summon assistance.
- **Embezzlement:** Appropriating fraudulently to one's own use or benefit property entrusted to one's care. The property stolen might be sold (fenced) or retained for the personal use of the embezzler.
- **Glass Break Detector:** Device that detects breaking glass. There are two types: frequency discriminators and metallic foil or wire. Frequency Discriminators detect the high frequency sounds generated when glass breaks. Metallic Foil or Wire is a ribbon of lead foil or small wire that carries an electrical current. It is attached to the glass around the perimeter of a window so when the glass breaks, the foil or wire breaks, breaking the electrical circuit, causing an alarm.
- **Larceny:** Unlawful taking or stealing of property or articles of value without the use of violence or fraud. There is a presumption that the property was not entrusted to the care of the person committing the theft. A presumption of theft also can be raised by possession of recently stolen property.
- **Local Alarm System:** A fire or intrusion detection system that causes an audible or visual alarm at the protected site, but which is not monitored off-site.
- **Magnetic Contact:** A detection device that uses a magnet mounted on a movable surface to open or close a contact switch mounted on a fixed surface.
- **Microwave Motion Detector:** A device that transmits electromagnetic energy in the microwave range (radar). The device measures the amount of energy reflected back to it and detects motion based on the doppler effect (a frequency shift that occurs as an object moves toward or away from the detector).
- **Passive Audio or Sonic Sensors:** Audio and sonic sensors detect sound. An Audio Sensor is a sound activated microphone that transmits sounds from the protected space to a loud speaker in the monitoring station so the person monitoring the sensor hears what is going on in the protected space. Sonic Sensors are frequency discriminators that detect sound in the frequency range associated with movement.
- **Passive Infrared Motion Detector (PIR):** A device sensitive to infrared heat in the range generated by the average human body. The detector transmits no energy, but uses a series of heat sensitive elements to cover the protected area in a pattern of zones resembling the fingers on a hand. The device detects motion when a heat source moves from one detection zone to another. Everything has an infrared signature, and many mimic that of the human body (for example, a large animal or a radiant heater).
- **Photoelectric Beam Motion Detector:** A device with a transmitter that projects a beam of infrared light across an open space to a receiver. The receiver may be located directly across from the transmitter, or the light beam can be directed around the room with a series of small mirrors. Photoelectric beam devices may use just one beam or, to minimize unwanted alarms, several beams (stacked array).
- **Photoelectric Detector:** A device that detects large combustion particles in visible smoke.
- **Physical Security:** All measures intended to prevent acts of violence against persons and destructive or unauthorized access to, or removal of, property.
- **Pressure Mat:** A pressure-sensitive mat, usually placed under a rug or carpet, to detect an intruder stepping into the protected space.
- **Probability:** The likelihood of a threat becoming an actual loss event.
- **Risk:**
  - **Conventional Risk:** A condition that entails both the possibility of loss and gain, such as investing in the stock market.
  - **Pure Risk:** A condition that is loss-only oriented. Among the pure risks that threaten park assets are crimes, natural disasters, civil unrest, and accidents.
- **Risk Assumption:** Using existing resources to absorb losses as and when they occur.
- **Risk Management:** The process of identifying, evaluating, and eliminating as many risks as possible by selecting and implementing effective countermeasures.

- **Risk Transfer:** The process of transferring a risk to another entity for a fee. A known cost, such as an insurance premium, may be substituted for the chance of a greater loss.
- **Robbery:** Theft by violence or threat of violence to one's person. Also included under this heading is the taking of a hostage to force someone on the museum staff to open the building or a secure area within the building.
- **Security:** Security includes all techniques, procedures, equipment and planning intended to prevent loss of or damage to collection objects from criminal activity, negligence, fire, or other catastrophic events.
- **Security Survey:** The National Institute of Law Enforcement and Criminal Justice describes the security survey as "a critical on-site examination and analysis of an industrial plant, business or home, public or private institution to ascertain the present security status; to identify deficiencies or excesses; to determine the protection needed; and to make recommendation to improve the security."
- **Severity:** The impact or effect upon the assets or upon the organization if a loss does occur.
- **Shoplifting:** A specific type of larceny that involves theft of merchandise for sale. This threat is a concern when there are sales operations within the park.
- **Strain Sensor:** A device that detects the distortion that occurs on the under side of a joist, floor, or platform when weight is applied to the top surface.
- **Threat:** A potential to inflict harm or cause damage or loss.
- **Ultrasonic Motion Detector:** Similar to the microwave motion detector, except the device uses high frequency acoustic (sound) energy that will not penetrate solids.
- **Vandalism:** Willful or malicious destruction or defacement of objects, exhibits, or structures. This crime may be random and indiscriminate or directed toward a particular object, building, or exhibit. Vandalism is called sabotage if committed to hinder operations.
- **Vibration or Shock Detector:** A device that attaches directly to a protected object, an exhibit platform, or the structure of an exhibit case, which detects vibration, such as might occur when someone moves the protected object or strikes the protected exhibit case.
- **Warded Lock:** A lock with gates to which the correct key aligns to allow movement of the bolt and with internal wards, or obstructions, that block the entry or turning of an incorrect key.

F. List of Figures

See also *Museum Handbook*, Part I, Chapter 9: Museum Fire Protection (2019) and Chapter 10: Emergency Planning (2019) for additional information.

SCOPE OF WORK
Museum Security Survey
[*Park Name*]

Purpose of Work

The work consists of conducting a museum security survey of the [*facility/ facilities*] described below. There are two purposes for the survey. The first is to reveal and identify weaknesses in existing protection systems, equipment, procedures, policies, and operations that could result in the loss of such museum resources as collections, collection records, and exhibits, as well as the museum [*structure/structures*] [*itself/themselves*]. The second purpose is to identify alternatives to correct any weaknesses or deficiencies that may be found. The ultimate goal of performing the survey[s] and of implementing corrective actions is protecting museum property against all forms of losses.

Description of Site[*s*] to be Surveyed

[*Here describe the buildings--visitor center, furnished historic structure, storage facility--to be surveyed. Characterize it/them in terms of location, size, functions, construction, and nature of contents. Provide whatever information is deemed necessary for the contractor to have in advance. In particular, indicate the nature of exhibits to be surveyed, making clear whether they are conventional exhibits or furnished rooms or both. In most cases, the Scope of Work (SOW) statement will become part of the request for proposal sent out to prospective contractors. It is important that prospective contractors have sufficient information about the site and facilities to be surveyed to permit them to make responsive proposals. You may wish to attach more detailed information, such as park brochures, to the SOW to avoid having to put a lot of detail in this section.*]

Scope of Work

The Contractor will survey the structures or facilities described above, identify security weaknesses and deficiencies, and make recommendations for their correction in a separate formal report. [If more than one park is involved, you should request a separate report for each park. Only rarely might you specify a separate report for each structure in the same park.] The Contractor will visit and survey operations and conditions at [the site/each site] for [number of days]. In addition, the Contractor will return to [the site/each site] an additional one-half day to orally present his/her findings and recommendations to the site staff[s]. After completion of the return visit, the final report[s] will be revised as necessary based on comments made during the oral presentation and submitted to the park.

In carrying out this work, the Contractor will perform at a minimum the following tasks:

1. Prior to identifying himself/herself to the staff, tour public spaces in each of the specified facilities as an ordinary visitor and observe conditions and activities affecting protection of the collections and the structures. [If visitors normally have to pay a fee for admission to the site, indicate in this paragraph that fees paid will constitute a cost-reimbursable expense.]

2. Meet with management and staff at each site including [Here specify by title each of the site staff that the contractor must meet. At a minimum, the contractor should meet with the superintendent, the chief ranger, and the park curator.] [At each site other/Other] staff may be interviewed as deemed appropriate by the local manager or necessary by the Contractor and as may be arranged by the local staff.

Figure G.1. Sample Scope of Work for a Security Survey

3. Evaluate the physical security of each building in both public and non-public areas. Note problems with perimeters, including doors, windows, air intakes, roof hatches, and other penetrations. Evaluate perimeter lighting, locks, hardware, hinges, and other security equipment and devices. Evaluate the ease with which someone could penetrate the perimeter with or without being detected. Observe and evaluate perimeter security during the daytime and after dark. Before conducting surveys after hours, inform the local superintendent or site manager of when and how they will be carried out; that will preclude harm to the Contractor or site staff and ensure cooperation of staff on the night shift.

4. Examine and evaluate the electronic alarm systems, including controls, detectors, exhibit case sensors, panic devices, alarm and signaling devices, remote monitoring equipment, remote alarm transmission media (including line supervision), and other pertinent components. Test the proper functioning of the systems and evaluate their operation and maintenance. Evaluate [contract/proprietary] central station services (monitoring, response, premises security, and maintenance support).

5. Examine security staffing for adequacy. Review staffing levels, position descriptions, performance standards, standard operating procedures, training, and delegations of responsibility for all personnel and staff components directly responsible for museum security. Evaluate protection of all areas by security personnel. Review the scheduling and conduct of security patrols. Evaluate adequacy of protection provided by interpreters during interpretive tours or programs. Evaluate the interpretive operations plan in respect to how well it incorporates security concerns into the responsibilities of interpreters. If guards are used on the night shift, evaluate their effectiveness and response capabilities and the extent to which they may be vulnerable to personal injury, attack, or accident during their rounds.

6. Evaluate security training or security awareness programs provided at the site for both security and non-security personnel.

7. Evaluate policies for and staff compliance with access and parcel controls in use at the site[s], particularly in office and work areas, in exhibit areas, and in collections storage.

8. Evaluate security policies and procedures, including standard operating procedures, delegations of authority, and memoranda of agreement or understanding with local police and emergency agencies.

9. Evaluate key control and retrieval. Evaluate the adequacy of locking systems, key documentation, and key security. Determine whether card access or similar control systems would be appropriate and practical for securing or controlling access to buildings and to high-security areas, such as collections storage.

10. Evaluate internal security programs, particularly procedures to account for objects taken outside of collection storage and exhibit areas, such as in offices and workrooms or in transit.

11. Evaluate security for objects on exhibit and in storage, including case design, security hardware, detection systems, locks, keying, accountability procedures, and other internal control procedures and systems. In particular, evaluate the ease with which objects may be stolen from exhibits [and furnished rooms] without immediate detection of the act. Evaluate the ease with which objects on exhibit [and in furnished rooms] may be vandalized, with or without immediate detection.

Figure G.1. Sample Scope of Work for a Security Survey (continued)

12 [*This paragraph is needed only when historic structures are to be surveyed*.] All recommendations for improvements to or replacements of systems and hardware will take into account and be sensitive to the historic nature of the structure[*s*]. As appropriate, alternative recommendations for equipment and/or installation techniques will be made to allow for maximum preservation of historic fabric.

13 Evaluate the timeliness, effectiveness, and accuracy of how the [*site/sites*] report[*s*] criminal or other incidents involving collections.

14 Observe and comment on other security problems that may be noted during the survey[*s*]. Evaluate park policies and documentation for all security procedures not otherwise specified above.

Standards

The following published documents shall be considered the standards against which Contractor shall evaluate security at the site[*s*]. The first [*qty*] items are available for loan to Contractor upon request. The remaining items are standard industry publications, which should already be available to Contractor.

[*Here list relevant documents, such as: NPS Museum Handbook, Part I; NPS-28 "Cultural Resource Management Guideline"; NPS-44 "Personal Property Management Guideline"; NPS-50 "Loss Control Management Guideline"; NPS Management Policies; Special Directive 80-1 and NPS Checklist for Preservation and Protection of Museum Collections; and any other NPS documents that may be relevant. List the American Society for Industrial Security (ASIS) Suggested Guidelines in Museum Security; and other industry publications.]*

Protection of Information

All information and documentation gathered or produced by the Contractor during the course of this work shall be held in strictest confidence and shall be fully protected from access by unauthorized persons. Any documentation furnished by the site[*s*] and retained by the Contractor during the course of the work or thereafter shall be secured in a locked filing cabinet or safe at a minimum. During the initial visit to the site[*s*], the Contractor shall indicate to the superintendent[*s*] the manner in which he/she intends to secure any documentation the site[*s*] may furnish; the superintendent[*s*] will have the prerogative to specify when more stringent security must be provided for any particular documentation furnished to the Contractor. Documentation that cannot be secured to the superintendent's[*s'*] satisfaction still will be furnished to the Contractor, but only for on-site use.

Notes and other information produced by the Contractor, including all versions and copies of his/her report and any drawings that may be produced, shall be secured in a locked filing cabinet or safe, at a minimum. Word processor and other computer files shall be secured in an equivalent manner, such as by retaining files only on diskettes kept in a safe, rather than on a hard drive, and by the use of passwords or encryption. During the initial visit to the site[*s*], the Contractor shall indicate to the superintendent[*s*] the manner in which he/she intends to secure computer data generated during the course of the work; the superintendent[*s*] will have the prerogative of specifying that additional security measures be taken whenever circumstances so dictate.

Figure G.1. Sample Scope of Work for a Security Survey (continued)

Products, Deliverables, and Performance

1. Contractor should discuss his/her findings and recommendations with protection and museum staff at [the/each] site during the initial visit[s], and is encouraged also to discuss recommendations for corrective actions, but is not obliged to do so. Contractor has an ethical obligation to verbally point out serious protection weaknesses as they are encountered, if such weaknesses could, in his/her judgment, result in imminent loss of park resources.

2. Contractor shall prepare and submit a written report of survey [*for each site visited*]. The report shall present findings and recommendations for each applicable subject listed above in the Scope of Work and shall be organized in a logical, easily comprehended manner. [*The/Each*] report shall include an executive summary, a discussion of observations and problems (organized according to areas within [*the/each*] structure or according to each security issue, e.g., training, staffing, and hardware), a list of recommendations and possible alternative solutions for problem areas, a comprehensive prioritized list of recommendations, a list of recommended suppliers of security hardware and systems and cut sheets or other manufacturer's literature on recommended hardware or system components, and a bibliography of recommended readings on the specific protection problems and solutions presented in the report[*s*].

3. Submit draft reports to the park according to the schedule below. Reports will be reviewed promptly and returned with comments. Contractor will be expected to incorporate each comment into the report or be prepared to explain why doing so is not appropriate.

4. After approval of the second draft, return to [*the/each*] park for a followup visit. Orally present findings and recommendations to the assembled park staff. Orally respond to questions, comments, and concerns from the staff. [*The/Each*] presentation[*s*] should include a walk-through of the surveyed [*facility/facilities*] as necessary to make findings and recommendations clear. In order to ensure sufficient time for the presentation[*s*], [*it/they*] should be scheduled to allow for one-half day [*per site*].

Time for performance is [*number of months*]. [*The*] Initial site visit[*s*] must be completed within [*number of days*] from award of contract. The final report must be completed within [*number of days*] after completion of the initial visit[*s*]. [*The following schedule of completion is suggested. Modify as instructed by your contracting officer.*]

Work Element	Completion Time After Award
Initial site visits	[*number of days*]
Submit first draft of report[s] to park	[*number of days*]
Correct report[s] by Contractor	at Contractor’s discretion

Figure G.1. Sample Scope of Work for a Security Survey (continued)

Work Element	Completion Time After Award
Followup site visit[*s*] and present report[*s*] to park staffs	[*number of days*]
Complete final report[*s*]	at Contractor's discretion
Submit final report[*s*] to park staffs	[*number of days*]

Schedule of Partial Payments

Partial payments will be made upon successful completion of each successive phase of the work, as outlined below:

Initial site visit[*s*]	50%
Submit second draft[s] of report[*s*]	25%
Submit final report[*s*]	25%

Inspection and Acceptance

[*Insert Name and Title*] shall serve as the Contracting Officer's Technical Representative (COTR) on this project. The COTR is empowered to inspect and evaluate all work of this Contract for compliance with terms of this Scope of Work Statement.

Acceptance of the work of this contract and any changes to the terms of this contract shall be made in writing only by the Contracting Officer.

Figure G.1. Sample Scope of Work for a Security Survey (continued)

NATIONAL PARK SERVICE

[Park's Name]

To: All Park Personnel

From: Superintendent

Subject: Opening and Closing Procedures for [*Structure's Name*]

Purpose: To establish responsibilities for security and daily opening and closing procedures of [*Structure's Name*].

Policy: Park personnel assigned to [*Structure's Name*] will follow established guidelines to ensure proper security of the site and protection of the resource.

Guidelines:

The intrusion detection system will be activated during all non-business hours. Generally this is from 4:30 PM to 7:30 AM daily. Hours may vary slightly on weekends.

On days when it is not open to the public, the Curator is responsible for arming the intrusion detection system at the end of the workday. On days when the furnished historic structure is open to the public, it is the responsibility of the interpretive staff to arm the system. Generally the furnished historic structure is open on weekends and [days] during the summer.

Each morning, it is the responsibility of the Park Ranger staff to disarm the intrusion detection system. The guards on duty will turn off the systems during the early morning patrol at about [*Time*].

It is the responsibility of the Curator and custodian to maintain security on days when the house is not open to the public. Exterior doors should remain locked at all times and the house should be secured and alarmed at the end of each workday.

It is the responsibility of the Interpretive staff to secure the structure on weekends and on other days that the furnished historic structure is open to the public. The closing procedures should include inspecting the entire furnished historic structure, not just the areas used by the public.

The evening ranger patrol will include an inspection to ensure that the structure has been properly secured. Before entering, the park ranger will patrol around the exterior of the furnished historic structure shining the flashlight on each of the windows to ensure that they are closed. Only if all appears secure, will the ranger enter the structure alone to complete the inspection.

Closing Procedures:

The following steps are taken by designated interpretive or museum staff. As you walk through the house, note maintenance or safety concerns or questions about museum object security.

1. Ensure that visitors are out of the house. Record tour and visitation statistics when the house has been open to the public.

Figure G.3. Sample Furnished Historic Structure Opening and Closing Procedures

2. Place the moveable "entrance" signs inside the Conservatory when the house has been open to the public.

3. Lock all exterior doors. Exterior doors are located in:
   - Conservatory (2 doors)
   - Front entrance
   - Atrium or Small Conservatory
   - Den
   - Kitchen Pantry Hall
   - Servants' Hallway

4. Close all windows and fasten those that can be locked. Check windows in the Conservatory and on all three floors of the house.

5. Pull down the window shades as you check each window.

6. Put the two tripods with fire detectors in their proper position in the Foyer and the Dining Room. Poles should be extended so the detector heads are as close to the ceiling as possible.

7. Close the following interior doors:
   - Front double doors (dead-bolted top & bottom & chained)
   - Basement electrical room
   - First floor Servants' Hall door to Basement
   - Second floor hall door between Servants' Wing and Staircase
   (Intrusion alarm does not arm properly if they are open.)
   - Basement Furnace Room
   - Third floor door to Attic stairs

8. Close the following interior doors, if possible:
   - All basement room doors except fire control panel room
   - Both doors to China Storage area
   - Servants' Hall door to Front Foyer
   (**NOTE:** Closing these doors reduces the chances for false alarms.)

9. Leave night lights on in the following areas:
   - Laundry Room, above the sinks
   - Kitchen, above the sink
   - Servants' Hall, above the radiator
   - Dining Room, one light on each of the two sconces
   - Entrance Hall, inner chandelier globe. (**NOTE:** The switch is in closet.)
   - Second floor Servants' Hall staircase

10. Activate the two intrusion detection system panels in the Laundry Room. Remember the Servants' Wing exit must be closed before the system is armed. Exit the house through the Servants' Wing door.

11. Make a final patrol around the outside of the house to check doors and windows. Do not jiggle doors or windows from the outside. (Doing so might cause an intrusion alarm.)

Figure G.3. Sample Furnished Historic Structure Opening and Closing Procedures (continued)

Opening Procedures:

Intrusion detection systems are disarmed each morning by the park ranger staff. The systems will be off prior to the time that other park staff need to enter the house.

1. Before entering, walk around the outside of the house and check for signs of entry. If anything looks suspicious do not enter. Report the observation to the protection staff immediately.

2. Enter through the Servants' Wing door. Lock the door behind you.

3. Check the status lamps and alarms on both alarm system panels in the Laundry Room and report any malfunctions.

4. Make a walk-through visual inspection of the entire house, including the basement and upper floors. Make particular note of signs of attempted entry, safety or maintenance needs, and the location of museum objects. Report concerns or problems to the appropriate protection or museum staff.

5. Take down the two portable fire detectors in the Foyer and Dining Room, when the house is open to the public. Place them in the Hall Closet.

6. Prepare the rooms along the tour route by opening shades and turning on the appropriate lights, if the house is to be open to visitors. Make a special note of safety and security concerns in these visitor use areas.

7. Prepare for greeting visitors by placing the entrance signs outside. Establish tour assignments, prepare the visitor statistic sheet and ensure that a supply of park folders is available.

8. In summer, when temperatures are hot, visitors will enter through the front door. When weather is cool, the Conservatory will be opened as a waiting area for visitors. If the Conservatory is to be opened, clean up the room, place literature out on display, and unlock both exit doors from the room.

9. Call the Park's Visitor Center desk to let them know that the house is ready for visitors and to check for any special tours or activities.

10. Throughout the day, be certain that all doors into the house are locked unless you can observe them. Generally, the only doors that should be unlocked during the day are those in the Conservatory when it is being used as a visitor waiting area.

Figure G.3. Sample Furnished Historic Structure Opening and Closing Procedures (continued)

NATIONAL PARK SERVICE
[Park's Name]

To: All Park Personnel

From: Superintendent

Subject: Opening and Closing Procedures for [*Storage Facility's Name*]

Purpose: To establish responsibilities for security, fire prevention and daily opening/closing procedures for the park's museum collection storage facility.

Policy: Park personnel who are assigned responsibility for the park's museum collection are required to follow the established guidelines to ensure the proper security of the site and protection of the resources.

Guidelines

Opening Procedures:

1. Before entering the facility, check for any unusual circumstances (e.g., signs of illegal entry, vandalism or maintenance problems). If anything looks suspicious **DO NOT ENTER**. Report any problems to the appropriate staff person in law enforcement, maintenance and/or supervisor immediately.
2. Unlock exterior doors. Turn off the intrusion detection system.
3. Turn on museum workspace lights.
4. Unlock collection storage space door (when needed) and turn on lights.
5. Inspect museum workspace and collection storage space for unauthorized entry, fire hazards, or other unusual happenings (such as roof leaks, fire suppression system leaks, pests, and damaged objects).

Closing Procedures:

1. Inspect the collection storage space to be sure all museum objects and associated records are returned to their proper locations; dust covers are in place; all storage cabinets are closed and locked, and that all tools, equipment, reference books have been returned to their proper places.
2. Check that all museum storage cabinets that were used during the day are locked. Return all storage cabinet keys to keybox and secure it.
3. Check the workspace and collection storage space to be sure that all staff or any other persons are out of the facility.
4. Turn off lights. Make sure that collection storage space door is locked.
5. Turn off all computer equipment, other electrical equipment, and lights in adjacent office spaces.
6. Lock windows in office spaces.
7. Turn on the intrusion detection system.
8. Lock exterior doors.

Figure G.4. Sample Museum Collections Storage Opening and Closing Procedures

NATIONAL PARK SERVICE

[*Park's Name*]

To: All Park Personnel

From: Superintendent

Subject: Museum Collection Access Policy and Procedures

Purpose: To establish park policy and procedures for access to the museum collection. It is the policy of the National Park Service, and of [*Name of Park*], that its natural and cultural resources shall be made available for educational and research purposes, as long as this access doesn't:

- endanger the item's preservation and security
- conflict with Federal legislation (such as the Copyright Act, the Freedom of Information Act) or state legislation (such as privacy and public laws)

NPS museum collections possess internal administrative importance, as well as importance to educational, research, and publishing communities both inside and outside the Service. Protecting these valuable resources, while making them available to the widest possible audience, requires the park museum staff to manage access to the museum collection.

Times of Operation: Normal hours of access to the park's museum collection are [*Days and Hours*].

General Access Procedures:

1. Except as otherwise noted, this written procedural statement applies equally to museum objects, archival and manuscript materials, museum collection records, and information about such park resources prepared by the staff in the course of their official duties.

2. Access to objects in the collection, to storage cabinets and exhibit cases, and to keys to locks on storage rooms, storage cabinets, and exhibit cases, will be strictly controlled by the Superintendent or designee. These areas shall be designated as secure areas, and except for emergencies, access shall be limited to authorized park staff. Park staff are discouraged from routinely using museum storage space as work or reference room space.

3. Only those persons authorized in writing by the superintendent (authorized park staff) will be permitted unaccompanied access to secure areas, including museum storage, work, and reference/study room spaces, under normal conditions. All other persons must be accompanied by authorized staff while in a secure area. In an emergency, designated emergency response personnel may have access to secure areas in accordance with the provisions of the park's Emergency Operations Plan. An authorized person will continuosly supervise anyone in a secure area who is not on the list of authorized park staff.

4. Granting of access to a secure area does not automatically include access to museum objects, archival materials, or museum records kept in those areas. Only persons with a legitimate need to use collection items will be granted access to them.

5. Anyone requesting access to secure areas or to museum collections must agree to comply with the provisions of the park's "Conditions for Access to Museum Collections."

6. These procedures will be reviewed every two years and revised as necessary.

Figure G.5. Sample Park Museum Collection Access Policy and Procedures

<u>Eligibility for Access to Museum Collections</u>:

Access to the collections should be granted by the Superintendent or designee to the following individuals:

1. **Individuals seeking to use collection for research or study.** An individual may request to conduct research on the collection by registering and making an appointment with the park museum staff.

2. **National Park Service staff from the Field Area Office, System Support Office, the Washington Office, centers, or other parks who are visiting the park on official business**. The nature of their work must require them to evaluate, inspect, or work with the collections or the rooms, cabinets, or cases housing the collections or with park records on the collections. Persons granted access under this category of eligibility do not necessarily have to be accompanied by park staff at all times; a decision in that respect will be based on their reasons for needing access and on other factors that the Superintendent may consider germane at the time.

3. **Representatives of Indian Tribes or Native Hawaiian organizations having official business with the park staff for examining archeological or ethnographic objects in the collections.** The Superintendent should ascertain if the individuals are official tribal representatives. Under this category, individuals will have access to collections associated with their own tribes.

4. **Non-museum park employees, including volunteers, who are being oriented to the park and their work or who require access to collections as part of their internal training.**

5. **Park maintenance and protection staff in the performance of their official duties**. Except in the most unusual circumstances, such personnel shall have access only to rooms in which collections are kept, not to storage cabinets or exhibit cases or to key boxes or other places where keys to cabinets and cases are secured. As provided below, other means shall be made available to these personnel for emergency access. Persons granted access under this item of eligibility do not necessarily have to be accompanied by curatorial staff, but should be whenever possible.
6. **Individuals or representatives of organizations, institutions, or corporations desiring to use objects or records in the collection for commercial or publicity purposes**. Such persons must satisfy the Superintendent that their purposes are legitimate and that the proposed uses are in keeping with park purposes and the NPS mission and will not reflect adversely on the park, the National Park Service, or a Native American tribe, if the request is for tribal materials. Access should not be granted solely on the grounds that access to the park's collection would be more economical or "easier" for them than access to another collection. When the park provides access, it is not authorizing publication, distribution, derivitive works, exhibitions, reproductions, or other non-research activity.

7. **Employees of construction or service companies who require access to collection storage or exhibit areas in order to service or maintain the building or its utilities, including alarm systems**. Such persons will be allowed access only under the terms of a contract or purchase order issued by or for the park and only to those areas where they are supposed to work. Under no circumstances shall such persons be allowed unsupervised access to objects kept in storage cabinets and exhibit cases. Except as may be

Figure G.5. Sample Park Museum Collection Access Policy and Procedures (continued)

otherwise provided in the language of the contract or purchase order, all persons granted access under this item of eligibility must be accompanied at all times by authorized staff. The Superintendent or designee shall have the authority to restrict access otherwise granted by this paragraph, under such circumstances where it is deemed advisable.

8. **Other persons or groups of persons may be allowed limited access to the collections, on determination by the Superintendent or designee that such access will be to the mutual benefit of the persons or groups and the park**. Examples of circumstances to which this item of eligibility might apply include: tours for school classes, tours for members of museum organizations or historical societies, tours for families of park employees, orientation for local political/ governmental officials, orientation for visiting Park Service employees not on official business, and tours for non-NPS museum personnel, teachers, and prospective researchers who are considering applying for permission to use or view the collection.

Figure G.5. Sample Park Museum Collection Access Policy and Procedures (continued)

U.S. Department of the Interior
National Park Service

VISITOR LOG

By signing this visitor log I acknowledge that I have read and agreed to conditions listed on the reverse of this log.

DATE	TIME IN TIME OUT	NAME (Print) (Signature)	ORGANIZATION (Name, Address, Telephone Number)	AREA AND ITEMS OF INTEREST

Figure G.6. Sample Visitor Log

U.S. Department of the Interior
National Park Service

CONDITIONS FOR ACCESS TO MUSEUM COLLECTIONS

1. Access to collections and/or to a secure area by researchers is by appointment. Any limitations imposed on access due to collection conditions, staff availability, and security considerations must be imposed equally on all users, including park staff's personal research. Persons needing to have access are urged to make their requests known to the Superintendent or designee as far in advance as possible.

2. Prospective visitors should be aware that the park staff is extremely busy at certain times of the year and that authorized staff may not be available to assist them at those times. Accordingly, it is suggested that persons needing access make an appointment and be prepared to discuss alternative times with the staff when they submit their requests.

3. The park's decision to allow access may depend upon the condition of the materials, the availability of space for the requester to work, and appropriate supervisory staff. The park keeps space and staff available for visiting researchers.

4. The park requires registration of all researchers (including those inquiring through the mail, on the phone, or Internet). Registration information needs to include full name, address, telephone number(s), institutional affiliation, research topic and publication plans. This information must be updated yearly to remain valid. A valid picture identification card must be shown at the time of the visit. All materials requested by the user are recorded.

5. All non-staff visitors and all staff visitors who are not designated as authorized staff will be accompanied at all times by authorized staff when in museum collection storage areas, when working in open exhibits, or when working with original museum and archival materials.

6. All visitors must sign in and out of museum collection storage area(s) and reference/study rooms on the park's "Visitor Log."

7. Smoking, drinking, and eating are prohibited in collection storage and work spaces and reference/study rooms. Suitcases, briefcases, overcoats, plants, and animals, except guide dogs, are not allowed in collection storage and study areas. Researchers must use pencils/paper or portable computers for taking notes.

8. All guidelines for handling objects and archival and manuscript materials <u>must</u> be read and signed by <u>all</u> collection users, whether staff or non-staff. These guidelines are published separately and may be requested in advance of a visit. A copy of the guidelines also will be provided to each user at the time he/she arrives.

9. The park reserves the right to the following as a condition for granting access to the collections:

   a. The researcher must agree to abide by any copyrights and state privacy and publicity legislation as well as duplication, publication, and citation policies.

   b. The park, as a courtesy, requests two copies of completed research papers; publications; CD-ROMs; screen captures of World Wide Web work, derived from work on the collections, or which contain photographs of objects in the collections or copies of documents in the archival collections. Copies of formal reports and other published materials shall be provided at the researcher's expense. Copies of drawings, photographs, and other products of research shall be provided at the researcher's expense, except when doing so constitutes an economic burden, in which case the Superintendent can elect to defray those costs or waive the requirement for the researcher to provide the materials.

Figure G.7. Conditions for Access to Museum Collections

Appendix A: Mandates and Standards for NPS Museum Collections

Page

APPENDIX A: MANDATES AND STANDARDS FOR NPS MUSEUM COLLECTIONS MANAGEMENT

A. Overview

In this appendix you will find information on:

- appropriate laws, regulations, and conventions related to NPS museum collections
- governmentwide and departmental standards related to NPS museum collections
- NPS management policies and servicewide standards for museum collections
- mandates and policies for NPS integrated pest management programs

B. Laws, Regulations, and Conventions – NPS Cultural Collections

1. *Laws related to NPS cultural collections*

These laws provide the legal mandates for NPS management of museum collections.

- Act for the Preservation of American Antiquities, June 8, l906 ("The Antiquities Act") (16 USC 431-433):
  - authorizes the President to declare national monuments to protect sites and objects
  - authorizes federal departments to grant permits for survey and excavation and to enforce protection of archeological sites and objects under their jurisdiction
  - requires that excavated materials be permanently preserved in public museums
- Organic Act of 1916 (16 USC 1 et seq.):
  - authorizes the creation of the National Park Service
  - states that the mission of the NPS is "...to conserve the scenery and the natural and historic objects...therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations"
- Historic Sites Act of 1935 (16 USC 461-467) authorizes the Secretary of the Interior through NPS:
  - to preserve and maintain objects of national historical or archeological significance
  - to establish and maintain museums

- Museum Properties Management Act of 1955, as amended (16 USC, Sect. 18 [f]) authorizes the Secretary of the Interior through NPS:

  – to acquire collections through donation, bequest, and purchase and through transfer from other federal agencies

  – to exchange collections

  – to accept and make loans of museum collections

  – to deaccession collections by transfer to qualified federal agencies, conveyance (donation) to qualified tax exempt private institutions and non-federal governmental agencies, and destruction

  See Figure A.1 for the complete text of this law.

- Reservoir Salvage Act of 1960, as amended (16 USC 469 - 469C):

  provides for the recovery and preservation of "historical and archeological data (including relics and specimens)" that might be lost or destroyed as a result of the construction of dams and reservoirs.

- Archeological and Historic Preservation Act of 1974 (16 USC 469-469C):

  extends the application of the Reservoir Salvage Act of 1960 to recover and preserve "historical and archeological data (including relics and specimens)" that might be lost or destroyed as a result of any federal construction project or federally-licensed activity or program.

- National Historic Preservation Act of 1966, as amended (16 USC 470 - 470t, Sect. 110):

  directs the Secretary of the Interior to issue regulations that ensure that significant prehistoric and historic artifacts, and associated records, subject to Section 110 of this Act, the Reservoir Salvage Act (as amended), and the Archaeological Resources Protection Act are deposited in an institution with adequate long-term curatorial capabilities.

- Archaeological Resources Protection Act of 1979 (ARPA) (16 USC 470aa-mm):

  – defines archeological resources as any material remains of human life or activities that are at least 100 years of age, and which are capable of providing scientific or humanistic understandings of past human behavior, cultural adaptation, and related topics through the application of scientific or scholarly techniques

  – requires that a permit be obtained before conducting archeological studies on public and Indian lands

  – requires that information on the nature and location of resources on public and Indian lands remain confidential if its release may harm the resources

- establishes civil and criminal penalties for the excavation, removal, or damage of resources on public and Indian lands without a permit (materials lawfully acquired prior to the passage of the law are not subject to the penalties)

- requires that materials excavated from public lands and Indian lands and associated records be preserved in a suitable repository

- gives the Secretary of the Interior authority to issue regulations for the proper curation of federally-owned and administered archeological collections

• American Indian Religious Freedom Act of 1978 (42 USC 1996):

  reaffirms the constitutional right of "freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use, and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites"

• Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 USC 3001-13):

  - states that lineal descendants or culturally affiliated Indian tribes or Native Hawaiian Organizations may claim ownership or control of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony that are excavated or discovered on federal or tribal lands after passage of the law

  - establishes criminal penalties for trafficking in remains or objects obtained in violation of the law

  - requires federal agencies and museums that receive federal funding to inventory Native American human remains and associated funerary objects in their possession or control and identify their cultural and geographical affiliations within 5 years

  - requires federal agencies and museums that receive federal funding to prepare summaries of information about Native American unassociated funerary objects, sacred objects, or objects of cultural patrimony within 3 years

  Note: The inventories and summaries provide for repatriation of items when lineal descendants or Native American groups request it.

• National Parks Omnibus Management Act of 1998 (16 USC 5937) Sec. 5937:

  - establishes the confidentially of sensitive information regarding certain types of museum objects and other resources

  - mandates a program of inventory and monitoring for NPS resources

  - allows the withholding of information (in response to a Freedom of Information Act request) on the nature and specific location of resources (specimens) that are endangered, threatened, rare, or commercially valuable, mineral or paleontological, and of objects of cultural patrimony

2. *Regulations related to NPS cultural collections*

The following regulations include major requirements for NPS museum collections management. Many other regulations may apply in specific situations.

- 43 CFR Part 3 "Preservation of American Antiquities" (implementing regulations for the Antiquities Act):
  - authorizes federal land managers to seize materials recovered illegally from archeological resources located on federal lands
  - directs federal land managers to dispose of seized materials by depositing them in the proper national depository or by other means
  - requires that every collection recovered under the Antiquities Act be preserved in the public museum designated in the Antiquities Act permit, and be accessible to the public
  - states that the Secretary of the Smithsonian Institution must approve in writing the removal (deaccession) of an Antiquities Act collection
  - mandates that deaccessioned Antiquities Act collections must be transferred to another public museum
  - requires that an Antiquities Act collection revert to the national collections whenever a museum holding such collections ceases to exist
- 43 CFR Part 7 "Protection of Archeological Resources: Uniform Regulations":
  - requires that repositories proposed by ARPA permit applicants to certify in writing their willingness to assume curatorial responsibility for the collections
  - requires that, for resources located on public lands, repositories must certify that they will safeguard and preserve the collections as property of the United States
  - requires that ARPA permit applicants certify that, not later than 90 days after the final report is submitted to the federal land manager, the collections will be delivered to the repository named in the ARPA permit
  - requires that federal land managers specify in ARPA permits the name of the repository in which collections are to be deposited
  - states that archeological resources excavated or removed from public lands remain the property of the United States
  - states that archeological resources excavated or removed from Indian lands remain the property of the Indian or Indian tribe having rights of ownership over such resources
  - authorizes the Secretary of the Interior to issue regulations for the curation of federally-owned and administered collections. In the absence of such regulations Federal land managers are authorized

to provide for the exchange of collections among suitable repositories

– restates the confidentiality requirement specified in ARPA

- 36 CFR Part 79 “Curation of Federally-Owned and Administered Archeological Collections”:

  – states the responsibilities of federal agencies to manage and preserve collections

  – identifies methods for federal agencies to use to secure and fund curatorial services

  – states terms and conditions for federal agencies to include in contracts, memoranda, agreements, and other written instruments with repositories for curatorial services

  – establishes standards for federal agencies to use to determine when a repository has the capability to provide long-term curatorial services

  – provides guidelines for collections use

  – specifies procedures and guidelines for conducting periodic inspections and inventories of collections

3. *International Conventions related to NPS cultural collections*

The following international convention applies to NPS cultural collections.

- 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property (implemented in the United States by P.L. 97-446 in 1983, 19 USC 260l). Signatory nations agree to work to prevent the import of and trade in archeological and ethnographic materials (when requested) and in stolen cultural collections. This convention:

  – was ratified by the United States and 90 other nations by 2000.

  – provides protection for archeological and ethnographic materials when the home nation requests that other signatories not import these materials. (As of 2000, Bolivia, Cambodia, Canada, Cyprus, El Salvador, Guatemala, Mali, and Peru have had such requests approved.)

  – provides protection for stolen property, including cultural and natural history collections, that have been taken from a museum or public institution (including churches, monuments, and archeological sites) To be covered, the materials must have been previously inventoried as part of the institution’s collection.

  – exempts objects imported for temporary exhibits

  Note: The United States and France are the only major art-importing countries to sign the convention to date; Canada, Korea, and Australia are also signatories. It is enforced in the United States by the Customs Service.

4. *Contacts for laws, regulations, and conventions – NPS cultural collections*

Direct questions relevant to laws and regulations about cultural collections to the regional/support office (SO) curator, the regional archeologist, historian, archivist, and ethnographer.

For information on the 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property, contact:

Cultural Property Advisory Committee
United States Department of State
SA 44, Room 247
Washington, DC 20547

Telephone: 202-619-6612
Fax: 202-619-5177
Email: culprop@usia.gov
http://exchanges.state.gov/education/culprop

C. Laws, Regulations, and Conventions – NPS Natural History Collections

1. *Laws related to NPS natural history collections*

These laws relate to NPS natural history collections.

- Lacey Act of 1900 (18 USC 43-44):
  - makes the violation of any state, federal, or foreign wildlife law a federal offense
  - places stipulations on the importing and labeling of wildlife and their parts
  - poses complex problems for museums in relation to the acquisition and deaccession of wildlife materials and the sale of wildlife materials in museum shops because it is hard to prove the legal history of such pieces
  - requires proof of intentional violation for enforcement, but ignorance of the relevant state, federal, or foreign statutes is not excusable.

  Note: The Black Bass Act of 1930 (16 USC 851) added fish to the list of wildlife under the Lacey Act.

- Migratory Bird Treaty Act of 1918 (16 USC 703-711):
  - protects birds flying between the United States and Canada, Mexico, and Japan
  - covers all wild, native birds not legally hunted by state law
  - clarifies that some non-native species may be covered by state law and, therefore, by the Lacey Act

  - makes it illegal to kill, capture, collect, possess, buy, sell, ship, import, or export listed species including their parts, nests, and eggs

  - allows museums and non-commercial institutions to get permits for legal possession, collection, and transportation of objects, but permits impose extensive record-keeping requirements

  - states that only museums and other specified institutions can purchase any protected bird or part thereof, and the seller must possess a federal permit for a legal sale

- Bald Eagle Protection Act of 1940 (16 USC 668a), amended in 1962 to include golden eagles:

  - prohibits taking, buying, selling, trading, possession, importation or exportation of eagles or their parts, nests, eggs, or products made of them

  - authorizes permits for taking, possessing, and transporting eagles and their parts for scientific, exhibition, and Native American religious purposes

  - exempts possession and transportation of eagles held prior to the law

  - requires permits for any materials acquired by museums after the law was established

- Marine Mammal Protection Act of 1972 (16 USC 1361-1407):

  - places a moratorium on the killing of marine mammals by United States citizens

  - restricts the possession, sale, purchase, importation, or transportation of the animals and their products and parts

  - requires permits for exhibiting marine mammals and their parts and for holding them in storage.

  - allows Native peoples to use such parts for the manufacture and sale of handcrafts as long as the sale is handled by a licensed dealer

  - exempts museums from permit requirements for pre-Act materials or to purchase legitimate handcrafts, although they should consider getting permits for all other marine mammal materials.

- Endangered Species Act of 1973, as amended (16 USC 1531-1543):

  - prohibits harassing, harming, or killing listed species

  - prohibits the purchase, sale, or use of listed species or parts thereof in the course of an interstate commercial activity. Intra-state transactions are allowed if pre-Act ownership can be proven.

  - doesn't apply to fossils and objects greater than 100 years old, but age must be verified

- requires park museums to have a permit to purchase more recent objects that contain parts of endangered or threatened species

- allows gifts of endangered or threatened specimens to museums if there is proof of pre-Act ownership and if the objects have not been offered for sale since the date of this law.

- allows loans or gifts between educational institutions. In such instances permits are not required, even if the objects cross state lines.

2. *Regulations related to NPS natural history collections*

The following regulations apply to NPS museum collections.

- 36 CFR, Section 2.5 (Revision effective April 30, 1984), "Research Specimens" Section 2.5(g) states: "Specimen collection permits shall contain the following conditions:

  - Specimens placed in displays or collections will bear official National Park Service museum labels and their catalog numbers will be registered in the National Park Service National Catalog.

  - Specimens and data derived from consumed specimens will be made available to the public and reports and publications resulting from a research specimen collection permit shall be filed with the superintendent."

  Note: A revision to 36 CFR 2.5 is in progress.

- 50 CFR, Sections 17.11 and 17.12, "Endangered and Threatened Wildlife and Plants." These annually revised sections provide lists of names of all the species of wildlife and plants determined to be endangered or threatened.

3. *International conventions related to NPS natural history collections*

The following international convention applies to NPS natural history collections.

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES):

  - protects endangered species of plants and animals by regulating imports and exports

  - was ratified by the United States in 1974, and by 150 other nations by 2000

  - allows for certificates of exemption for the import or export of items acquired before CITES, and for non-commercial exchange between institutions

  - is enforced in the United States by the Fish and Wildlife Service

  - includes three appendices that protect materials of varying degrees of scarcity:

    <u>Appendix I</u>. Species are in danger of extinction and there is no commercial trade in them. Any international transport of these materials requires permits from both the exporting and importing nations.

Appendix II. Species require strict regulation to prevent the danger of extinction and/or look like Appendix I species. Permits for international transport are issued by the exporting nation, and are allowed for any purpose not detrimental to the species.

Appendix III. Species are protected only within their native countries. They require permits for export even if they are plentiful elsewhere.

4. *Contacts for laws, regulations, and conventions – NPS natural history collections*

Direct questions relevant to the Endangered Species Act, and other laws and regulations about natural history collections to the regional/SO curator and the regional chief of natural resources management (or equivalent).

For information on CITES and other wildlife laws, including procedures and applications for getting permits to have endangered or threatened wildlife and plants in a park's museum collection, contact:

U.S. Department of the Interior
Fish and Wildlife Service
Office of Management Authority
4401 North Fairfax Drive, Room 700
Arlington, VA 22203

Tel: 703-358-2104
<http://international.fws.gov/global/cities.html

CITES Secretariat
15 chemin des Anemones
1219 Chatelaine-Geneva
Switzerland

<http://www.cites.org>

D. Policies and Standards

1. *Governmentwide and departmental policies and standards related to NPS museum collections*

The following governmentwide and departmental policies and standards apply to NPS museum collections:

- 41 CFR 101 Federal Property Management Regulations (FPMR) prescribes regulations, policies, procedures, and delegations of authority about the management of federal property.

- Interior Property Management Regulations, *Departmental Manual* Part 410, Personal Property Management (Subpart 114-60):

  – prescribes policies, procedures, and responsibilities governing the receipt, accountability, record-keeping, management, and survey of personal property in the Department of the Interior (DOI)

  – applies to all personal property acquired by all DOI bureaus and offices

  – ensures the safeguarding of government property against waste, fraud, and abuse

– references the management of museum collections, noting exceptions to normal property procedures. These references are summarized in Figure A.2.

- *Departmental Manual* Part 411, Museum Property Management, Chapters 1-3:

  – defines the types of museum property

  – establishes organizational responsibilities, policies, and standards for the preservation, protection, and documentation of museum property

  – establishes organizational responsibilities for developing plans to implement these policies and standards

  – identifies mandatory procedures, reports, and data

- *Departmental Manual* Part 517, Chapter 1, Pesticide Use Policy, outlines the pesticide use policy of the Department of the Interior. It is the policy of the Department:

  "To use pesticides only after full consideration of alternatives - based on competent analyses of environmental effects, safety, specificity, effectiveness, and costs. The full range of alternatives including chemical, biological, and physical methods, and no action will be considered. When it is determined that a pesticide must be used in order to meet important management goals, the least hazardous material that will meet such goals will be chosen."

2. *NPS management policies for museum collections*

Excerpts from NPS *Management Policies* (1988) that are specifically relevant to museum objects are as follows (chapter and page references appear in parentheses). This section will be updated when the revised *Management Policies* is issued (anticipated fall 2000).

Chapter 5 - Cultural Resource Management

Inventories (Page 5:1)

> "The following cultural resource inventories will be maintained for the national park system: …(3) a National Catalog of Museum Objects encompassing all cultural and natural history objects in NPS collections."

Preservation of Data and Collections and Protection of Research Potential (Page 5:3)

> "Field data, objects, specimens, and features of structures retrieved for preservation during cultural resource research and treatment projects, together with associated records and reports, will be managed within the park museum collection. Where practical, the features of sites and structures will be left in place."

Treatment of Museum Objects (Pages 5:9-10)

> "Preservation. A museum object will be preserved in its present condition through ongoing preventive conservation if (1) that condition is satisfactory for exhibit or research, or (2) another treatment is

warranted but cannot be accomplished until some future time. Interventional measures will be taken when preventive conservation measures are insufficient to reduce deterioration to a tolerable level, or when the object is so fragile as to be endangered under any circumstances. Intervention will be minimized to reduce the possibility of compromising the object's integrity.

Restoration. A museum object may be restored to an earlier appearance if (1) restoration is required for exhibit or research purposes, (2) sufficient data exist to permit restoration with minimal conjecture, and (3) restoration will not modify the object's known original character. Restoration will be accomplished using the techniques and materials that least modify the object and in such manner that the materials will be removable at a later time with minimal adverse effect. Restored areas will be distinguishable from original material and documented. Restoration will take into account the possible importance of preserving signs of wear, damage, former maintenance, and other historical and scientific evidence.

Reproduction. Museum objects needed for interpretive presentations will be reproduced for such use when the originals are unavailable or would be subject to undue deterioration or loss. The National Park Service will observe copyright laws with respect to reproduction."

Acquisition, Management, and Disposition of Museum Objects (Page 5:10)

"Objects and related documentation essential to achieving the purposes and objectives of the parks will be acquired and maintained in accordance with approved Scope of Collection Statements for each park. Archeological objects systematically collected within a park and natural history specimens systematically collected within a park for exhibit or permanent retention will be managed as part of the museum collection. Museum collection management and care will be addressed at all appropriate levels of planning.

Museum objects will be acquired and disposed of in conformance with legal authorizations and current NPS curatorial procedures. The National Park Service will acquire only collections having legal and ethical pedigrees, and each park will maintain complete and current accession records to establish the basis for legal custody of the objects in its possession. Museum catalog records will be prepared by each park to record basic property management data and other documentary information for museum objects. Objects will be inventoried in accordance with current procedures."

Historic Furnishings (Page 5:10)

"When the historic furnishings of a structure are present in their original arrangement, they will not be moved or replaced unless required for their protection or preservation, or unless the structure is designated for another use in an approved planning document. A structure may be refurnished in whole or in part if (1) its history is significantly related to a primary park theme, (2) refurnishing is the best way to interpret that history to the public, and (3) sufficient evidence of furniture design and placement exists to refurnish with minimal conjecture. Reproductions will be used only when prototypes exist to ensure the accurate re-recreation of historic pieces."

Archives and Manuscripts (Pages 5:10-11)

> "Archival and manuscript collections are considered museum property and will be managed in ways that preserve them intact for the future while providing current access.
>
> When an archival collection not owned by the National Park Service falls within a park's approved Scope of Collection Statement, every reasonable effort will be made to acquire it if (1) an appropriate storage facility will be provided by the Park Service or a cooperating institution, (2) the facility will be staffed by at least one archivist, curator, librarian, or other person experienced in caring for documentary materials, and (3) the collection will be made available to serious researchers under conditions that maximize both preservation and use and ensure security against theft and vandalism.
>
> Parks will retain notes or copies of records significant to their administrative histories when they periodically ship their official records to federal record centers."

Fire Detection and Suppression (Page 5:14)

> "When warranted by the significance of a historic structure or of the museum objects in a nonhistoric structure, adequate fire detection, warning, and suppression systems will be installed. Fire-fighting personnel will be advised of any peculiarities or dangers inherent in a structure and any objects to be given priority for protection or rescue. Park personnel will receive training in fire prevention and suppression with hand-held extinguishers at historic structures and museums, and designated personnel will be trained to respond to all emergencies involving museum collections.
>
> Smoking will not be permitted in spaces housing museum collections or in historic structures other than those adapted for modern residential and administrative uses."

Pest Management (Page 5:14)

> "The National Park Service will follow the integrated pest management approach in addressing pest problems related to cultural resources. All feasible nonchemical methods will be exhausted before resorting to the use of chemicals. Any use of pesticides for cultural resources will conform to the NPS pesticide use policy."

Chapter 4 - Natural Resource Management

Natural Resource Collections (Page 4:4)

> "Natural resource collections include nonliving and living specimens and associated field records. If placed in exhibits or retained in permanent collections, nonliving specimens and their associated field records will be cataloged into a park's museum collection. Management standards for such collections are specified in the *Cultural Resource Management Guideline* and the *Museum Handbook*."

Integrated Pest Management Procedures (Page 4:13)

> Integrated pest management (IPM) procedures will be used to determine when to control pests and whether to use mechanical, physical, chemical, cultural, or biological means….
>
> The choice to use a chemical pesticide will be based on a review by regional and Washington office coordinators of all other available options and a determination that these options are either not acceptable or not feasible; cost or staffing considerations alone will not be adequate justification for use of chemical control agents. Chemical pesticides that are not specifically exempt from reporting (regardless of who the applicator is) will be used only with prior approval by the Director on an annual basis. The application of such pesticides is subject to the Federal Insecticide, Fungicide, and Rodenticide Act (7 USC 136 et seq.), Department of the Interior policies and procedures (DM 517),…Environmental Protection Agency regulations in 40 CFR, and Occupational Safety and Health Administration regulations."

Paleontologic Resource Management (Page 4:19)

> "Management actions will be taken to prevent illegal collecting and may be taken to prevent damage from natural processes such as erosion. Protection may include construction of shelters over specimens for interpretation in situ, stabilization in the field, or collection, preparation, and placement of specimens in museum collections. The localities and geologic settings of specimens will be adequately documented when specimens are collected."

Chapter 7 - Interpretation and Education

Interpretation and Native Americans (Page 7:5)

> "The National Park Service will not exhibit native American disinterred skeletal or mummified human remains or photographs or replicas of them. There will be no display of grave goods or other objects if native Americans who are culturally associated with them object to such exhibit. Associated native American tribes and groups will be consulted to determine the religious status of any object, the sacred nature of which is suspected but not confirmed, before it is exhibited or before any action is taken."

Chapter 8 - Use of the Parks

Research and Collection Activities (Pages 8:15-16)

> "Research activities by non-NPS personnel that, in the superintendent's judgment, might disturb resources or visitors or that require the waiver of any regulation may be allowed in parks only pursuant to the terms and conditions of an appropriate permit. Scientific collecting activities that involve the removal of plants, animals, minerals, or archeological, historical, or paleontological objects will be allowed only if they are (1) proposed in conjunction with authorized research activities and (2) authorized and conducted in accordance with all applicable legislation, regulations, and guidelines…."

Chapter 9 - Park Facilities

Curatorial Facilities (Page 9:15)

> "Park curatorial facilities should be adapted to the needs of each park. They may share space in visitor centers or administrative office buildings or be housed in completely separate buildings; however, incorporation with maintenance facilities should be avoided because of the heightened danger of fire, chemical spills, and similar accidents. Curatorial facilities will meet the collection's special requirements for security, fire suppression, and environmental controls."

Chapter 10 - Concessions Management

Merchandise and Handcrafts (Pages 10.8-9)

> "Concessioners may not sell merchandise that violates conservation principles. The sale of original prehistoric or historic archeological artifacts or vertebrate paleontologic specimens is prohibited. Clearly labeled replicas of such artifacts and specimens may be sold."

3. *NPS Director's Orders and guidance for museum collections*

Director's Orders supplement the NPS *Management Policies*. All Director's Orders are on the Web at <http://www.nps.gov/refdesk/DOorders/>.

Director's Order #28: Cultural Resource Management

Director's Order #28: Cultural Resource Management, is implemented through Release No. 5 of the *Cultural Resource Management Guideline* (1997). The *Cultural Resource Management Guideline* gives guidance on how to apply policies and standards. The *Cultural Resource Management Guideline* applies to museum objects and archival and manuscript collections that are housed in parks, archeological and preservation centers, and other NPS organizational units. Excerpts from this guideline follow:

Research

- Each park has an approved stand-alone Scope of Collection Statement defining the purpose and prescribing limits and use of its museum collection.

- Every museum object is accessioned as soon as it is in NPS custody and cataloged promptly thereafter. Paper museum records and ANCS+ magnetic media are kept in secure fire-resistant storage.

- All materials resulting from systematic research projects associated with an accession are housed at the same repository, except when on temporary loan for specific use elsewhere. Within that repository, objects and records composing an accession may be stored or filed separately from related objects and records to the extent required for security, fire protection, enhanced or reduced access, preservation, fiscal control, or exhibition.

- Each park has consulted with affected Native Americans on any acquisitions that involve human remains and associated funerary objects, unassociated funerary objects, sacred objects, or objects of cultural patrimony.

- Archival and manuscript collections are surveyed, appraised, accessioned, cataloged, rehoused, arranged, and described according to procedures and guidelines contained in the *Museum Handbook,* Part II, Appendix D.

- Archival and manuscript collections are arranged and described by or under the guidance of an archivist in accordance with professional standards and procedures. A preliminary finding aid is produced as described in the *Museum Handbook*, Part II, Appendix D.

- Museum objects not relevant to a park according to its SOCS are deaccessioned as permitted by current NPS procedures.

- Archeological objects and natural history specimens systematically collected within a park are deaccessioned only if lost or so deteriorated that they no longer have scientific value.

- Objects and archival and manuscript collections in a park's museum collection are made available to qualified researchers who can demonstrate a need to use them. Access is permitted under conditions designed to ensure the security and preservation of the materials, including adequate staff supervision. Copyright is respected in accordance with guidance in the *Museum Handbook,* Part I, Chapter 2; the *Museum Handbook,* Part II, Chapter 2 and Appendix D.

- Each outgoing loan is documented by an outgoing loan agreement. All loaned museum objects are cataloged unless loaned to NPS repositories for collections management and storage purposes. Conditions for preserving, handling, and shipping and an itemized list of museum objects are included in a loan agreement.

Planning

- Plans for park management, development, exhibits, interpretation, and research address the proper documentation, protection, preservation, and use of objects.

- Each park and center has a collection management plan to guide proper management and care of its museum collection and a separate collection storage plan if necessary.

- Each park and center has one or more collection condition surveys to detect problems with the condition of museum objects and determine conservation treatment priorities.

- Proposals for environmental control measures in historic structures are based on data from environmental monitoring for at least one year.

- Each park ensures that the cataloging and curation of objects, specimens, and associated records recovered from archeological and scientific projects are accomplished.

- Each park ensures that approved museum plans and reports are entered in the Cultural Resources Management Bibliography (CRBIB).

Stewardship

- Each park and center has identified threats to the security and protection of its museum collection and has taken appropriate measures to deal with them, including emergency planning.

- Each park and center has implemented a preventive conservation program whereby museum objects are exhibited, handled, and stored with sensitivity to their specific environmental needs and vulnerabilities and are regularly inspected for evidence of deterioration.

- Preservation and use of museum objects accords with Director's Order #24: NPS Museum Collections Management; the *Museum Handbook*, Part I; and National Archives and Records Administration standards.

- Conservation treatment required to stabilize or restore museum objects entails the least intervention necessary to satisfy treatment goals.

- Inventories of museum objects and status reports on collections are completed and submitted in accordance with current NPS museum property procedures and other administrative requirements.

- Any use of museum objects likely to damage them or hasten their deterioration is undertaken only after careful review and approval.

Director's Order #24: NPS Museum Collections Management

Director's Order #24: NPS Museum Collections Management, gives requirements for managing park museum collections. It is supplemented by the *Museum Handbook*, Parts I-III. Director's Order #24 is reprinted in full in Figure A.3.

E. List of Figures

16 USC Sec. 18f Management of museum properties

The purpose of this section and sections 18f-2 and 18f-3 of this title shall be to increase the public benefits from museums established within the individual areas administered by the Secretary of the Interior through the National Park Service as a means of informing the public concerning the areas and preserving valuable objects and relics relating thereto. The Secretary of the Interior, notwithstanding other provisions or limitations of law, may perform the following functions in such manner as he shall consider to be in the public interest:

(a)   Donations and bequests—Accept donations and bequests of money or other personal property, and hold, use, expend, and administer the same for purposes of this section and sections 18f-2 and 18f-3 of this title;
(b)   Purchases—Purchase museum objects, museum collections, and other personal properties at prices he considers to be reasonable;
(c)   Exchanges—Make exchanges by accepting museum objects, museum collections, and other personal properties, and by granting in exchange therefore museum property under the administrative jurisdiction of the Secretary which is no longer needed or which may be held in duplicate among the museum properties administered by the Secretary, such exchanges to be consummated on a basis which the Secretary considers to be equitable and in the public interest;
(d)   Accepting loans of museum objects—Accept the loan of museum objects, museum collections, and other personal properties and pay transportation costs incidental thereto, such loans to be accepted upon terms and conditions which he shall consider necessary; and
(e)   Making loans of museum objects—Loan to responsible public or private organizations, institutions, or agencies, without cost to the United States, such museum objects, museum collections, and other personal property as he shall consider advisable, such loans to be made upon terms and conditions which he shall consider necessary to protect the public interest in such properties.

Sec. 18f-1. [Does not apply to the National Park Service.]

Sec. 18f-2. Additional functions

(a)   Museum objects and collections—In addition to the functions specified in section 18f of this title, the Secretary of the Interior may perform the following functions in such manner as he shall consider to be in the public interest:

(1) Transfer museum objects and museum collections that the Secretary determines are no longer needed for museum purposes to qualified Federal agencies, including the Smithsonian Institution, that have programs to preserve and interpret cultural or natural heritage, and accept the transfer of museum objects and museum collections for the purposes of this section and sections 18f and 18f-3 of this title from any other Federal agency, without reimbursement. The head of any other Federal agency may transfer, without reimbursement, museum objects and museum collections directly to the administrative jurisdiction of the Secretary of the Interior for the purpose of this section and sections 18f and 18f-3 of this title.

(2)   Convey museum objects and museum collections that the Secretary determines are no longer needed for museum purposes, without monetary consideration but subject to such terms and conditions as the Secretary deems necessary, to private institutions exempt from Federal taxation under section 501(c)(3) of title 26 and to non-Federal governmental entities if the Secretary determines that the recipient is dedicated to the preservation and interpretation of natural or cultural heritage and is qualified to manage the property, prior to any conveyance under this subsection.

(3)   Destroy or cause to be destroyed museum objects and museum collections that the Secretary determines to have no scientific, cultural, historic, educational, esthetic, or monetary value.

(b)   Review and approval—The Secretary shall ensure that museum collections are treated in a careful and deliberate manner that protects the public interest. Prior to taking any action under subsection (a) of this section, the Secretary shall establish a systematic review and approval process, including consultation with appropriate experts, that meets the highest standards of the museum profession for all actions taken under this section.

Sec. 18f-3. Application and definitions

(a)   Application—Authorities in this section and sections 18f and 18f-2 of this title shall be available to the Secretary of the Interior with regard to museum objects and museum collections that were under the administrative jurisdiction of the Secretary for the purposes of the National Park System before November 12, 1996, as well as those museum objects and museum collections that may be acquired on or after November 12, 1996.
(b)   Definitions—For the purposes of this section and sections 18f and 18f-2 of this title, the terms “museum objects” and “museum collections” mean objects that are eligible to be or are made part of a museum, library, or archive collection through a formal procedure, such as accessioning. Such objects are usually movable and include but are not limited to prehistoric and historic artifacts, works of art, books, documents, photographs, and natural history specimens.

Figure A.1. Museum Properties Act of 1955 as amended November 12, 1996

114-60.100(b)	All museum property is accountable with no dollar threshold.
114-60.100(e)	Museum property is not capitalized.
114-60.100(n)	Definition of museum property
114-60.100(bb)	Sensitive property shall, at a minimum, include firearms…
114-60.200(a)	(1)…museum property will not be controlled in a general ledger control account. All items in a museum collection will be controlled through accessioning and cataloging.
114-60.401(c)	All museum property is controlled through accessioning and cataloging, regardless of value.
114-60.503(e)	An Accession Receiving Report will be used to document receipt of museum property.
114-60.601(b)	Because permanent marking of museum property is potentially damaging, items of museum collections are exempted from the marking requirements of this subpart. Bureaus and offices having museum collections will develop and implement procedures: (NPS procedures are outlined in the NPS *Museum Handbook*, Part II).
114-60.802-1(a)	A Certificate on Unserviceable Property will not be issued for…museum property.
114-60.811-2(f)	Examples of property irregularities include…loss or theft of a firearm or weapon.

Figure A.2. References to Museum Collections Management in Interior Property Management Regulations, *Departmental Manual* Part 410, Personal Property Management (Subpart 114-60)

Figure A.3. Director's Order #24: NPS Museum Collections Management

National Park Service

DIRECTOR'S ORDER #24: NPS MUSEUM COLLECTIONS MANAGEMENT

Approved: /s/ Robert Stanton (original on file)
Director, National Park Service

Effective Date: August 21, 2000
Sunset Date: August 21, 2004

This Director's Order supplements NPS *Management Policies* and, augmented by procedures in the *Museum Handbook*, supercedes Special Directives 80-1, "Guidance for Meeting NPS Preservation and Protection Standards for Museum Collections"; 87-3, "Conservation of Archeological Resources," as it pertains to museum collections; 91-4, "Ensuring that Natural Resource Projects Fund the Curation of Collections"; 94-6, "Ensuring that Projects Generating Museum Collections Fund Cataloging and Basic Preservation"; 93-2, "Preserving NPS Cellulose Nitrate Film Collections"; and Staff Directive 87-1, "NPS Clearinghouse Procedures and Requirements Regarding Disposal and Acquisition of Excess and Needed Museum Objects."

1. Background and Purpose

The National Park Service is custodian in perpetuity of irreplaceable and priceless museum collections that include objects, specimens, and archival and manuscript materials (textual, electronic, and audio-visual documents), representing cultural and natural resources in the United States, including but not limited to the disciplines of archeology, biology, ethnology, geology, history, and paleontology. NPS museum collections are part of the natural and cultural heritage of the country and are collected, preserved, and interpreted for public benefit.

NPS museum collections inform and enhance every aspect of park work, from resource management and interpretation, to research and public accountability. Featured in exhibits, interpretive programs, films, and print and electronic publications, NPS museum collections are key resources for educators, students, researchers, park managers, park neighbors, and the general public. Accessibility of museum collections is a prime component of museum management.

The NPS *Management Policies* lay the foundation by which the NPS meets its responsibilities toward these museum collections. This Director's Order provides further policy guidance, standards, and requirements for preserving, protecting, documenting, and providing access to, and use of, NPS museum collections.

2. Authority for this Director's Order

Authority for issuing this Director's Order is found in 16 U.S.C. 1 through 4, and delegations of authority contained in Part 245 of the Department of the Interior Manual. Additional key related authorities are found in the Antiquities Act of 1906 (16 U.S.C. 431-433), the Historic Sites Act of 1935 (16 U.S.C. 461-467), the Management of Museum Properties Act of 1955, as amended (16 U.S.C. 18f), the Archaeological Resources Protection Act of 1979 (16 U.S.C. 470aa-mm), the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001), and the Departmental Manual 411 DM, Managing Museum Property.

3. Objectives

The objectives of this Director's Order, in conjunction with the accompanying Level 3 *Museum Handbook*, are to:

- Ensure that NPS managers and staff have information on the standards and actions for successfully and ethically complying with NPS *Management Policies* on museum collections.

- Provide a means of measuring and evaluating progress in preserving, protecting, documenting, accessing, and using museum collections.

4. Responsibilities

4.1 Associate Director, Cultural Resource Stewardship and Partnerships

The Associate Director, Cultural Resource Stewardship and Partnerships, with the assistance of the Chief Curator, has the following responsibilities:

4.1.1 Code of Ethics: Follow the Code of Ethics for the museum management program.

4.1.2 *Museum Handbook*: Develop, issue, and periodically update a *Museum Handbook* containing the information park managers need to know to comply with laws, departmental and Service-wide policies, regulations, professional standards, and a code of ethics applicable to museum collections management. Include in the *Museum Handbook*, as a supplement to this Director's Order, specific guidance for collecting, preserving, protecting (including security and fire protection), documenting, accessing, and using museum collections, clearly distinguishing between those actions that are mandatory requirements and those that are discretionary. Cite those laws, policies, and regulations in relevant sections.

4.1.3 Strategic Plans: Develop strategic plans and goals to improve and maintain the management of NPS museum collections Service-wide, consistent with the Government Performance and Results Act of 1993 (31 USC 1115).

4.1.4 National Catalog: Maintain for management and public benefit a National Catalog of Museum Objects, consisting of electronic and paper catalog records, with accession and catalog data for all parks. Develop and maintain an automated collections management program (the Automated National Catalog System [ANCS+ and its successor]) for use by parks, centers, and offices Service-wide, as well as the general public.

4.1.5 Report Requirements and Analysis: Identify reports that are required annually, or at other times, to further museum collections management. Reporting requirements will be kept to the minimum necessary. Maintain, analyze, and report on data submitted by parks, centers, and regions, including: the Collections Management Report, the NPS Checklist for Preservation and Protection of Museum Collections; funding distributions and accomplishments; and other required reports and surveys.

4.1.6 Annual Inventory: Review regional certifications of annual inventories, and take any necessary corrective action.

4.1.7 Museum Supplies, Equipment, and Technologies: Research products and facilitate park and center acquisition and use of appropriate supplies, forms, equipment, and technologies for management of museum collections.

4.1.8 Service-wide Initiatives: Develop and coordinate Service-wide initiatives and funding to improve museum management.

4.1.9 Technical Information: Publicize and disseminate technical information on museum management, including conservation and archival collections management.

4.1.10 Information Access: Develop and maintain access to Service-wide information on NPS museum collections through various media (for example, ANCS+ and World Wide Web).

4.1.11 Professional Qualifications and Training: Evaluate Service-wide professional competencies and training needs in museum management, and develop strategies, guidelines, and curricula to meet those needs. Coordinate training to address new technologies, programs, and initiatives.

4.1.12 Plan Review: Review draft park plans that receive Washington Office review, such as General Management Plans, for appropriate coverage of museum management.

4.1.13 Technical Assistance: Provide technical assistance and advice to park and center managers regarding acquiring, preserving, protecting, documenting, accessing, and using museum collections. Provide this assistance and advice at the request of regions.

4.2 Regional Directors and WASO Associate Directors with Museum Collections Responsibility

Regional directors (assisted by regional museum support staff), and WASO associate directors accountable for museum collections, have the following responsibilities:

4.2.1 Code of Ethics: Follow the Code of Ethics for the museum management program.

4.2.2 Plan and Performance Review: Use the strategic and annual performance planning processes, the park planning process, and the performance management system to ensure that superintendents and center managers meet their responsibilities to manage museum collections according to this directive. Review park plans for appropriate coverage of museum collections management, and to ensure consistency with NPS requirements.

4.2.3 Technical Assistance: Provide technical assistance to parks and centers to assist them in meeting NPS museum management requirements, and in providing for access and use of collections.

4.2.4 Staffing and Training: Evaluate museum management staffing and training needs, and develop and provide training to park and center staff. Regional directors will alert the Associate Director, Cultural Resource Stewardship and Partnerships, about regional training needs that may apply Service-wide.

4.2.5 Plans, Priorities, and Reports: Develop plans and set priorities (including funding priorities) for managing museum collections based on all approved planning documents and information provided through Service-wide reports and requirements, including the Collections Management Report, NPS Checklist for Preservation and Protection of Museum Collections, and Automated Inventory Program. Review reports to ensure that parks and centers meet reporting requirements.

4.2.6 Annual Inventory Certification: Annually certify to the Associate Director, Cultural Resource Stewardship and Partnerships, Attention: Chief Curator, no later than September 30 each fiscal year, that parks and centers have completed their annual inventories. Review park and center annual inventories and take any necessary corrective actions. Establish a regular schedule for parks in the region to submit the inventories.

4.2.7 Destructive Analysis and Consumptive Use: After careful review, if the benefits can be clearly shown to outweigh the resulting or potential damage or loss, approve destructive analysis of rare or highly significant objects, specimens, and archival items, and any consumptive use of museum collections.

4.2.8 Unconditional Gifts: Grant exceptions to the unconditional gift policy on a rare, and case-by-case basis.

4.3 Park Superintendents and Center Managers

Park superintendents, center managers, and others who manage collections (with the assistance of museum management staff) have the following responsibilities:

4.3.1 Code of Ethics: Follow the Code of Ethics for the museum management program.

4.3.2 Standards: Meet museum management standards in the NPS *Museum Handbook* (Parts I-III) for:

- acquiring, preserving, protecting, documenting (including accessioning, cataloging, lending, deaccessioning), accessing, and using museum collections; and
- completing actions specific to archival and manuscript collections (appraising, arranging, describing, producing finding aids, and providing reference and duplication services).

4.3.3 Procedures: Follow procedures in the *Museum Handbook*.

4.3.4 Ongoing and Corrective Actions: Provide ongoing funding for recurring museum management functions and take appropriate action to correct identified preservation, protection, documentation, and access and use deficiencies, including programming for funding to correct such deficiencies. Complete Project Management Information System (PMIS) and Resource Management Plan (RMP) project statements that identify all preservation, protection, documentation, access and use needs.

4.3.5 Staffing and Training: Evaluate and address museum management staffing and training needs according to established personnel qualifications standards and Service-wide professional competencies.

4.3.6 Scope of Collection: Approve and keep current a Scope of Collection Statement to identify the scope of collecting activities and define the purpose of the collection. Ensure acquisitions are consistent with the Scope of Collection Statement. Deaccession objects inconsistent with the Scope of Collection Statement.

4.3.7 Collection Management Plan: Approve, keep current, and implement a Collection Management Plan to:

- evaluate issues of preserving, protecting (including security and fire protection), documenting, accessing and using collections;
- address issues specific to archival and manuscript collections (appraising, arranging, describing, producing finding aids, and providing reference and duplication services); and
- propose a strategy to address the issues, including staffing and cost estimates.

4.3.8 Housekeeping Plan: Approve, keep current, and implement a Housekeeping Plan for every space that houses museum collections, to ensure that housekeeping routines are sensitive to museum collections preservation needs.

4.3.9 Integrated Pest Management: Approve, keep current, and implement an Integrated Pest Management Plan that addresses the museum collections.

4.3.10 Emergency Operation: Approve, keep current, and implement a Museum Collections Emergency Operations Plan, as part of the park's Emergency Operations Plan, that identifies museum collection vulnerabilities to events (such as fire, earthquakes, and floods), and identifies responses that will protect resources without endangering human health and safety. Ensure staff is practiced and prepared for emergency response.

4.3.11 Job Hazard Analysis: Complete a Job Hazard Analysis (JHA) for all museum jobs that have an associated history of injury, illness, or death; or that require the use of personal protection equipment, such as respirators; or that involve activities that are clearly dangerous, such as handling collections with mold, working with toxic or flammable chemicals, or operating heavy machinery.

4.3.12 Collection Condition: Monitor and record information about the environment in spaces housing collections and manage the environment to maximize preservation. Complete Collection Condition Surveys, as needed, to assess conditions in spaces housing museum collections, to record the condition of objects or groups of objects, and to determine treatment needs and priorities. Incorporate survey data in ANCS+ and in accession or catalog files.

4.3.13 Accession and Catalog Records: Accession collections upon acquisition to establish basic accountability. Catalog the collections immediately following acquisition, or program to catalog them in the near future. Survey, appraise, rehouse, arrange, and describe archival and manuscript collections and prepare finding aids. Develop park archival duplication and reference procedures. Have PMIS statements in place to address eliminating any archival processing backlog.

4.3.14 Accession and Catalog Backup: Maintain a complete current backup of all electronic accession and catalog records at a location that is not vulnerable to the same catastrophic events as the computer workstation. Submit a complete annual backup to the National Catalog in Harpers Ferry, West Virginia.

4.3.15 Unconditional Gifts: Accept only unconditional gifts and bequests, and, where possible, obtain applicable copyrights and releases with acquisitions. Obtain regional director's approval for rare exceptions, on a case-by-case basis.

4.3.16 Project-generated Collections: Require project budgets to include funding for the basic management of collections that are project-generated. Collections management includes cataloging; labeling; conservation examination and treatment (including specimen preparation); initial storage of objects and specimens; and organization and storage of project documentation, including appraisal, arrangement, description, finding aid production, and appropriate archival housing.

- Before starting, permitting, or contracting a project, specify in writing in the task directive, proposal, agreement, permit, or contract, the parties responsible, the designated NPS or non-NPS repository, the collections management tasks, and a time schedule for completion.
- Fund subsequent ongoing maintenance costs of collections management from the operating base of the responsible park, center, or other repository.
- If project-generated collections cannot be accommodated in available storage space, and new storage space construction is necessary, program to construct new space to accommodate the expanded collection. If interim storage is needed, specify in the project task directive the location of that storage, and state that it must meet NPS standards. Identify the funding source for interim storage.

4.3.17 Systematic Collections: Add collections made through systematic research to the museum collection. House those associated with a single accession at the same repository to facilitate research and use. As appropriate, lend these collections for exhibit, research, conservation, and other approved uses. Superintendents may authorize housing of collections from the same accession at different repositories if by so doing preservation, research, and use will be improved.

4.3.18 Collections Management Report: Annually complete the automated Collections Management Report (CMR), using ANCS+. The report provides information on accessions, deaccessions, cataloging, backlogs of objects to be cataloged, use of museum collections, and total collection size. The report must include all collections, whether kept in park facilities, other NPS facilities, or in non-NPS repositories. Submit the CMR using ANCS+.

4.3.19 Annual Inventory: Conduct an annual collection inventory on a regular schedule using the Automated Inventory Program (AIP) in ANCS+ and reconcile the results with existing accession and catalog records. Take any necessary corrective action.

4.3.20 Checklist: Keep the NPS Checklist for Preservation and Protection of Museum Collections (Checklist) up-to-date in the Automated Checklist Program (ACP) in ANCS+. The Checklist records information on preservation and protection conditions in parks and centers, identifies deficiencies, and provides estimated costs to correct deficiencies.

4.3.21 Treatment Documentation: Document treatment of collections, and record that information in ANCS+ and retain reports and documentation in accession or catalog files.

4.3.22 Cellulose Nitrate and Cellulose Ester Film: Identify cellulose nitrate and cellulose ester film, and take steps to preserve the visual information contained by duplicating the images onto safety film. After inspecting the copies, evaluate and either deaccession and destroy or provide for long-term storage of the original film according to the criteria in *Museum Handbook*, Part I, Appendix M, "Management of Cellulose Nitrate and Ester Film."

4.3.23 Access and Use: Promote access to cataloged collections for research and interpretive purposes through a variety of means and media, such as exhibits, interpretive programs, loans, publications, film and television, the World Wide Web, archival finding aid production and distribution, and posting of finding aids and repository-level guides for archival and manuscript collections in the National Union Catalog of Manuscript Collections (NUCMC).

- Ensure that access and use are consistent with the laws and NPS policies pertaining to Freedom of Information Act disclosures, copyright, privacy, publicity, obscenity and pornography, defamation, and resource protection.
- Document access and use with a researcher logbook, signed access policy statement, researcher registration, copyright and privacy restriction statement, and duplication forms.

4.3.24 Consultation: Consult with affiliated groups in managing collections, including Native American groups when managing collections subject to the Native American Graves Protection and Repatriation Act.

4.3.25 Preservation vs. Destructive Use: Manage objects to preserve their condition, including using reproductions when originals may be damaged by use. Authorize in writing destructive analysis of collections, except for rare or highly significant objects, specimens, and archival materials. Obtain regional director approval for destructive analysis of rare or highly significant objects, specimens, and archival materials and for any consumptive use of collections.

4.3.26 Exhibits: Exhibit collections according to an approved exhibit plan, accompanied by maintenance instructions. Ensure that all exhibits meet the standards in the NPS Checklist for Preservation and Protection of Museum Collections.

4.3.27 Objects in Historic Structures: Document furnishings that are exhibited in their associated historic structures with an approved Historic Furnishings Report. Consider the preservation requirements of both objects and historic structures when objects are on exhibit or in storage in historic structures.

4.3.28 Exhibit of Human Remains: Never exhibit Native American human remains or photographs, drawings or renderings, or casts of the remains. Exhibit non-Native-American human remains and photographs, drawings or renderings, or casts of the remains only in consultation with traditionally associated groups.

4.3.29 CRBIB: Ensure that approved museum plans are entered in the Cultural Resource Management Bibliography (CRBIB).

5. Submissions and Deadlines

5.1 Collections Management Report: Parks and centers will submit the CMR for the previous fiscal year by **November 1** simultaneously to the Regional Director, Attention: Regional Curator, and to the Museum Management Program (MMP), National Center for Cultural Resources. The MMP will prepare this information for the strategic planning and annual reporting processes and compile and distribute cluster, regional, and Service-wide reports.

Parks and MMP use CMR data to report on Strategic Plan Goal Ia6 in compliance with the Government Performance and Results Act.

5.2 Checklist: Parks and centers will update their Checklist in the ACP by **November 1** to show changes as of the end of the previous fiscal year. Parks and centers will submit their Checklist data using the ACP simultaneously to the Regional Director, Attention: Regional Curator, and to the MMP. The MMP will compile and distribute cluster, regional, and Service-wide reports.

Parks and MMP use Checklist data to report on Strategic Plan Goal Ib2D in compliance with the Government Performance and Results Act.

5.3 Annual Inventory: Parks and centers will annually submit the inventory generated using the AIP to the regional director, according to a schedule that the region approves. The regional director will certify the completion of the inventories to the Associate Director, Cultural Resource Stewardship and Partnerships, Attention: Chief Curator, no later than **September 30** each fiscal year.

5.4 National Catalog Submissions: Parks and centers will annually submit to the National Catalog complete electronic backups of their ANCS+ accession and catalog records, identifying new or modified records. The submission for the previous fiscal year is due in **November, December, or January,** according to the schedule established in the *Museum Handbook*, Part II. The National Catalog will print and store archival paper copies of the catalog records. The National Catalog will print and send paper copies of catalog records to parks and centers upon request.

--- End of Director's Order **---**

Appendix B: Accreditation

List of Figures

APPENDIX B: ACCREDITATION

A. Overview

1. *What is museum accreditation?*

In the United States, the American Association of Museums (AAM) operates a museum accreditation program. The program assesses how well a museum meets current professional standards. The assessment process involves self-study by the museum as well as peer review. The AAM Accreditation Commission, composed of appointed members of the museum community, grants accreditation status to museums that meet the generally accepted standards. The Commission reviews an accredited museum's status every five to ten years.

2. *What institutions are eligible to apply?*

Applicants must meet eligibility criteria and demonstrate the characteristics of an accreditable museum as published by the AAM. Application information is on the AAM Web site at http://www.aam-us.org/museumresources/accred/apply.cfm. See Section A.8 for additional information.

Park museums that have been open for at least two years, have public exhibits, and are operating according to NPS policies and procedures are likely to meet the AAM accreditation eligibility criteria.

In addition, NPS requires that parks meet the following requirements before applying for accreditation:

- All collections are accessioned.
- All collections are cataloged ***or*** the park has an approved action plan that addresses cataloging of the backlog (park-approved Project Management Information System [PMIS] Project Statement for backlog cataloging).
- Collections are adequately stored, secured, and protected by fire detection and suppression systems, ***or*** the park has approved program management plans (such as the park resource stewardship strategy and the Collection Management Plan) that address the correction of deficiencies identified on the NPS Checklist for Preservation and Protection of Museum Collections (Museum Checklist).
- An approved Scope of Collection Statement is in effect.
- Exhibits are relevant to the park mission and adequately maintained.

3. *Why should a park museum apply for accreditation?*

Accreditation provides review and recognition of the park's museum programs and operations by the museum profession. It offers the benefits of ongoing critical self-evaluation and peer review. Accreditation gains public recognition, which attracts volunteers and visitors. It also facilitates loans, traveling exhibitions, and fundraising to support park museum operations.

4. *What does accreditation involve?*

The accreditation process involves the following steps:

- Park reviews information about accreditation, including tips for preparedness, tools for determining readiness, and eligibility criteria, on the AAM Web site.

- Park consults with regional curator about accreditation.

- Park requests approval to apply and Regional Director grants approval or identifies improvements needed.

- Park completes and submits the application form. When the application is accepted, the AAM will bill the park for the application fee of $400. The park should pay this fee with the charge card.

- Park completes self-study.

- AAM Accreditation Commission reviews self-study and grants interim approval, tables interim approval pending submission of clarifying information or correction of deficiencies within six to twelve months, or denies interim approval. Interim approval is necessary to continue in the accreditation process.

- Park reviews list of potential Visiting Committee members that AAM provides, noting any conflicts of interest.

- AAM selects the Visiting Committee Team Contact who then selects a second team member and schedules the visit directly with the park superintendent.

- Visiting Committee visits park.

- Visiting Committee submits report to AAM Accreditation Commission.

- Accreditation Commission reviews the report and grants accreditation, tables the decision pending correction of identified concerns within one year, denies accreditation, or defers a decision pending submission of additional clarifying information.

- AAM initiates mandatory subsequent review of accreditation within ten years (or within five years if the museum was identified for early subsequent review at the time of accreditation).

See Section B for step-by-step procedures in the accreditation process.

5. *How long will accreditation take?*

Generally, the initial accreditation process requires 31-43 months and the subsequent review takes 27-38 months. The process varies for each museum depending on such factors as the:

- time the park takes to prepare the documents

- scheduling of Accreditation Commission reviews and follow-up actions if tabling, denials, or deferrals are involved

- time required to schedule the Visiting Committee

See the "Quick Reference Guide to the Accreditation Review Process" on the AAM Web site.

6. *How much will accreditation cost the park?*

The accreditation process represents a significant commitment of park staff time. In addition, the park pays accreditation fees and travel expenses.

AAM bills the park for accreditation fees and the park uses the charge card to pay:

- a non-refundable one-time application fee billed following acceptance of the application ($400; subject to change). This fee is not required for subsequent reviews.

- an annual participation fee billed each January for accredited museums and applicants ($200 for members; $500 for non-members; both subject to change).

For the Visiting Committee's travel expenses, the park must issue a purchase order to the AAM in advance of the visit for the Visiting Committee's services. The cost estimate should be based on the anticipated travel expenses of the Visiting Committee. Following the visit, the AAM will bill the park for the Visiting Committee's costs.

7. *What funds are available for accreditation?*

Parks may use appropriated funds and donated funds, including cooperating association funds, to pay accreditation fees.

8. *Where can I get an application and further information?*

Complete information on the Accreditation Program, a downloadable application form, and information on ordering an Accreditation Resource Kit are on the AAM Web site at http://www.aam-us.org/museumresources/accred/apply.cfm.

The Accreditation Resource Kit includes the following publications:

- ***A Higher Standard: The Museum Accreditation Handbook.*** This publication is the definitive guide to the accreditation process and a preview of what is expected of an accredited institution.

- ***The Accreditation Self-Study Guide.*** This booklet provides a framework for the institution to conduct a self-evaluation of its operations and for application to the accreditation program.

- ***The Accreditation Self-Study Guide on CD-ROM***

You may also order the Accreditation Resource Kit from the AAM

Bookstore by mail, telephone, or via the online catalog:

AAM Bookstore
1575 Eye Street, NW, Suite 400
Washington, DC 20005
(202) 289-9127
E-mail: bookstore@aam-us.org
http://www.aam-us.org/bookstore/index.cfm

AAM Accreditation Program
1575 Eye St. N.W., Suite 400
Washington, DC 20005
(202) 289-9116
E-mail: accreditation@aam-us.org

> ***If you are interested in gaining accreditation for the park museum, be sure to consult the regional curator as far in advance as possible. The region may have additional guidelines and procedures for the park to follow. Also, the regional curator can provide helpful information, insight, and support throughout the process.***

B. Accreditation Step-by-Step

Step 1: Consultation

Consult with the regional curator about the park's readiness to apply for accreditation. Confirm that the park meets AAM and NPS eligibility criteria. See Section A.2. If the park doesn't meet the eligibility criteria, correct the deficiencies and repeat Step 1.

Note: During the application or accreditation process the park, regional office, or the Accreditation Commission may identify deficiencies that the park needs to correct before going to the next step.

Step 2: Regional Director Approval

Request Regional Director approval to apply for accreditation. The Regional Director, upon the recommendation of the regional curator, grants approval for the park to apply for accreditation, or identifies deficiencies that the park needs to correct.

Step 3: Application

Study information on the AAM Web site at http://www.aam-us.org/museumresources/accred/index.cfm. Download and complete the application. Consult the regional curator and submit the application to the AAM. Pay the application fee when the AAM bills the park. See Section A.6.

Step 4: Self-Study

The AAM sends the Accreditation Self-Study Questionnaire to the park. Complete the self-study in consultation with the regional curator. Submit the self-study and supporting documents to the AAM within one year of the application. Use Figure B.1, "Attachments Required for Self-Study: AAM Documents and NPS Equivalents," to select supporting documents for submission with the questionnaire.

Step 5: Accreditation Commission Review of Self-Study (first-time applicants only)

The Accreditation Commission reviews the self-study and takes one of the following actions:

- Grants interim approval: the park may proceed to the next step.

- Denies interim approval: the park must withdraw its application but may reapply in the future.

- Tables the decision: the park must provide further information or clarification within six to twelve months. Upon reviewing the additional information, the Accreditation Commission will grant interim approval or deny accreditation.

Step 6: Selection of Visiting Committee

The AAM will send the park a roster of potential Visiting Committee members. Work with the regional curator to identify any conflicts of interest and return the list by the due date (generally one month). AAM selects the Visiting Committee team contact who then selects a second team member.

Step 7: Scheduling the Visiting Committee Visit

The team contact works with the park superintendent to schedule the Visiting Committee's visit. The park issues a purchase order to AAM to cover the travel expenses of the Visiting Committee. See Section A.6.

Step 8: Visiting Committee Visits Park

The Visiting Committee visits the park. AAM bills the park to cover the committee's travel expenses.

Step 9: Visiting Committee Report

The Visiting Committee submits its report to the AAM Accreditation Commission within four weeks of the visit.

Step 10: Accreditation Commission Review

The Accreditation Commission reviews the self-study and the report and takes one of the following actions:

- Grants accreditation (usually for ten years, but may be granted for only five years if the Commission has concerns)
- Denies the award
- Tables its decision for specific concerns or deficiencies to be addressed within one year
- Defers a decision if additional information is needed

The Accreditation Commission Chair sends a written notification to the park superintendent stating the decision and providing a copy of the Visiting Committee's report. The AAM separately returns the self-study materials to the park. If the park museum is accredited, the notification states the date to initiate subsequent accreditation.

Step 11: Subsequent Accreditation

On a cycle of ten (or five) years, as specified at the time of accreditation, the AAM notifies the park of the need to review the park's accredited status. This review involves Steps 4-10. (The Accreditation Commission reviews the self-study only in Step 10.) This process is called subsequent accreditation.

Attachments Required for Self-Study: AAM Documents and NPS Equivalents	
Required AAM Documents Note: See links to document descriptions at http://www.aam-us.org/museumresources/accred/document-list.cfm	**NPS Equivalents** Note: For documents on the Web, provide the URL rather than hardcopy when submitting attachments for the Self-Study.
Institutional code of ethics	NPS *Museum Handbook*, Part I, Appendix D, Code of Ethics for NPS Museums (2006) at http://www.cr.nps.gov/museum/publications/index.htm.
Mission statement	NPS Mission Statement at http://www.nps.gov/legacy/mission.html. Park mission statement (Foundation Statement) is in the park's General Management Plan and in the park's strategic plan posted on the park Web site.
Institutional plan	Strategic plans show goals and accomplishments—see Park Strategic Plan available on park Web site, NPS Strategic Plan at http://www.nps.gov/refdesk/policies.html, Department of the Interior Strategic Plan at http://www.doi.gov/gpra/ (see Resource Protection Goal 3). Provide the park's Annual Performance Plan based on GPRA goals and performance using data from the Performance Management Data System at http://www.nps.gov/performance/. If the Annual Performance Plan is on the park's Web site, provide the URL. As needed, ask the park Government Performance and Results Act (GPRA) coordinator to assist. Park's General Management Plan
Articles of incorporation, charter, or enabling legislation	NPS Organic Act (1916) (16 USC 1) at http://www4.law.cornell.edu/uscode/html/uscode16/usc_sup_01_16_10_1.html. Park's enabling legislation.
Bylaws, constitution, or will	NPS *Management Policies* at http://www.nps.gov/refdesk/mp/index.html.
IRS letter of notification regarding tax-exempt status	Not applicable to US Government.

Figure B. 1. Attachments Required for Self-Study:
AAM Documents and NPS Equivalents

Required AAM Documents	NPS Equivalents
If the museum has a parent organization: Documentation regarding the importance of the museum to the parent, expressing its commitment to support the museum (e.g., resolution of permanence passed by parent, parent organization's by-laws or organizing documents, memorandum of understanding, or management agreement between the parent and the museum)	Park's enabling legislation. The following are optional references that may be submitted: NPS Organic Act (1916) (16 USC 1) at http://www4.law.cornell.edu/uscode/html/uscode16/usc_sup_01_16_10_1.html. Museum Act (1955) (16 USC 18f—18f-3) at http://www.cr.nps.gov/museum/laws/lawregad.html. NPS *Management Policies* at http://www.nps.gov/refdesk/mp/index.html
Documentation of operational relationships with other organizations integrally connected to the museum's governance or operations (e.g., written memorandum of understanding or other type of formal agreement)	*Management Policies*, Chapter 7, section 7.6.2, Cooperating Associations, and Chapter 10, section 10.2, Concessions, at http://www.nps.gov/refdesk/mp/index.html. Cooperating Association Agreement. Concessions Contract.
List of current members of the governing authority	Secretary of the Interior; Director, National Park Service; Regional Director.
Evidence of delegation of authority for day-to-day operation of the museum to the museum director or the equivalent position	Department of the Interior, Departmental Manual, Part 145, National Park Service, Chapter 2, Basic Organization, showing delegation of authority from Director to park superintendent at http://elips.doi.gov/app_dm/act_getfiles.cfm?relnum=3642. Park superintendent is equivalent to the museum director.
Table of contents of the governance manual (i.e., reference manual assembled for use by members of the governing authority to assist with orientation, training, and ongoing work)	Table of Contents of Department of the Interior Departmental Manual available at http://elips.doi.gov/app_dm/index.cfm?fuseaction=home. National Park Service *Management Policies* and Director's Orders available at http://data2.itc.nps.gov/npspolicy/index.cfm.
Organizational chart(s) (including parent organization, governing authority, partner organization, advisory board, supporting organizations, staff, and volunteers as applicable)	NPS organization chart available at http://elips.doi.gov/app_dm/act_getfiles.cfm?relnum=3642. Park organization chart.

Figure B. 1. Attachments Required for Self-Study:
AAM Documents and NPS Equivalents (continued)

Required AAM Documents	NPS Equivalents
List of principal professional and administrative staff positions (including the following for each: title, incumbent's name, salary, and employment category)	Park staff list for all supervisors showing title, name, salary, job classification series.
Position descriptions and current resumes for principal professional and administrative staff (both current and vacant positions)	Position descriptions and personal resumes for key positions in chain of command with oversight for museum operations, including superintendent.
List summarizing staffing levels (numbers) by category (e.g., administrative, curatorial, education, security, physical plant, visitor services, etc.)	Same
Personnel policies manual	Department of the Interior, Office of Human Resources, policy guidance at http://www.doi.gov/hrm/guidance/curronly.htm
Repository agreement for objects in custody without title (required for some museums)	Repository Agreement and/or incoming loan agreement if park manages collections for a non-NPS entity.
Visual images to illustrate the scope of the museum's collections	If available, provide URLs for images of the park's collection on the park's Web site, in the Web Catalog at http://www.museum.nps.gov/, or on the Museum Management Program Web site at http://www.cr.nps.gov/museum/. Otherwise, provide a CD of images illustrating the scope of the museum's collections (no more than 20-30 images). If possible, combine all image requirements from this chart on a single CD.
Collections management policy and loan policies (custodial care and borrowing policies for museums that do not own or manage collections, but borrow and use collections for exhibits, education, or research)	Director's Order #24, NPS Museum Collections Management at http://www.nps.gov/policy/DOrders/DOrder24.html. NPS *Museum Handbook*, Parts I-III; *Automated National Catalog System User Manual*; and *Conserve O Gram* at http://www.cr.nps.gov/museum/publications/index.htm.
Sample copy of completed collections documentation record(s) (with accession, catalog, and inventory information)	Copies of the following records with information completed: a Catalog Record (10-254) and an All Fields Report for each of the major disciplines represented in the park's collection (archeology, ethnology, history, archives, biology, geology, paleontology); an Accession Receiving Report (10-95); an Accession Folder Cover Sheet (10-255); a Deed of Gift (10-830); a Receipt for Property (DI-105); the most recently completed annual inventory forms (10-349).

Figure B. 1. Attachments Required for Self-Study:

Required AAM Documents	NPS Equivalents
If the museum is authorized to deaccession, a copy of a deaccession form or other written documentation used for deaccessioning purposes (a completed form if applicable, otherwise a blank form)	Copy of completed Deaccession Form (10-643).
Sample copy of a completed outgoing loan agreement	Copy of completed Outgoing Loan Agreement (10-127) with Conditions (10-127a).
Sample copy of a completed incoming loan agreement	Copy of completed Incoming Loan Agreement (10-98) with Conditions (10-98a).
Sample copy of completed condition report form	Copy of completed Condition Report (10-637)
List of titles and dates of the museum's exhibit offerings during the last three years (long-term, temporary, traveling exhibits)	List of long-term, traveling, and temporary exhibits that the park has shown in last three years. Give titles, dates, and locations for exhibits.
Images of exhibits to illustrate various exhibition design techniques used (in galleries, other interiors, interpreted landscapes, other exterior settings)	Provide images of exhibits, historic structures, interiors of furnished historic structures, park features, and landscapes to illustrate exhibit design and visitor-presentation techniques. Include wayside exhibits. Exhibit producers (Harpers Ferry Center or contractors) are good sources of images. If possible, include all image requirements from this chart on a single CD.
Images that illustrate the museum's live interpretive activities in action (e.g., programs, outreach, demonstrations, tours, interpreters, classes, etc.)	Images of the park's interpretive programs (personal services). Contact the park's Chief Interpreter. If possible, combine all image requirements from this chart on a single CD.
List of museum publications and non-print media projects (print, audio, electronic) produced in the past three years (list name, format, and date)	Work with the Chief Interpreter and Chief of Resources Management to identify relevant NPS and cooperating association publications and non-print media projects, such as films, slide shows, postcards, and CDs produced in last three years. List name, media format, and date.
If the museum does original research: List of staff research results published in publications (e.g., books, popular or scholarly journals) other than the museum's in the last three years	Work with the Chief of Resources Management to identify published research results for the last three years. Contact the Inventory and Monitoring Network and the region's Archeological Center for publications relevant to the park.

Figure B. 1. Attachments Required for Self-Study:
AAM Documents and NPS Equivalents (continued)

Required AAM Documents	NPS Equivalents
Most recent museum program/exhibit/events calendar	Coordinate with the Public Affairs Officer and Chief of Interpretation for the most recent park events calendar.
Samples of: promotional materials (e.g. program announcements, exhibit brochures, etc.) that illustrate the scope of the museum's interpretive offerings; materials that illustrate the range of programs for students and teachers; museum publications and/or non-print media materials (Four maximum for each category)	Same
Current year operating budget and non-operating expenditures	Provide a copy of the park's current financial plan and information on any construction program activities or other non-operating expenditures.
Audited financial statements for two years plus management letters (if most recent year is not yet available, submit unaudited year-end financial report)	NPS Performance and Accountability Reports are posted at http://www.doi.gov/pfm/burrept.html. The independent auditors' report is at the back of each year's report. Cross-reference the park's Annual Performance Plan provided above. Provide the park's Annual Performance Report based on GPRA goals and data from the Performance Management Data System at http://www.nps.gov/performance/. If this document is on the park's Web site, provide the URL.
Floor plan and/or site map	Official park brochure, plus other site maps and museum floor plans, if available.
Emergency/disaster preparedness plan (covering staff, visitors, and collections)	Park Emergency Operations Plan including the Museum Collections Emergency Operations Plan component (see *Management Policies* 8.2.5.2 and Director's Order #24, 4.3.10).
Images of the museum's public and non-public areas, both indoors and outside (e.g.: grounds, exteriors, galleries/exhibit spaces, classrooms/studios/programming spaces, sales areas, food service areas, collections processing/storage, mechanical areas, laboratories, offices, workshops, loading dock/receiving area, etc.)	Same. Provide a CD with these images. If possible, combine all image requirements from this chart on a single CD.

Figure B. 1. Attachments Required for Self-Study:
AAM Documents and NPS Equivalents (continued)

AAM Documents, If Available	NPS Equivalents, If Available
Samples of tools the museum uses to assess whether it has achieved its goals (e.g., visitor satisfaction surveys, exhibition evaluations, program evaluations, focus group questions/reports, community surveys, financial/other performance indicators, etc.)	Strategic plans show goals and accomplishments, see Park Strategic Plan available on park Web site, NPS Strategic Plan at http://www.nps.gov/refdesk/policies.html, Department of the Interior Strategic Plan at http://www.doi.gov/gpra/ (see Resource Protection Goal 3). Recent results for Visitor Survey Card (park reports posted at http://www.psu.uidaho.edu/vsc.schedule.htm, see http://www.psu.uidaho.edu/ for additional information). Office of Management and Budget NPS Visitor Services Assessment at http://www.whitehouse.gov/omb/expectmore/detail.10003723.2005.html. Other park-specific surveys. .
Vision/value statement(s)	Same
Documentation regarding any internal, non-governing groups that serve in an advisory capacity (e.g., resolution of the board establishing this group, statement of purpose, operating guidelines, etc.)	General information on NPS advisory and operating committees at http://www.nps.gov/policy/advisory/boardscomms.htm. National Park System Advisory Board documentation at http://www.nps.gov/policy/advisory/advboard.htm. Park-specific information, as applicable.
Table of contents of volunteer manual	Director's Order #7, Volunteers in Parks at http://www.nps.gov/policy/DOrders/DO-7.htm.
Collections plan	Park's Collection Management Plan; Scope of Collections Statement.
Conservation plan	Park's Collection Management Plan and Collection Condition Survey.
Interpretive plan or education master plan	Park's Comprehensive Interpretive Plan.
Furnishing plan	Park's Historic Furnishings Report, as applicable.
Investment policy	Not applicable to US Government.
Annual reports produced within the last three years	Cross-reference the park's Annual Performance Plan and Annual Performance Report provided above.

Figure B. 1. Attachments Required for Self-Study:
AAM Documents and NPS Equivalents (continued)

AAM Documents, If Available	**NPS Equivalents, If Available**
Printed descriptive materials pertaining to any membership/donor programs (should include dues and benefits structure for each program)	Information on National Park Foundation at http://www.nationalparks.org/Home.asp.
Individual donor support policy	Director's Order #21, Donations and Fundraising, http://data2.itc.nps.gov/npspolicy/DOrders.cfm.
Business support policy	Director's Order #21, Donations and Fundraising, http://data2.itc.nps.gov/npspolicy/DOrders.cfm.
Completed RC-AAM Standard Facility Report	Completed NPS Checklist for Preservation and Protection of Museum Collections (from Automated Checklist Program in ANCS+).

Note: A complete Accreditation Self-Study consists of a detailed questionnaire plus the attachments. The Self-Study Questionnaire is not available on the AAM Web site. Accreditation Program participants can get a copy by calling 202-289-9116 or e-mailing accreditation@aam-us.org. The questionnaire is available to others by purchasing the Accreditation Resource Kit from the AAM Bookstore.

Figure B. 1. Attachments Required for Self-Study:
AAM Documents and NPS Equivalents (continued)

Appendix C: Professional Organizations and Societies

APPENDIX C: PROFESSIONAL ORGANIZATIONS AND SOCIETIES

G. Overview

There are several organizations and societies that are involved in various aspects of museum work. This appendix provides a list of the major organizations and societies that provide professional guidance to individuals and institutions in the functions of museum and archival work.

H. National Museum Organizations

- ***The American Association of Museums (AAM),*** founded in 1906, addresses the concerns of the country''s museum community as a whole and represents art and natural history museums, zoos, botanical gardens, arboretums, planetariums, science and technology centers, nature centers, children's museums, and historic museums, sites, and societies. Members include museum directors, curators, registrars, educators, marketing and development directors, public relations personnel, and others. The AAM's Accreditation Program (refer to Appendix B) has long been a leader in establishing professional standards for museums and museum professionals. Publications include a bi-monthly journal, *Museum News*, and a monthly newsletter *Aviso*. The AAM bookstore stocks publications that address such topics as collections management, museum ethics, conservation, marketing, and fund raising. The association holds an annual meeting. Write, call, or visit the AAM Website for information on membership, publications, and other programs.

  American Association of Museums
  1575 Eye Street, NW, Suite 400
  Washington, DC 20005

  Tel: (202) 289-1818
  <http://www.aam-us.org>

- ***The American Association for State and Local History (AASLH***) is a national non-profit organization that serves agencies and people who work to preserve and interpret history, including historical societies, museums, historic sites, parks, libraries, archives, historic preservation organizations, and schools and colleges. The association has adopted and published the "AASLH Statement of Professional Ethics." Publications include a quarterly magazine, *History News,* and a monthly newsletter, *Dispatch*. The association's sales program provides publications and educational materials (e.g., books, technical leaflets, reports, and video
programs) on the documentation, preservation, and interpretation of

history, including the care and conservation of museum objects.

The association sponsors seminars, workshops, and an annual meeting. Write, call, or visit the AASLH Website for information on membership, publications, and other programs.

American Association for State
and Local History
1717 Church Street
Nashville, TN 37203

Tel: (615) 320-3203
<http://www.aaslh.org>

- ***The American Institute for Conservation of Historic and Artistic Works (AIC)*** addresses the concerns of the conservation profession. Members include conservators who practice in all of the material specialties (e.g., paintings, books and paper, textiles, wood, photographic materials, and objects of leather, ceramic, glass, and stone) and conservation scientists. Librarians, archivists, and curators may also be members. This organization has adopted and published the "AIC Code of Ethics and Guidelines for Practice" for the conservation profession in the United States (refer to Appendix D). Publications include the *Journal of the American Institute for Conservation* (published three times a year) and the bimonthly newsletter, *AIC News*. The newsletter includes information from the various specialties, health and safety updates, preventive conservation information, and a list of conferences, courses, and seminars. The association sponsors an annual meeting, including a pre-meeting workshop. The association also publishes an annual directory of its membership. Write, call, or visit the association's Website for membership or other information.

  American Institute for Conservation
  of Historic and Artistic Works
  1717 K Street, NW, Suite 200
  Washington, DC 20006

  Tel: (202) 452-9545
  <http://aic.stanford.edu>

- ***The Society of American Archivists (SAA),*** founded in 1936, promotes the preservation and use of records materials (e.g., manuscripts, films, maps, photographs, sound recordings, and machine-readable records). This organization provides a wide range of educational workshops, maintains an active publications program, and promotes cooperation, growth, and development in the archival field. The society has adopted and published "A Code of Ethics for Archivists with Commentary." Publications include a semi-annual journal, *American Archivist*, and a bimonthly newsletter, *Archival Outlook*. The SAA's publication program offers basic manuals on the arrangement, description, access, conservation and care, and exhibition of archival collections. The society sponsors an annual meeting. Write, call, or visit the SAA

Website for information on membership, publications, and other programs.

Society of American Archivists
527 South Wells Street, 5th Floor
Chicago, IL 60607

Tel: (312) 922-0140
<http://www.archivists.org>

- ***The Society for the Preservation of Natural History Collections (SPNHC)*** represents the interests of natural history collections and the people associated with the management and care of these collections. Membership includes individuals from the fields of anthropology, botany, geology, paleontology, and zoology and others interested in the development and preservation of natural history collections. Publications include a journal, *Collection Forum*, a newsletter, *SPNHC Newsletter,* and the "Guidelines for Care of Natural History Collections." The journal, published twice a year, provides up-to-date technical and documentary information on the care of natural history collections. The society conducts annual meetings that include formal presentations and workshops. Write, call, or visit the SPNHC Website for membership information.

  Society for the Preservation
  of Natural History Collections
  PO Box 797
  Washington, DC 20044

  Tel: (202) 786-2426
  <http://www.spnhc.org>

I. Regional Museum Conferences and Associations

- Association of Midwest Museums
  PO Box 11940
  St. Louis, MO 63112

  Tel: (314) 454-3110
  <http://www.midwestmuseums.org>

- Mid-Atlantic Association of Museums
  PO Box 27151
  Baltimore, MD 21230

  Tel: (410) 223-1194
  <http://www.midatlanticmuseums.org>

- Mountain Plains Museum Association
  PO Box 8321
  Durango, CO 81301

  Tel: (970) 259-7866
  <http://www.frontier.net/~mpma/mpmaindex.htm>

- New England Museum Association
  Boston National Historical Park
  Charlestown Navy Yard
  Boston, MA 02129

  Tel: (617) 242-2283
  <http://www.nemanet.org>

- Southeastern Museums Conference
  PO Box 3494
  Baton Rouge, LA 70821

  Tel: (225) 383-5042
  <http://www.semcdirect.net>

- Western Museums Association
  PO Box 13314
  Suite 578
  Oakland, CA 94661

  Tel: (510) 428-1380
  <http://www.westmuse.org>

For a list of other regional, state, national, and international museum organizations, contact the American Association of Museums (AAM), or visit the AAM Website at <http://www.aam-us.org>.

J. Regional Conservation Guilds and Associations

There are several regional conservation associations located throughout the country. These groups usually hold monthly meetings that address special topics in conservation including museum environment and other preventive conservation issues. Contact the regional/SO curator or write to or call the American Institute for Conservation for a current list of the names and addresses of these regional associations.

K. Museum Journals and Technical Publications

- ***ASC Newsletter***

  This bimonthly publication is available by subscription from the Association of Systematics Collections (ASC). The newsletter contains articles on systematic natural history collections, as well as brief notes on funding sources, meetings and conferences, and book reviews. For information on subscribing to this newsletter, write or call:

  Association for Systematics Collections
  1725 K Street, NW
  Suite 601
  Washington, DC 20006

  Tel: (202) 835-9050
  <http://www.ascoll.org>

- ***Curator: The Museum Journal***

  This journal, published quarterly by the California Academy of Sciences and Altamira Press, is available by annual subscription. *Curator* provides timely articles on philosophical issues concerning the museum profession, documentation, and care of museum collections, and specific articles on solving storage and exhibit problems. For subscription information write to:

  Curator: The Museum Journal
  15200 NBN Way
  Blue Ridge Summit, PA 17214

  Tel: (717) 794-3800 ext. 3154

- ***Canadian Conservation Institute (CCI/ICC) Notes*** and ***Newsletter***

  The Canadian Conservation Institute (CCI) publishes a series of technical notes, *CCI Notes* (similar to NPS Conserve O Grams), on museum collections care topics (e.g., the museum environment; disaster management; equipment; and techniques of caring for specific types of objects, including paintings, leather, skin, ethnographic materials, textiles, photographic materials). In addition to *CCI Notes*, the institute also publishes the semiannual *CCI Newsletter*, periodic *Technical Bulletins*, books, and other publications. For additional information contact CCI at:

Canadian Conservation Institute
1030 Innes Road
Ottawa, Ontario K1A 0M5
Canada

Tel: (613) 998-3721
<http://www.cci-icc.gc.ca>

L. Funding Organizations

In addition to National Park Service funding programs, parks can apply for other funding to support museum programs. The park's cooperating association may apply for federal funding for a museum collections project on behalf of a park. Parks may also apply to foundations, charitable organizations, and other outside organizations for museum funding. Consult with the regional/SO curator.

Parks can contact the following organizations for further information on the types of grants available:

Federal Programs

- Institute of Museum and Library Services
  Office of Museum Services
  1100 Pennsylvania Avenue, NW
  Suite 609
  Washington, DC 20506

  Tel: (202) 606-8536
  <http://www.imls.gov>

- National Endowment for the Arts
  1100 Pennsylvania Avenue, NW
  Washington, DC 20506

  Tel: (202) 682-5400
  <http://www.nea.gov>

- National Endowment for the Humanities
  1100 Pennsylvania Avenue, NW
  Washington, DC 20506

  Tel: (202) 606-8400
  <http://www.neh.gov>

Non-Governmental Programs

- ***The Foundation Directory***, published by the Foundation Center, lists foundations that provide grants to museums. For a copy of this directory, write to the following address:

  The Foundation Center
  79 Fifth Avenue
  New York, NY 10003

  Tel: (212) 620-4230
  <http://www.fdncenter.org>

Appendix D: Code of Ethics for NPS Museums

APPENDIX D: CODE OF ETHICS FOR NPS MUSEUMS

A. Overview

1. *What information will I find in this appendix?*

This appendix summarizes Federal standards of ethical conduct applicable to NPS museums and provides a Code of Ethics for NPS Museums in section C. It also references codes of ethics statements from the American Association of Museums (AAM), Society of American Archivists, American Institute for Conservation of Historic and Artistic Works (AIC), and other related professional organizations.

2. *What is ethics in the museum context?*

Ethics is a system of moral principles that governs the behavior of individuals and groups, for example, museum employees individually and as a group in a single or multiple museums. It is about what is right, fair, truthful, honest, beautiful, or, in one word, good. Ethics derives from a general moral consciousness affecting individual and group choices about what is best for the common welfare.

3. *What is a code of ethics?*

A code of ethics is a systematic collection of moral principles that a group believes will benefit the whole. There is agreement in the subscribing group that individual choices must be governed by these principles in order for the individual to contribute to the common good. Codes of ethics may evolve over time, as a group (for example, a society, a community, a profession, or a team) collectively identifies and refines its understanding of what is best for the group.

4. *What is a code of ethics for museums?*

A code of ethics for museums identifies principles that govern the conduct of museum employees and the choices that museums make in order to benefit the societal good. The principles must address the choices made by individuals in the museum organization, as well as groups of individuals, and the museum as a whole.

5. *Does the museum profession have a single code of ethics?*

No. Diverse professional organizations of museum workers, such as archivists, conservators, and curators, as well as individual museums, have different codes of ethics. Professional organizations representing individual disciplines, such as anthropology, history, and paleontology, also have codes of ethics. The AAM has issued a Code of Ethics for Museums that applies exclusively to museums, including botanical gardens, planetariums, and zoos. Museums also subscribe to codes of ethics that apply to specific functions and disciplines represented in the museum. See Section D for references to codes of ethics for museums and other professional organizations. The AAM requires all accredited museums to have a formally approved, separate and distinct institutional code of ethics.

6. *How does a code of ethics relate to law?*

The law protects specific interests, such as property rights and freedoms, in service to the common good. The law sets a minimum standard. A code of ethics often goes beyond the law in establishing principles for the common good. For example, although bleaching an 18th century quilt so that it is bright white may be legal, doing so would not be consistent with the AIC Code of Ethics and Standards of Practice. Such severe treatment would accelerate the deterioration of the quilt, and diminish the public benefit. The legal rights of individuals may come into conflict with ethics and the common good as well. For example, although a museum curator might legally purchase for his own collection paintings of the same type that the museum has, most museum codes of ethics would consider this a conflict of interest and prohibit or place restrictions on this activity.

B. Federal Standards of Ethical Conduct Applicable to NPS Museums

1. *What codes of ethics apply to all NPS employees with responsibility for museum collections?*

All NPS employees with responsibility for museum collections and functions must follow the:

- Standards of Ethical Conduct for Employees of the Executive Branch (5 CFR 2635)
- Employee Responsibilities and Conduct (43 CFR 20), Department of the Interior
- Supplemental Standards of Ethical Conduct for Employees of the Department of the Interior (5 CFR 3501)
- Criminal Conflict of Interest Statutes (18 USC 201, 203, 205, 207-209)
- Code of Ethics for NPS Museums (see Section C)

2. *What does the Ethics Guide for Employees of the Department of the Interior cover?*

Making Ethics a Part of the Workplace: Ethics Guide for Employees of the Department of the Interior, available at http://www.inside.nps.gov/waso/custommenu.cfm?lv=3&prg=37&id=3889, provides plain language guidance to the ethics laws and regulations that apply to employees of the Department of the Interior (DOI). It addresses actions and responsibilities of the individual employee as follows:

- Basic obligation of public service
- Governmentwide ethics laws
- Department ethics prohibitions
- Accepting gifts
- Traveling for the Department
- Outside work and activities
- Seeking non-Federal employment
- Using Government property, time, and information
- Restrictions that apply after you leave Federal service
- Disclosure of financial interests
- Ethics training and contacts

3. *Where can I find additional information on ethics for NPS employees?*

For all questions concerning ethics, consult your servicing ethics official. Following advice from an ethics official gives an employee a "safe harbor" from disciplinary action. Further information on ethics is in Chapter 9 of *Cultural Resource Management Guideline* (NPS-28, Release No. 5, 1997). In addition, you may want to consult your supervisor, regional curator, or the organizations listed in this appendix. DOI is developing a chapter in the Departmental Manual to address the integrity of scientific activities and a code of scientific conduct.

C. Code of Ethics for NPS Museums

1. *What is the Code of Ethics for NPS Museums?*

The Code of Ethics for NPS Museums is a set of principles that guide the decisions of employees and volunteers who manage or work with NPS museum collections or perform other museum functions. The Code of Ethics was first issued in 1990 in Museum Handbook, Part I (MH-I), Chapter 1. It is reviewed and updated every five years, or more frequently as needed.

2. *How do NPS policies relate to the Code of*

The principles in the Code of Ethics for NPS Museums are

Ethics for NPS Museums?

addressed in all levels of NPS policy. The policy documents include NPS Management Policies, the Director's Order (DO) series, and handbooks. The Code of Ethics for NPS Museums consolidates the ethics information specific to museums.

3. *Who follows the Code of Ethics for NPS Museums?*

The Code of Ethics for NPS Museums applies to NPS employees and volunteers whose actions and decisions directly affect the management of NPS museum collections and/or museum-related functions. It applies to superintendents, managers, museum curators, museum technicians, museum aids, archivists, archives technicians, conservators, housekeepers, maintenance staff, interpreters, park rangers, cultural and natural resource specialists, and all other staff with museum-related functions. It also applies to other staff and volunteers when their jobs interface with museum operations.

4. *What ethics principles do I follow if I am responsible for governance and administration of NPS museums?*

If you are a superintendent, manager, or other employee with administrative responsibility for NPS museums or direct responsibility for museum collections, following NPS Management Policies and Director's Orders you will:

Acquisition, Disposal, and Documentation

- Acquire and dispose of collections consistent with the park's mission and Scope of Collection Statement and in accordance with the Museum Act (16 USC 18f), the Native American Graves Protection and Repatriation Act (25 USC 3001-3013), and NPS policies and procedures.

- Acquire items only if the park can manage them according to NPS policies and standards.

- Acquire items for the museum collections only when you have determined that they have a legal and ethical pedigree. Avoid acquiring, borrowing, and retaining (if previously acquired) any object that has been acquired, exported, or imported contrary to the laws of its country of origin, or any intermediary country, or contrary to the laws and treaties of the United States, including Nazi-era objects that were unlawfully appropriated without subsequent restitution.

- Accept only unconditional gifts for the museum collections, unless the regional director makes exception on a case-by-case basis.

- Avoid conflict of interest and the appearance of conflict of interest when acquiring, borrowing, or disposing of collections and making other decisions affecting collections, including avoiding personal collecting in the same subject area as the museum.

- Follow the prescribed order of preference when deaccessioning, giving preference to NPS, other DOI bureaus, other Federal agencies, and then non-Federal museums.

See 18 USC 208, Acts Affecting a Personal Financial Interest; 5 CFR 2635.502, Personal and Business Relationships; Management Policies, 5.3.5.5.4 Acquisition, Management and Disposition; DO #24: NPS Museum Collections Management (DO #24), 4.3.2 Standards, 4.3.6 Scope of Collection, 4.3.15 Unconditional Gifts; Cultural Resource Management Guideline, Chapter 9, B.2 Acquisition, B.3 Documentation, and B.7 Deaccessioning; MH-II, Chapter 2 Accessioning, Chapter 6 Deaccessioning.

Preservation and Protection

- Preserve and protect collections while also providing public access.
- Maintain a current Museum Collections Emergency Operations Plan identifying actions required for preparedness and response to protect collections and human health and safety under all risks.
- Authorize conservation treatment consistent with the American Institute for Conservation of Historic and Artistic Works Code of Ethics (AIC)
- Keep information about the security of the museum or of private collections and locations visited during official duties confidential, except to assist law enforcement authorities.

See Management Policies, 5.3.5.5.1 Preservation, 8.2.5.2 Emergency Preparedness and Emergency Operations; DO #24, 4.3.10 Emergency Operation; MH-I, Museum Collections.

Access and Exhibits

- Actively promote appropriate access to collections and data about the collections in order to increase public benefit.
- Ensure that merchandise sold or provided by concessions promotes the park's theme and servicewide mission and values.
- Ensure that concession operations
  - do not sell or offer for sale original objects, artifacts, or specimens of a historic, archeological, paleontological, or biological nature;
  - include with geological merchandise appropriate educational material and a written disclaimer that the items are not from within park boundaries;

– clearly label replicas.

See Management Policies, 10.2.4.5 Merchandise, 10.2.4.6 Artifacts and Specimens; DO #24, 4.3.23 Access and Use; Museum Handbook, Part III (MH-III), Access and Use.

Management

- Ensure that all decisions involving donations to NPS maintain integrity, impartiality, and public confidence as established by the review process in DO#21, Donations and Fundraising (DO #21). Avoid soliciting donations. Avoid accepting donations of money, collections, or services from sources that would contribute to creating a conflict of interest or the appearance of a conflict of interest, including:

  – organizations in which an NPS employee has a leadership role

  – entities that have litigation pending with the Department of Interior, unless that litigation is sufficiently removed so that the donation does not appear to be an attempt to influence the litigation outcome.

  – companies that hold or are seeking concessions contracts or are otherwise engaged in business with the park

  – sources that would identify NPS with alcohol or tobacco products

  – parties that offer donations in order to state or imply the NPS endorsement of a product, service, or entity.

- Authorize fundraising efforts (including marketing relationships with businesses or corporations) to benefit park programs in accordance with DO #21.

- Maintain donation boxes on NPS property only if 100% of the donations go to NPS.

- Avoid naming features or facilities for a donor.

- Provide an annual report on donations.

- Seek and allocate funds sufficient to preserve, document and provide access to the collections and associated documentation.

- Expend funds according to established criteria.

See 5 CFR 2635.201, Gifts from Outside Sources; 5 CFR 2635.502, Personal and Business Relationships; 5 CFR 2635.702, Use of Public Office for Private Gain; 5 CFR 2635.808, Fundraising Activities; 5 CFR 3501.105, Outside Employment and Activities; DO#21, 6.1.1 Maintaining the Integrity and Impartiality of, and Public Confidence in, NPS and the Department of the Interior, 6.1.2 Reviewing Direct Donations, 6.3.1 Donation Boxes, 10.2.6 In-Park Displays, Name Plaques, and Plates; DO#24, 4.3.4 Ongoing and Corrective Actions, 4.3.16 Project-generated Collections.

Human Resources

- Avoid requiring museum staff to act in conflict with this code of ethics or other international, national, or relevant professional codes of ethics.

- Ensure that employees, volunteers and visitors working with museum collections are informed of hazards inherent to the collections (such as pesticides) and protective measures.

- Ensure that all employees with direct responsibility for museum collections management have the knowledge, skill, and ability to perform assigned jobs.

- Foster a cooperative relationship between park cooperating associations and park staff in the interest of the museum collection.

See DO #24, 4.2.4 Staffing and Training, 4.3.11 Job Hazard Analysis.

5. *What ethics principles do I follow if I am responsible for the direct management of collections?*

In addition to the ethics principles in Sections B and C.4, your actions and decisions will follow the ethics principles below.

Acquisition, Disposal, and Documentation

- Fully and accurately document items in the museum collection and ensure that the documentation is current.

- Verify that all acquisitions and incoming loans have a legal and ethical pedigree, including required permits. Document in writing research related to this verification.

- Never traffic in objects and specimens originating on public lands.

- Avoid making any judgment for another party about the value of an object, archival document, or specimen. You may provide information on obtaining appraisals, but not recommend any single appraiser.

- Cooperate with other institutions to ensure the preservation of significant cultural and natural heritage and avoid competing for acquisitions if such competition would endanger the integrity or safety of such materials.

- Make all deaccession actions open to public scrutiny.

See DO#24, 4.3.2 Standards, 4.3.13 Accession and Catalog Records; MH-II, Museum Records, Chapter 4 Inventory and Other Special Instructions, Section IX, Determining the Monetary Value of Museum Objects, Chapter 6 Deaccessioning.

Preservation and Protection

- Protect and preserve the integrity of collections.

- Avoid using methods and materials that may adversely affect museum collections or their future examination, scientific investigation, treatment or function.

- Document examination, scientific investigation, and treatment of collections for preservation purposes.

- Protect collections against physical threats and unauthorized access.

- Store, handle, use, and exhibit objects to maximize their long-term preservation unless destructive analysis or consumptive use is specifically authorized in writing according to DO#24, 4.2.7 Destructive Analysis and Consumptive Use, 4.3.25 Preservation vs. Destructive Use.

See Management Policies, Chapter 5 Cultural Resource Management; DO #24; MH-I.

Access and Exhibits

- Encourage use of the collections and data for research, exhibits, and education in order to increase public benefit. See also Section C.6.

- Ensure fair and equitable public access to collections, associated documentation, policies, and technical information.

- Maintain the confidentiality of data about the nature and specific location of 1) a national park system resource which is endangered, threatened, rare, or commercially valuable; 2) mineral or paleontological objects within units of the national park system; or 3) objects of cultural patrimony within units of the national park system, unless the Secretary determines that disclosure would further NPS purposes and would not create an unreasonable risk of harm, theft or destruction of the resource or object, including individual organic or inorganic specimens, and disclosure is consistent with other applicable laws protecting the resource (National Parks Omnibus Management Act of 1998 [16 USC 5937]).

- Ensure that access is consistent with the laws and NPS policies pertaining to Freedom of Information Act disclosures, copyright, privacy, publicity, obscenity and pornography, defamation, and resource protection.

- Never use objects from the museum collection or museum venues for personal purposes, and inform your relatives that they are similarly restricted.

- Never exhibit Native American human remains or photographs of the remains. You may exhibit drawings, renderings or casts of remains with the consent of culturally affiliated Indian tribes and native Hawaiian organizations.

- Borrow and lend museum collections consistent with the Museum Act (16 USC 18f).

- Provide accurate, well-researched information to the public, and maintain accurate documentation about the collections in files and databases.

- Inform researchers of parallel research by others, and supply names if agreeable to the parties involved.

- Avoid borrowing and exhibiting collections from individuals who may have a conflict of interest or an appearance of a conflict of interest (for example, park staff).

- Ensure that reproductions, replicas, and copies are permanently marked as facsimiles to avoid confusion with the original.

See Management Policies, 4.1.2 Natural Resource Information, 5.2.3 Confidentiality, 5.3.4 Stewardship of Human Remains and Burials; DO #24, 4.3.28 Exhibit of Human Remains; MH-II, Chapter 2 Accessioning, Chapter 5 Outgoing Loans; *MH-III, Chapter 1 Evaluating and Documenting Use, Chapter 2 Legal Issues, Chapter 4 Two-Dimensional Reproductions, Chapter 5 Three-Dimensional Reproductions.*

Management

- Consult with affiliated parties in managing collections, including parties subject to the Native American Graves Protection and Repatriation Act.

See Management Policies, 5.2.1 Consultation; DO #24, 4.3.24 Consultation.

Professional Conduct

- Act in the best interests of the museum collection.

- Maintain current knowledge of and follow relevant professional standards and ethics.

- Seek the expertise and advice of colleagues when such input will benefit the museum collections and programs.

- Share information with colleagues and co-workers in order to benefit the museum profession at large, and credit sources for information received.

- Act only within the scope of your knowledge, and seek training to acquire needed knowledge and skills to perform your job.

- Maintain current knowledge of the safety of materials and procedures, and take appropriate protective measures when handling hazardous materials.

- If you perform personal research using NPS collections, inform your supervisor of the research; do the research on your own time, during regular hours when other members of the public also have access, and inform others doing parallel research.

- Obtain a permit in accordance with 36 CFR 2.5 to personally collect in a park for non-official purposes, and do such collecting off-duty. For information on permits and conditions see http://science.nature.nps.gov/research/ac/ResearchIndex.

- Avoid conflict of interest or apparent conflict of interest in pursuing professional activities outside your NPS job responsibilities. Some outside activities may benefit the NPS museum program, such as teaching; participating as an AAM Museum Assessment Program consultant or accreditation team member; or serving a local, regional, national, or international museum association, but be mindful of restrictions in 18 USC 208, Acts Affecting a Personal Financial Interest, and the appearance of a conflict of interest in personal and business relationships as described in 5 CFR 2635.502.

- Clear outside professional activities with your supervisor and servicing ethics official when done on official time. Such activities involving a professional organization may require an ethics Memorandum of Understanding (MOU) between NPS and the organization and/or a waiver in accordance with 18 USC 208(b)(1).

- Avoid using your official title when not representing NPS.

- When you obtain information while performing duties as a Government employee, avoid using that information for personal research or other outside activities, except when that information is also available to the general public.

- Avoid revealing or profiting from information gained through work with restricted collections.

- Have no personal business with dealers who also sell objects to parks.

- Avoid dealing (buying or selling for personal profit) in natural and cultural resources.

- Avoid personal collecting in the same subject area as the museum. If such a collection exists prior to park employment, you should:

  - provide the superintendent with a current inventory

  - keep the private collection in your residence or off of public lands

  - avoid lending items from the private collection for park use

  - avoid adding to the private collection while employed by the park

  - offer the park first option to buy any objects that you propose to sell from your private collection, in order to avoid the appearance of a conflict of interest.

- Never acquire anything for yourself that has formerly been part of any park museum collection. Inform your relatives that they are similarly restricted.

- Avoid using your official title, position, or authority to endorse a product, service, or enterprise, except in furtherance of a specific statutory authority authorizing such endorsement, such as in support of authorized fundraising efforts of friends groups and cooperating associations.

- Avoid irresponsible criticism of other museum professionals or institutions. Address complaints about professional or ethical behavior directly to the individual or institution.

See 18 USC 208, Acts Affecting a Personal Financial Interest; 5 CFR 2635.502, Personal and Business Relationships; 5 CFR 2635.702, Use of Public Office for Private Gain; 5 CFR 2635.703, Use of Nonpublic Information; DO #21, 3.1 Ethical Considerations.

6. *What ethics principles do I follow if I am responsible for interpretation or education programs in the park museum or involving the museum collection?*

Persons responsible for interpretation or education programs that involve the park museum and/or the museum collections will ensure that services:

- Focus on the park's resources and themes and park and servicewide mission.
- Present factual material that is accurate and based on current scholarship and science, and that maintains the intellectual integrity of the information.
- Are accessible to wide audiences, including those with impairments.
- Are available without discrimination. (See 43 CFR 17, subpart E.)
- Consider factors that might influence an individual's needs and interests, such as age, physical and intellectual ability, level of education, ethnicity, religion, social/economic status, sexuality, and gender.

See Management Policies, Chapter 7 Interpretation and Education; DO #6, Interpretation and Education.

See also section C.4 and 5, Access and Exhibits.

7. *What should I do if the Code of Ethics for NPS Museums conflicts with another code of ethics?*

Follow the Code of Ethics for NPS Museums, unless the conflict is with the Standards of Ethical Conduct for Employees of the Executive Branch, the Employee Responsibilities and Conduct, the Supplemental Standards of Ethical Conduct for Employees of the Department of the Interior, or the criminal statutes (see B.1). These regulations and statutes always take precedence.

8. *Where can I find assistance in resolving ethics issues specific to the Code of Ethics for NPS Museums?*

Contact the sources in section B.3. Ethics officials at the park, region, and Washington Office are specifically trained to address ethics issues of all types. As necessary, they will consult with the DOI ethics staff in the Office of the Solicitor before advising you. Regional curators will be especially helpful on ethics issues unique to museum collections or the museum profession. Contact information for park, regional, servicewide center, and Washington Office ethics officials is at http://www.inside.nps.gov/waso/custommenu.cfm?lv=3&prg=37&id=4451.

D. Codes of Ethics for Professional Organizations

American Association of Museums (AAM)

The AAM Code of Ethics for Museums is available at http://www.aam-us.org/museumresources/ethics/coe.cfm. Guidelines on specific ethics-related issues are available at http://www.aam-us.org/museumresources/ethics/index.cfm. The AAM publication entitled Codes of Ethics and Practice of Interest to Museums has codes from all the AAM Standing Professional Committees as well as standards and policy statements from related organizations. This publication and others on ethics are available through the AAM online bookstore at http://www.aam-us.org/bookstore/index.cfm or by contacting the AAM Bookstore at:

American Association of Museums
1575 Eye Street, NW, Suite 400
Washington, DC 20005
(202) 289-1818
Fax (202) 289-6578
E-mail bookstore@aam-us.org

The Curator's Committee of the American Association of Museums has a Curators Code of Ethics available at http://www.curcom.org/ethics.php.

The Society of American Archivists (SAA)

The SAA Code of Ethics for Archivists is available at http://www.archivists.org/governance/handbook/app_ethics.asp. Publication information is online at http://www.archivists.org/catalog/index.asp. For further information contact the SAA at:

The Society of American Archivists
527 S. Wells St., 5th Floor
Chicago, IL 60607
(312) 922-0140
Fax 312/347-1452
E-mail info@archivists.org

The American Institute for Conservation of Historic and Artistic Works (AIC)

The AIC Code of Ethics and Guidelines for Practice is available at http://aic.stanford.edu/about/coredocs/index.html. For further information on ethics, using a keyword, you can search the AIC Web site, including posted publications, such as the *Journal of the American Institute for Conservation*. For additional information contact the AIC at:

The American Institute for Conservation of Historic and Artistic Works
1717 K Street, NW
Suite 200
Washington, DC 20006
(202) 452-9545
Fax (202) 452-9328
E-mail info@aic-faic.org

American Association for State and Local History (AASLH)

The AASLH Statement of Professional Standards and Ethics is available at http://www.aaslh.org/ethics.htm. For additional information contact the AASLH at:

American Association for State and Local History
1717 Church Street
Nashville, TN 37203-2991
(615) 320-3203
Fax (615) 327-9013
E-mail membership@AASLH.org

International Council of Museums (ICOM)

The ICOM Code of Ethics for Museums is accessible at http://www.icom.org/ethics_rev_engl.html. Using the Web site keyword search function, you may access additional sources on ethics. Further information is available through AAM or from ICOM headquarters at:

International Council of Museums
Maison de l'UNESCO
1, rue Miollis
75732 Paris cedex 15
France
+33(0) 1 4734 0500
Fax +33(0) 1 4306 7862
E-mail secretariat@icom.museum

Other Organizations

Many other organizations devoted to the preservation, protection, and interpretation of natural and cultural resources have adopted codes of ethics for their members. Some organizations you might contact for additional information are:

American Anthropological Association
2200 Wilson Blvd, Suite 600
Arlington, VA 22201
(703) 528-1902
Fax (703) 528-3546
http://www.aaanet.org

American Institute of Biological Sciences
1444 I Street, NW, Suite 200
Washington, DC 20005
(202) 628-1500
Fax (202) 628-1509
E-mail admin@aibs.org
http://www.aibs.org

American Institute of Professional Geologists
1400 W 122nd Avenue, Suite 250
Westminster, CO 80234
(303) 412-6205
Fax (303) 253-9220
E-mail aipg@aipg.org
http://www.aipg.org

American Library Association
50 E. Huron
Chicago, IL 60611
1-800-545-2433
(312) 944-2641
E-mail membership@ala.org
http://www.ala.org

Archaeological Institute of America
Located at Boston University
656 Beacon Street, Fourth Floor
Boston, MA 02215-2006
(617) 353-9361
Fax (617) 353-6550
E-mail aia@aia.bu.edu
http://www.archaeological.org

Ecological Society of America
1707 H Street, NW, Suite 400

Washington, DC 20006
(202) 833-8773
Fax (202) 833-8775
E-mail esahq@esa.org
http://www.esa.org

The Geological Society of America
P.O. Box 9140
Boulder, CO 80301-9140
1-888-443-4472
(303) 357-1000
Fax (303) 357-1070
E-mail gsaservice@geosociety.org
http://www.geosociety.org

National Council on Public History
327 Cavanaugh Hall – IUPUI
425 University Boulevard
Indianapolis, IN 46202
(317) 274-2716
Fax (317) 278-5230
E-mail ncph@iupui.edu
http://www.ncph.org

National Education Association
1201 16th Street, NW
Washington, DC 20036-3290
(202) 833-4000
Fax (202) 822-7974
http://www.nea.org

Natural Science Collections Alliance
PO Box 44095
Washington, DC 20026-4095
(202) 633-2772
Fax (202) 633-2821
E-mail general@nscalliance.org
http://www.nscalliance.org

The Paleontological Society
P.O. Box 7075
Lawrence, KS 66044-7075
(785) 843-1235
Fax (785) 843-1274
E-mail paleosoc@allenpress.com
http://www.paleosoc.org

Society for American Archaeology
900 Second Street NE #12
Washington, DC 20002-3560
(202) 789-8200
Fax (202) 789-0284
E-mail headquarters@saa.org
http://www.saa.org

Society for Historical Archaeology
15245 Shady Grove Road, Suite 130
Rockville, MD 20850
(301) 990-2454
Fax (301) 990-9771
E-mail hq@sha.org
http://www.sha.org/

Society for the Preservation of Natural History Collections
See Web site for current contact information.
http://www.spnhc.org/

Society of Vertebrate Paleontology
60 Revere Dr., Suite 500
Northbrook, IL 60062
(847) 480-9095
Fax (847) 480-9282
E-mail svp@vertpaleo.org
http://www.vertpaleo.org

The Wildlife Society
5410 Grosvenor Lane
Bethesda, MD 20814-2144
(301) 897-9770
Fax (301) 530-2471
E-mail membership@Wildlife.org
http://www.wildlife.org

Appendix E: Scope of Collection Statement

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Appendix E: Scope of Collection Statement

A. Overview

1. *What information will I find in this appendix?*

You will find a Scope of Collection Statement checklist that you can use to review a draft or approved Scope of Collection Statement (SOCS). You also will find a sample completed SOCS. This appendix is a supplement to Chapter 2: Scope of Museum Collections.

2. *Who can assist me in writing or revising my park's Scope of Collection Statement?*

Contact your regional/SO curator for examples of approved SOCS that show how different parks have written their statement. If you have questions about what types of collections to include in the Types of Collections section, contact your park's interpretive staff, resource management staff, and other subject matter experts, as well as your regional/SO curator and other regional/SO discipline specialists.

3. *Are there any other resources that can help me prepare or revise my park's Scope of Collection Statement?*

Yes. Figure E.1 includes an example Scope of Collection Statement and Figure E.2 includes an example Scope of Collection Summary. These documents are available in electronic format. Contact your regional/SO curator to obtain copies that you can use as templates when developing or revising your park's Scope of Collection Statement and Scope of Collection Summary.

Refer to Chapter 2: Scope of Museum Collections, the resources listed in the bibliography of Chapter 2, and your regional/SO curator for additional information.

B. Evaluating Your Scope of Collection Statement

1. *How do I evaluate a Scope of Collection Statement?*

Use the Scope of Collection Statement checklist included in Figure E.3 to review a draft or approved SOCS.

2. *How do I use the Scope of Collection Statement Checklist?*

To use the Scope of Collection Statement checklist:

- Enter the unit's complete name. A unit is a park, center, or office with a museum collection. Place an "X" in either the draft or approved block. Enter the date (month, day, and year) of the draft or approved document. Enter the name of the reviewer and date reviewed.
- Place a checkmark in the "YES" column to indicate that the required wording is in the SOCS, that the wording is accurate, and that it is in the appropriate section.
- Place a checkmark in the "NO" column to indicate that the required statement does not appear in the SOCS.
- Place a checkmark in the "N/A" column to indicate that the question is not applicable to the SOCS.
- Place an "X" in the "Note" column to indicate that there is an attached note pertaining to this question.

- There may be times when the reviewer cannot determine the answer to a specific checklist question. If this is the case, print "ND" meaning "Not Determined" in the "YES" column.

3. *Where do I find the Scope of Collection Statement Checklist?*

See Figure E.3 for the checklist. An unpunched full size checklist accompanies this appendix. Keep the full size checklist as a master and make copies for your use.

C. List of Figures

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
LEWIS MOUNTAINS NATIONAL PARK

Scope of Collection Statement

Prepared/Recommended by:____
Museum Curator Date

Concured by:____
Chief of Resource Management Date

Approved by:____
Superintendent Date

Figure E.1. Example Approved Scope of Collection Statement

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Figure E.1. Example Approved Scope of Collection Statement (continued)

Figure E.1. Example Approved Scope of Collection Statement (continued)

I. INTRODUCTION

A. Executive Summary

The park's museum collection includes both natural history and cultural collections. The park's natural history collection includes: mammal and bird collections; the herbarium, which includes nearly all species of vascular plants that occur in the park; paleontological collections from the Bear Valley Shale Formation; geological specimens from the Bear Valley Shale and Lewis Granite Formations; associated project documentation and reports. Other natural history collections within the museum collection include: fungi; reptiles and amphibians; fish; insects and arachnids. At present, these collections are relatively small, as little research pertaining to these disciplines has been conducted in the park to date.

The cultural collection includes: archeological materials systematically excavated from within the park's boundaries and associated field records (circa 1000 BCE – circa 1940); an ethnology collection of Paiute and Shoshone basketry, watercolors, beadwork, and textiles; historic objects associated with the area's 19th century miners, railroad workers, and homesteaders, and items related to the Civilian Conservation Corps and President Franklin D. Roosevelt's 1938 park vacation; archival and manuscript collections such as the Joseph Jakes papers, oral histories, photographs, and scientific and resource management records.

B. Purpose of the Scope of Collection Statement

This Scope of Collection Statement defines the scope of present and future museum collection holdings of Lewis Mountains National Park that contribute directly to the understanding and interpretation of the park's purpose, themes and resources, as well as those objects that the Service is legally mandated to preserve. It is designed to ensure that the museum collection is clearly relevant to the park.

C. Legislation Related to National Park Service Museum Collections

The National Park Service's (NPS) legal mandate for acquiring and preserving museum collections is contained in the Antiquities Act of 1906 (16 USC 431-433); the Organic Act of 1916 (16 USC 1 et. seq.); the Historic Sites Act of 1935 (16 USC 461-467); the Management of Museum Properties Act of 1955, as amended (16 USC 18f); the Reservoir Salvage Act of 1960, as amended (16 USC 469-469c); the National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.); the Archeological and Historic Preservation Act of 1974, as amended (16 USC 469-469l-2); the Archaeological Resources Protection Act of 1979, as amended (16 USC 470aa-mm); the National Parks Omnibus Management Act of 1998 (16 USC 5901).

D. Park History, Significance, Purpose, Themes, and Goals

The enabling legislation (45 Stat. 616) which established Lewis Mountains National Park on June 12, 1928, states that the park was established to "...preserve from injury or spoliation the Lewis Mountains, Bear Valley, and Shawnee Lake…" as well as "…the structures, other works, and relics of prehistoric cultures contained therein..."

The Bear Valley Lodge, constructed by the Union Pacific Railroad in 1920, was acquired by the park in 1962 through the Mountain Foundation. Additional lands from the adjoining Lewis National Forest were added to the park in 1964 to "…preserve the historical, paleontological, and geological resources of the Buffalo Valley" (63 Stat. 981).

Figure E.1. Example Approved Scope of Collection Statement (continued)

Efforts to assemble a museum collection within the park began in 1929 when Superintendent Charles Jackson established a small museum within one room of the ranger station. The museum was very popular with visitors, and the collection quickly grew due to local donations of Native American, ranching, mining, and other "pioneer" materials as well as natural history specimens collected by the park staff. It was soon apparent that a separate museum building was needed to house this growing collection, and in 1934 the Civilian Conservation Corps (CCC) constructed the Bear Valley Museum.

In 1969, the Henderson Visitor Center (which includes museum exhibit galleries and collection storage space) was completed and the museum collection was moved to that building. Additional exhibit and collection storage space was added to the structure in 1992. Native American history exhibits that were determined through consultation to be offensive to traditionally associated groups (including NAGPRA-identified items) were removed from the museum in 1993. A new permanent exhibit focusing on Paiute and Shoshone tribal culture was developed in consultation with the two tribes and opened in 1995.

In 1988, the park hosted its first annual CCC Reunion. In the years since, the park has received numerous donations of park-related CCC museum objects. In 1998, these collections were moved to the newly renovated Bear Valley Museum, which reopened to the public as a CCC museum and reference library.

The park's natural history collection originally included the herbarium, mammal, and bird collections. The majority of these specimens were collected in the 1930s, 1940s, and 1950s. A limited number of specimens were added to the collection over the next twenty years, primarily herbarium specimens collected by researchers from Boise State University. Since 1992, the natural history collection has experienced tremendous growth, a result of various resource management projects conducted within the park. These include inventory and monitoring, fire effects studies, ethnobotanical studies, historic landscape reports, and studies conducted by researchers from Boise State University, Oregon State University, the Smithsonian Institution, Stanford University, and the University of Utah. It is anticipated that this collection will continue to grow due to park resource management activities, the Inventory and Monitoring program, and other scientific research activities.

The park's purpose, identified in the General Management Plan (1998) is to:

1. Preserve and protect the scenic beauty and unique geologic features of the Lewis Mountains and Bear Valley: jagged mountain peaks; alpine lakes and meadows; remarkable canyons; volcanic phenomena; fossiliferous deposits; rare sedimentation.

2. Preserve and protect the rare paleontological resources of the Buffalo Valley.

3. Preserve the archeological features that pertain to the prehistoric inhabitants of America and the ancestral Native American tribes.

4. Preserve the entire area intact for the purpose of scientific research.

5. Provide a variety of opportunities for visitors to learn about and enjoy the resources without degrading those resources.

The park's General Management Plan (1998), Long-Range Interpretive Plan (1999), and Resource Management Plan (1998) state that the purpose of the park's museum collection is to:

1. Increase knowledge, inspiration, and an awareness of preservation and stewardship among present and future generations through the effective use of exhibits, research, programs, and publications that are related to the park's interpretive themes and resource management objectives and goals.

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Figure E.1. Example Approved Scope Collection Statement (continued)

2. Support scientific research and resource management.

3. Assist in the establishment of a permanent database of all organisms found in the park.

4. Preserve important or locally significant species collected in response to specific research or interpretive needs.

5. Guarantee the protection of objects whose in-situ preservation cannot be assured.

The park's museum collection should also support the park's interpretive themes, identified in the Long-Range Interpretive Plan (1999):

1. Human Use

    a. Past Human Use: prehistoric and historic North American native cultures including Paleo and Archaic Indian, Shoshone, and Paiute (to 1928); Euro-American trappers, traders, and immigrants (1820–1928), Union Pacific Railroad (1870-1955); early National Park Service (1928-1940).

    b. Contemporary Human Use: a sanctuary with provisions for scientific use and controlled pursuits compatible with the park's purpose and significance.

    c. Desired Future Use: a sanctuary, but with an increased awareness on the part of citizens of their share in the responsibility of such protection. Future improvements to park infrastructure will serve as examples of sustainable design and construction.

2. Geologic History

    Park geology and morphology span the last 250 million years: deposition, the uplift of the Lewis Mountains, creation of the Bear and Buffalo Valleys, lava flows during the past one million years (that created Shawnee Lake), and earthquakes.

3. Paleontological History

    Within its many geologic formations, the park hides evidence of past life: from mountaintop fossilized seashells to dinosaur bones and footprints along the Buffalo River, from single ferns to petrified logjams.

4. Biological Diversity, Natural Processes, and Wilderness

    a. The park contains many diverse organisms. It preserves ongoing natural processes: geological and biological, which we deem inherently valuable.

    b. The park's many diverse and scientifically valuable resources are located in a wild land with few modern, man-made improvements. As such, they provide outstanding opportunities for preservation, study, and enjoyment.

    c. Wilderness is its own reason for existence. It provides a time capsule of processes and resources which should, to the greatest degree possible, be managed and preserved unencumbered by human intervention.

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Figure E.1. Example Approved Scope Collection Statement (continued)

The park's Resource Management Plan (1998) identifies the following resource management objectives and goals:

Management Objectives

1. The park's resources and natural processes are defined, inventoried, and understood by park staff and form a basis for management strategies to fulfill the park's mission.

2. The public and visitor understand and support the missions of the park and the National Park Service. They are advocates of the goals to preserve the nation's heritage and enhance environmental citizenship.

3. The park is managed to assure long-term protection of cultural and natural resources. This includes monitoring impacts of human use in and around the park.

4. The park is managed as a part of a greater regional ecosystem and recognizes the needs of the park, other land management agencies, and private landowners.

5. Management of all park resources, including employees, visitors, and natural resources is recognized and valued worldwide and is a model for national and international managers.

Management Goals:

1. Identify, inventory, and assess the park's natural and cultural resources and natural processes in order to form the basis for management strategies.

2. Manage park resources through a regional ecosystem approach and through cultural contexts.

3. Identify and evaluate the effects of human-caused impacts to park resources to form the basis for implementing management strategies.

4. Based on management strategies, provide a variety of visitor experiences compatible with resource protection.

E. Laws, Regulations, and Conventions Related to Museum Collections

Archeological collections, except inalienable and communal property (as defined by the Native American Graves Protection and Repatriation Act of 1990 [25 USC 3001-13]), recovered from within park boundaries through systematic collection are Federal property and must be retained in the park's museum collection in accordance with 43 CFR 7.13 and NPS *Management Policies* (2001).

In accordance with the NPS Research Permit and Reporting System, permits to collect natural resource specimens state that retained specimens remain Federal property, are incorporated into the park museum collection and, as required by 36 CFR 2.5g, must bear official National Park Service museum labels and their catalog numbers will be registered in the National Park Service National Catalog.

Other laws, regulations, directives and conventions pertinent to the acquisition of museum collections at the park include: the Lacey Act of 1900 (18 USC 43-44); the Migratory Bird Treaty Act of 1918 (16 USC 703-711); the Bald Eagle Protection Act of 1940, as amended (16 USC 668-668d); the Federal Property and Administrative Services Act of 1949, as amended (40 USC 483[b]); the Federal Records Act of 1950, as

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Figure E.1. Example Approved Scope Collection Statement (continued)

amended (“Records Management by Federal Agencies” [44 USC 3101 et. seq.]); the Freedom of Information Act of 1966, as amended (5 USC 552); the Marine Mammal Protection Act of 1972 (16 USC 1361-1407); the Endangered Species Act of 1973, as amended (16 USC 1531-1543); the Privacy Act of 1974 (5 USC 552a); the Copyright Act of 1976 (17 USC 101 et seq. [1988 & Supp. V 1993]); the American Indian Religious Freedom Act of 1978 (42 USC 1996); the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 USC 3001-3013); Federal Property Management Regulations (FPMR), 41 CFR 101; 410 Departmental Manual, Interior Property Management Regulations (IPMR); 411 Departmental Manual, “Managing Museum Property,” Chapters 1-3; “Curation of Federally-Owned and Administered Archeological Collections,” 36 CFR 79; NAGPRA Final Regulations, 43 CFR 10; “Disposition of Federal Records,” 36 CFR 1228; “Protection of Archeological Resources”, 43 CFR 7; “Preservation of American Antiquities”, 43 CFR 3; “Preservation, Arrangement, Duplication, Exhibition of Records” (44 USC 2109); “Disposal of Records” (44 USC 3301 et seq.); Director’s Order #19: Records Management; Director’s Order #24: NPS Museum Collections Management; Director’s Order #28: Cultural Resource Management; Director’s Order #44: Personal Property Management; the 1983 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); the 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property (implemented in the United States by P.L. 97-446 in 1983, 19 USC 2601).

F. Structures, Landmarks, and Other Park Resources Listed on National or International Registries

Historic resources within the park listed on the National Register of Historic Places include: Buffalo Valley Archeological District; Shawnee Lake Rendezvous Site; Lewis Mountain Railroad Tunnel; Shawnee Lake Mine Historic District; Bear Valley Lodge; Bear Valley Ranger Station, Museum, Maintenance Facility, Ranger’s Residence, Comfort Station, and Amphitheater; East Entrance Sign, Checking Station, and Ranger’s Residence; Lewis Mountain Highway and Tunnel.

The park was designated a Biosphere Reserve in 1984.

II. TYPES OF COLLECTIONS

The interpretive themes and resource management goals and objectives stated in the introduction provide direction for the acquisition of museum objects. The following guidelines will prevent arbitrary and excessive growth of the collection, while ensuring that it remains relevant to the park’s mission.

A. Cultural Collection

The purpose of this collection is to increase knowledge and inspiration among present and future generations through exhibits, research, and interpretive programs; support research, resource management and education; provide baseline data of park cultural resources; document changes these resources are undergoing because of internal park conditions and external effects; to guarantee the protection of important objects whose in-situ preservation cannot be assured.

Objects and archival collections with a direct association to the park are more desirable for inclusion within the collection than similar items without such primary significance. The cultural collection is subdivided into four disciplines: archeology, ethnology, history, and archives and manuscripts. The following list identifies, by discipline, object types appropriate to the park’s museum collection and, as needed, notes current representation.

Figure E.1. Example Approved Scope Collection Statement (continued)

The cultural collection must support these goals. This will ensure that only relevant objects and archival materials are accessioned into the collection. Future growth of the collection should be restricted to items related to:

1. Interpretive and/or research needs identified in the park's General Management Plan (1998), Resource Management Plan (1998), Long-Range Interpretive Plan (1999), historic furnishings reports, exhibit plans, and other applicable park planning documents and resource studies.

2. Enhancing understanding of and promoting increased stewardship of the park's cultural resources.

3. Cultural resources baselines/inventorying and monitoring activities.

4. Regulatory and compliance activities such as those mandated by the National Historic Preservation Act of 1966, as amended and the Archaeological Resources Protection Act of 1979 (ARPA).

1. Archeology Collection

Archeological collections are generated in response to cultural resource management requirements related to legal mandates, to development of park facilities, to preservation-related activities, to research requirements, and to interpretive needs. The archeological collection includes artifacts, human remains, and other materials obtained using archeological methods.

As per 43 CFR Part 7, any archeological materials discovered within the park (except inalienable and communal property, as defined by NAGPRA) are the property of the United States and will be maintained as a part of the park's museum collection.

a. Artifacts and Specimens

Archeological research projects within the park may result in the collection of artifacts, ecofacts, or other data.

Park staff and visitors should be discouraged from picking up surface artifacts. It is preferred that surface artifacts be left in-situ and their location documented. If materials are collected and brought to park staff, appropriate measures must be taken to ensure that the visitor collects no more material, that precise provenience information is recorded, if possible, and that the objects/data are promptly given to the curatorial staff upon receipt by staff members.

The park's archeology collection includes:

1) **Prehistoric Material**. The collection contains 2000 prehistoric Native American items (projectile points, flaked stone, ground stone, and pottery sherds), including twenty items associated with Paleo and Archaic Indian sites within the park.

2) **Historic Material**. The collection contains material from sites related to the settlement of the lands within the park during the historic period (through 1942), and sites associated with early park development, from circa 1920 through 1942. Materials from both Native American sites and Euro-American sites are included in this category. This collection consists of over 4,000 artifacts, including knives, projectile points, flaked stone, ground stone, pottery, household items, tools, glass, porcelain and ceramic sherds, objects related to mining and railroads, and other items.

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Figure E.1. Example Approved Scope Collection Statement (continued)

3) **Confiscated Archeological Objects.** These are objects recovered from unauthorized and illegal activities. They might include unearthed artifacts, ecofacts, and human remains illegally excavated or uncontrolled surface collecting by unauthorized individuals within the park boundaries. The museum curator should be consulted as soon as possible to ensure proper handling and transportation of these materials. Such objects might be held temporarily as evidence if legal action is to be taken, but should be formally turned over to the museum curator as soon as possible. Once all legal questions are resolved, the objects and all associated documentation will be added to the museum collection.

b. Associated Field Records

All records associated with archeological collections are retained as part of the museum collection. These records include field notes and catalogs, daily journals, drawings and maps, photographs and negatives, slides, sound recordings, raw data sheets, instrument charts, remote sensing materials, collection inventories, analytical study data, conservation treatment records, computer documentation and data, as well as any other documents generated through archeological activity.

2. Ethnology Collection

The park has important ties to both the Paiute and Shoshone tribes. The ethnology collection is an important component of the park's interpretive and resource management programs and furthers the park's mission. The collection is noted in the Long-Range Interpretive Plan (1999) and is an important element of the plan's Human Use section. The collection's importance is also noted in the General Management Plan (1998), especially concerning tribal consultation and traditional uses of park resources by tribal members.

a. **Objects.** Acquired, mostly through gifts between 1928 and 1976, the ethnology collection presently includes examples of Native American material culture from the Great Basin, Northwest, and adjacent culture areas. These artifacts illustrate the cultural continuity of the Native American cultures of the area, as well as their cultural adaptation and change as seen through their material culture. They also illustrate Native American artistic traditions in the vicinity and provide examples of the arts and crafts of groups with whom the park has been associated.

The collection consists primarily of Paiute basketry, watercolors, beadwork, and textiles. There are also several fine examples of Shoshone basketry, beadwork, and textiles, most notably the Lillian Wood Collection, acquired by loan in 1976.

b. **Associated Records.** All records associated with ethnographic collections are retained as part of the museum collection. These records may include field notes; interview schedules, tapes (video and audio), interview transcripts; negatives, prints and slides; data sheets (all subject to restrictions of confidentiality, if any); artifact inventories; analytical study data; computer documentation and data; reports generated by ethnographic investigations; as well as any other documents generated through ethnographic field work.

c. **Future Collections Activity.** The park will continue to acquire ethnographic material from the Paiute and Shoshone tribes, as well as other Native American groups that have aboriginal, historic, or religious ties to park lands, if such collections will address an interpretive and/or research need identified in the Ethnographic Overview and Assessment (1996), Long-Range

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Figure E.1. Example Approved Scope Collection Statement (continued)

Interpretive Plan (1999), Resource Management Plan (1998), cultural affiliation studies, exhibit plans, or other park planning documents. All such future collections activities will proceed in close cooperation with Paiute and Shoshone tribal councils, cultural resource management officers, and councils of Elders.

1) Lillian Wood Collection

The entire collection of Shoshone material culture items consists of the Lillian Wood Collection, which is on loan to the park. This collection is a superb representation of the area's Shoshone culture, circa 1840-1950, and is a vital component of the park's interpretive and research programs. Mrs. Wood's estate is committed to the collection remaining at the park, and the Shoshone tribe and Council of Elders concur. However, the park may be required to purchase the items in order to ensure that they remain at the park. To this end, the park's cooperating association, the Lewis Mountains Association and the Friends of the Lewis Mountains have established a fund-raising campaign to enable the park to purchase the collection outright.

2) Modern Works

During the General Management Plan process, the park and its stakeholders determined that the then-current ethnology collection did not include more recent representations of the area's Paiute and Shoshone material cultures. In response, both the General Management Plan (1998) and Long-Range Interpretive Plan (1999) stress the importance of acquiring a limited number of modern works "…to illustrate the endurance of the area's original Native Peoples, and the continuation and evolution of their culture, arts, and livelihoods through to the present era." The park has since acquired three modern Paiute baskets and two paintings in consultation with Paiute tribal authorities and Elders. Recent consultations with Shoshone Elders determined the need to obtain modern Shoshone textiles and paintings to address these interpretive deficiencies.

3. History

The history collection is an important component of the interpretive and resource management programs and supports the mission of the park. The collection's importance is noted in the Human Use section of the Long-Range Interpretive Plan (1999). The General Management Plan (1998) states that the collection is a "vital element in the interpretation and resource management of historic structures, sites, and other indicators of human use within the present boundaries of the park."

Only historic material that has a direct association with the park is included in the museum collection. When a large quantity of an object type is available, priority is given to acquiring the best-preserved examples. The history collection is based on the park's themes used to establish the following collecting categories:

a. **Historic Era: Native American Inhabitants, Euro-American Exploration, Fur Trade, Railroad, Mining, and Homesteading (Pre-1920).** There are few objects directly associated with historic era Native American inhabitants, Euro-American exploration, and the fur trade in the collection. It is unlikely that such material of this type will become available, however

Figure E.1. Example Approved Scope Collection Statement (continued)

the park should attempt to obtain an early 19th Century beaver trap to fulfill a deficiency noted in the Henderson Visitor Center Exhibit Plan (1992).

The collection includes several outstanding examples of excavation equipment, tools, and other items associated with the area's 19th century miners, railroad workers, and homesteaders, including the Jakes Collection (first family of homesteaders in the area, now part of the park).

b. **Early Park Development (1920-1940)**. Material in this category includes a Union Pacific/Bear Valley Lodge bus, historic furnishings, staff personal items (e.g., Superintendent Jackson's badge, 1928-35). The park will continue to collect staff members' personal items, furnishings, and other materials that address an interpretive and/or research need identified in an interpretive plan, exhibit plan, or other park planning document.

c. **Civilian Conservation Corps (CCC, 1933-1942)**. The CCC played an important role in the development of the park and in the preservation of its resources. Items in the museum collection from this period include: historic furnishings, copies of administrative records, construction drawings, photographic documentation of projects, tools, artwork (exhibition illustrations, personal sketches and watercolors), and architectural features. If additional material documenting park CCC activities becomes available, it should be collected when it does not duplicate what is presently available. Areas where documentation is incomplete include camp life, identification of personnel in the photographic records on hand, and copies of camp publications such as the *Bear Valley Camp News*.

Many of the park's administrative, maintenance, and residential buildings were either constructed or significantly modified during the CCC period, and are listed on the National Register of Historic Places.

Some works of art, created as exhibition illustrations, have been included in the museum collection. Other important examples remain in the exhibits and these, along with some individual exhibits (dioramas in the Bear Valley Museum) should become part of the museum collection.

d. **Commemorative Events.** Memorabilia from important current or commemorative events are included in the museum collection. Materials related to President Franklin D. Roosevelt's 1938 park vacation and the park's 75th anniversary have been included. Materials from these types of important park activities will continue to be preserved as they become available.

e. **Historic Fabric.** When original fabric is removed from a historic structure during a preservation or repair project, a representative portion of the fabric will be preserved and accessioned into the museum collection, along with any associated documentation.

f. **Future Collections Activity.** Future collections activity in this area will concentrate on the acquisition of outstanding examples of objects currently not represented in the collection, which meet the criteria referenced above and clearly correct an interpretive or research deficiency noted in the park's General Management Plan (1998), Long-Range Interpretive Plan (1999), future exhibit plans, or other planning documents. This will ensure that the history collection is relevant to the interpretive and research needs of the park.

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Figure E.1. Example Approved Scope Collection Statement (continued)

4. Archival and Manuscript Collection

The park's archival collection includes oral histories with local residents (including oral histories conducted in 1955 with Mrs. Elsie Johnson and other tribal elders); duplicate copies of administrative records such as Superintendent's Reports and Chief Naturalist's Reports; photographic prints, negatives, and slides; photographs, blueprints, specifications and other items documenting facility development; materials related to scientific studies and resource management activities (Peregrine Falcon studies, mine preservation studies, wilderness areas, etc.); the Josiah Jakes Papers (personal papers of the first Euro-American homesteader in Bear Valley).

Policy and procedures for archival collections and records management are outlined in NPS *Management Policies* (2001), Director's Order #19: Records Management (2001), the *Museum Handbook*, Part II, Appendix D: Archives and Manuscript Collections, and the NPS *Records Disposition Schedule* (1986).

Library Materials

A small number of library materials (e.g., rare books and manuscripts) are included in the museum collection. The park library contains other rare books (e.g., Jonas Fredericson's 1881 publication *Travels Through the Lewis Mountains*) that should also be included in the museum collection. Rare books and original manuscripts, having direct association with the park will continue to be included in the museum collection.

The park's library includes a large number of books that are out of print, technical references, and administrative documents. This material, though valuable, will not be included in the museum collection and will continue to be managed under the park's library management plan. The library and printed matter in the museum collection both support the park's research, interpretive, and resource management programs.

Future Collections Activity

In accordance with Director's Order #19: Records Management (2001) and the NPS *Records Disposition Schedule* (1986), the park Records Management Committee examines all current park files before they are transferred to the National Archives and Records Administration or disposed of, to ensure the retention of copies of important official records in the park. Other materials to be retained include materials related to scientific studies and resource management activities; oral histories, historic resource studies, and similar reports; photographs, blueprints, specifications and other items documenting facility development. Retained materials are managed as part of the museum collection.

In 2002, park staff learned of the existence of two diaries and several letters (circa 1860) kept by Betsy Jakes, niece of Josiah Jakes. These items are currently in the possession of Mrs. Dorothy Samuels of Santa Barbara, California. As these materials document many previously unknown aspects of the area's Euro-American settlement, acquisition of them by the park would constitute an important addition to the collection. The park recently obtained copies of these materials, and Mrs. Samuels has expressed willingness to bequeath the originals to the park. Obtaining these items is a high priority and park staff will continue to work with Mrs. Samuels in this regard.

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Figure E.1. Example Approved Scope Collection Statement (continued)

B. Natural History Collection

Purpose

The purpose of this collection is to support scientific research, resource management and education; provide baseline data of park natural resources; document changes these resources are undergoing because of internal park conditions and external effects; provide a database for researchers concerned with resources use by the park's prehistoric occupants; preserve important or locally significant species collected in response to specific research or interpretive needs; to guarantee the protection of important paleontological specimens whose in-situ preservation cannot be assured.

The natural history collection must support these goals. This will ensure that only well-documented and appropriate specimens are retained. Future growth of the collection should be restricted to specimens and associated records generated through:

1. Authorized scholarly research and selective acquisition based on:

   - Needs identified in the park's General Management Plan (1998), Resource Management Plan (1998), and other applicable park planning documents and resource studies

   - Servicewide initiatives such as the Natural Resource Challenge

   - Enhancing understanding of and promoting increased stewardship of the park's ecosystem

2. Inventorying and Monitoring Activities

3. Regulatory and compliance activities such as those mandated by the National Environmental Policy Act of 1969 (NEPA), as amended

Scholarly research may be conducted by park or non-park scientists. All collecting activities must be in compliance with 36 CFR 2.5, the Research Permit and Reporting System, Director's Order #77: Natural Resource Protection (under development), and NPS *Natural Resources Management Guideline* (1991). All researchers must comply with applicable state and Federal laws regulating collecting, documenting collections, and other associated activities. No collector (including park staff) can work in the park without first obtaining a signed permit. The collections section of the permit application must be completed, documenting where collections of specimens and associated records will be housed. Questions related to collecting within the park should be addressed to the park's research coordinator.

Three separate areas of the park, with a total of 8,100 acres, were designated as wilderness in 1973. Alpine Meadow received designation as a "Research Natural Area" in 1969. All collecting of natural resource specimens that impacts these areas must take into consideration restrictions in effect because of these special designations.

Natural resource specimens collected outside the park boundaries will not be included in the collection unless the specimens are required to illustrate interpretive exhibits, to augment specific park-related research projects, or to demonstrate effects on park resources. Written permission from landowners or appropriate officials is obtained when collecting occurs on their land. This documentation or copies must become part of the museum collection's accession file.

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Figure E.1. Example Approved Scope Collection Statement (continued)

Taxidermy "mounts" and freeze-dried specimens will be obtained only when a specific need (such as for an exhibit) is identified. Specialty collections such as frozen or other types of tissue samples are beyond the capability of the park to preserve. If they are collected and held by other repositories, they will be accessioned and cataloged in the park's collection. Archived soils and other strictly environmental monitoring samples will only be collected as part of authorized research projects.

This collection is divided into three disciplines: biology, geology, and paleontology. The following list identifies the categories of specimens that are to be included in the museum collection and notes their current representation.

1. **Biology**

   a. **Flora**. Major herbarium collections of vascular plants were made in the 1940s and 1960s. Thus, nearly all species are represented in the herbarium. The non-vascular flora are not well represented in the herbarium. One research project has been conducted in this area; a lichen study was conducted in 1981. Specimens from this project are stored in the park's herbarium. Duplicate specimens are on a repository loan to the University of Utah. It is anticipated that the herbarium collection will continue to grow as a result of park resource management activities (inventory and monitoring, fire effects, etc.) and authorized scholarly research.

   Two state-listed rare plant species have been identified in the park: *Spiranthes diluvialis* and *Astragalus aquilonius* (Barneby) Barneby. Researchers must comply with all regulations governing these species.

   Note: A teaching collection of herbarium specimens has been developed by the park's interpretive staff. This collection consists of specimens located in the park's Discovery Center, the Environmental Education Center, and additional specimens used for interpretive programs. This collection is managed for consumptive use by the Division of Interpretation; it is not part of the museum collection.

   b. **Fungi**. The fungi collection currently consists of fifty-two specimens collected in 1998 by a researcher from Stanford University. These specimens are currently housed at Stanford University. It is anticipated the fungi collection will continue to grow in the future, as a result of inventory and monitoring, other park resource management activities, and authorized scholarly research.

   c. **Mammals**. The majority of the mammal specimens in the collection were collected in the 1930s. Not all species found in the park are represented. A major research study of small mammals was conducted from 1989-1994. The study included the collection and preservation of small mammal species found in the park. It is anticipated the collection will continue to grow in the future, as a result of inventory and monitoring, other park resource management activities, and authorized scholarly research. The mammal collection is housed at the park.

   No known endangered, threatened, or rare species are known in the park.

   Note: A teaching collection of mammal specimens has been developed by the park's interpretive staff. These specimens include animals accidentally killed on nearby roads, seizures of illegal game by the state Department of Fish and Game and U.S. Fish and Wildlife Service, and skeletal materials. The collection consists of specimens located in the park's

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Figure E.1. Example Approved Scope Collection Statement (continued)

Discovery Center, the Environmental Education Center, and additional specimens used for interpretive programs. This collection is managed for consumptive use by the Division of Interpretation; it is not part of the museum collection.

d. **Birds**. The majority of the bird specimens presently in the collection were collected in the 1930s. Not all species found in the park are represented. It is anticipated the collection will continue to grow in the future, as a result of inventory and monitoring, other park resource management activities, and authorized scholarly research.

Two threatened, endangered, or rare species have been recorded in the park. These are: *Haliaeetus leucocephalus* and *Falco peregrinus*. Researchers must comply with all regulations governing these species.

Note: A teaching collection of bird specimens has been developed by the park's interpretive staff. These specimens include animals found dead, specimens seized by the state Department of Fish and Game and U.S. Fish and Wildlife Service, abandoned eggs and nests, and skeletal materials. The collection consists of specimens located in the park's Discovery Center, the Environmental Education Center, and additional specimens used for interpretive programs. The collection includes two examples of *Haliaeetus leucocephalus* and one *Aquila chrysaetos*. This collection is managed for consumptive use by the Division of Interpretation; it is not part of the museum collection. All required permits are maintained by the Division of Interpretation.

e. **Reptiles and Amphibians**. Few species of reptiles and amphibians are currently represented in the museum collection. No major scientific studies involving reptiles and amphibians in the park have been undertaken to date. It is anticipated this collection will grow in the future, as a result of inventory and monitoring, other park resource management activities, and authorized scholarly research.

No known threatened, endangered, or rare species are found in the park.

f. **Fish**. The Bear River flows through the central portion of the park. Other bodies of water in the park include Shawnee Lake and numerous other small lakes and streams. The aquatic life found in these bodies of water in the park have not been studied to date. It is anticipated this collection will grow in the future, as a result of inventory and monitoring, other park resource management activities, and authorized scholarly research.

g. **Insects and Arachnids**. The park's insect collection dates from the 1970s. It is a fairly extensive collection resulting from a cooperative agreement with Oregon State University. The collection also includes insect larvae and soft-bodied arachnids preserved in 70% ethanol.

It is anticipated that this collection will grow in the future, as a result of inventory and monitoring, other park resource management activities, and authorized scholarly research. Species of importance in park management (such as parasites, museum pests, and others potentially requiring control measures) should be similarly represented. This collection is stored at the park.

No known rare, threatened, or endangered species are found in the park.

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Figure E.1. Example Approved Scope Collection Statement (continued)

Note: A teaching collection of insect specimens has been developed by the park's interpretive staff. These specimens include those located in the park's Discovery Center, the Environmental Education Center, and additional specimens used for interpretive programs. This collection is managed for consumptive use by the Division of Interpretation; it is not part of the museum collection.

h. **Other Invertebrates**. Invertebrates other than those referred to above, both aquatic and terrestrial, are not well documented in the park. A small collection of dried land snail shells was made in the 1930s. It is anticipated that this collection may grow in the future, as a result of inventory and monitoring, other park resource management activities, and authorized scholarly research.

i. **Associated Records**. All records associated with specimens collected in conjunction with biological research are retained in addition to the specimens as part of the museum collection. Archival collections supplement future researchers' understanding of these collected specimens. These records include field notes; daily journals; maps and drawings; photographic negatives, prints, and slides; videotapes; sound recordings; raw data sheets; remote sensing data; copies of contracts; correspondence; repository agreements; specialists' reports and analyses; reports and manuscripts; specimens inventories and field catalogs; analytical study data; computer documentation and data; tabulations and lists; reports on all scientific samples lost through destructive analysis.

2. Geology

a. **Rocks and Minerals**. The collection contains a number of hand specimens, soil specimens, and mineral specimens that document the major rock types, formations, soils, and minerals found in the park. Additional specimens may be added to the collection as a result of resource management activities or other authorized scientific research.

Note: A small teaching collection of rock and mineral hand specimens has been developed by the park's interpretive staff. These specimens include those located in the park's Discovery Center, the Environmental Education Center, and additional specimens used for interpretive programs. This collection is managed for consumptive use by the Division of Interpretation; it is not part of the museum collection.

b. **Associated Records**. All records associated with specimens collected in conjunction with geological research are retained in addition to the specimens as part of the museum collection. Archival collections supplement future researchers' understanding of these collected specimens. These records include field notes; daily journals; maps and drawings; photographic negatives, prints, and slides; videotapes; sound recordings; raw data sheets; remote sensing data; copies of contracts; correspondence; repository agreements; specialists reports and analyses; reports and manuscripts; specimen inventories and field catalogs; analytical study data; computer documentation and data; tabulations and lists; reports on all scientific samples lost through destructive analysis.

3. Paleontology

Uncontrolled surface collecting by visitors and park staff is prohibited. Fossils found on the surface by visitors should not be removed from their original location by the finder. They should be reported to park staff. If materials are turned in to park staff, appropriate measures must be

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Figure E.1. Example Approved Scope Collection Statement (continued)

taken to ensure that the visitor collects no more material, that precise provenience information is recorded, if possible, and that the objects/data are promptly given to the museum curator upon receipt by staff members.

a. **Fossil Specimens**. The collection contains a representative and well-documented collection of invertebrates, mainly from the Bear Valley Shale Formation that were collected in the 1950s and 1960s. An additional twenty-nine specimens were collected in 1992, and are located at Boise State University. It is anticipated that this collection may grow in the future, as a result of park resource management activities and authorized scholarly research.

b. **Associated Records**. All records associated with specimens collected in conjunction with paleontological research are retained in addition to the specimens as part of the museum collection. Archival collections supplement future researchers' understanding of these collected specimens. These records include field notes; daily journals; maps and drawings; photographic negatives, prints, and slides; videotapes; sound recordings; raw data sheets; remote sensing data; copies of contracts; correspondence; repository agreements; specialists reports and analyses; reports and manuscripts; specimen inventories and field catalogs; analytical study data; computer documentation and data; tabulations and lists; reports on all scientific samples lost through destructive analysis.

III. MUSEUM COLLECTIONS SUBJECT TO THE NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION ACT OF 1990

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), 25 USC 3001-13, requires, in addition to other actions, a written summary of unassociated funerary objects, sacred objects, and objects of cultural patrimony. The park's holdings that fall into these NAGPRA categories are listed in a Servicewide summary that was distributed to all Indian Tribes, Alaska Native villages, and Native Hawaiian organizations on October 27, 1993. An updated copy of this summary is on file at the park.

NAGPRA requires a written, item-by-item inventory of human remains and associated funerary objects to be completed no later than November 16, 1995. The park has human remains and associated funerary objects subject to NAGPRA in its museum collection. A detailed listing of these items is contained in the park's NAGPRA Inventory, completed October 10, 1995. An updated copy of this inventory is on file at the park.

IV. ACQUISITION

The park acquires objects for its museum collections by gift, purchase, exchange, transfer, field collection, and loan. Museum objects must be acquired, accessioned, and cataloged in accordance with *Museum Handbook*, Part II, Museum Records. Acquisition of museum objects are governed by the park's ability to manage, preserve, and provide access to them according to NPS *Management Policies* (2001), Chapter 5; the standards for managing museum objects in Director's Order #28: Cultural Resource Management (1998), *Cultural Resource Management Guideline* (1997), and Director's Order #24: NPS Museum Collections Management; the NPS *Museum Handbook*, Part I, Museum Collections and Part III, Access and Use.

In accordance with NPS policy, the park will prohibit the acquisition of gifts with restrictions or limiting conditions. Such restrictions include copyrights; the park will acquire copyrights to all incoming accessions. Incoming loans will be acquired only for a particular purpose such as research or exhibition,

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Figure E.1. Example Approved Scope Collection Statement (continued)

and for a specified period of time. Museum objects are acquired, accessioned, and cataloged in accordance with the NPS *Museum Handbook*, Part II, Museum Records.

The park will not be a partner to, or encourage in any way, the trafficking in illicitly collected materials. All acquisitions must be collected, exported, imported, transported, or otherwise obtained and possessed in full compliance with the laws and regulations of the country of origin, the United States federal government (including NAGPRA), and the individual states of the United States.

The acquisition of firearms included on the Bureau of Alcohol, Tobacco, and Firearms (ATF) list of prohibited/restricted weapons requires concurrent review by the regional/SO curator and the regional/SO law enforcement specialist.

The park superintendent, by delegation, represents the Director of the National Park Service and the Secretary of the Interior in accepting title to and responsibility for museum objects. The superintendent will ensure that all collections acquired are in keeping with this Scope of Collection Statement before accepting the items as part of the permanent collection. The superintendent bears the ultimate responsibility for the acquisition and proper care and management of the museum collection. The superintendent has delegated the day-to-day care of the collection to the museum curator.

All acquisitions must receive formal approval from the superintendent before they can be accepted into the museum collection. Upon receipt, all newly acquired objects and related documentation must be turned over to the museum curator. The museum curator prepares, for the superintendent's signature, all instruments of conveyance, and letters of thanks, acceptance, or rejection, and transmits them as appropriate, to the donor, lender, vendor, or other source of acquisition.

V. USES OF COLLECTIONS

The park's museum collection may be used for exhibits, interpretive programs, research, publications, or other interpretive media. The primary considerations for the use of museum objects are the preservation of each object in question and of the collection as a whole, and accurate interpretation.

In accordance with NPS *Management Policies* (2001), Chapters 5 and 7, the park will not exhibit Native American human remains or photographs of those remains. Drawings, renderings, or casts of such remains will not be displayed without the consent of culturally affiliated Indian tribes and Native Hawaiian organizations. The park will consult with culturally affiliated or traditionally associated peoples to determine the religious status of any object whose sacred nature is suspected but not confirmed. These consultations will occur before such an object is exhibited or any action is taken that may have an adverse effect on its religious qualities.

Researchers and other specialists may examine objects and archival materials under the conditions and procedures outlined in Director's Order #24: NPS Museum Collections Management, Director's Order #28: Cultural Resource Management (1998), Cultural Resource Management Guideline (1997), and in the park's written "Museum Collections Access Procedures." Outside researchers must submit a research proposal to the superintendent for review by the park's Research Coordinator and other staff as appropriate. If applicable, the research proposal may be presented for review during consultation with the Paiute and Shoshone tribes before access to certain items in the collection is granted.

Any interpretive use defined as consumptive must be authorized in advance, as outlined in Director's Order #24: NPS Museum Collections Management, Director's Order #28: Cultural Resource Management (1998), *Cultural Resource Management Guideline* (1997), and Director's Order #6: Interpretation and Education (Draft, 2002). The use of reproductions is preferred to the consumptive use of original objects.

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Figure E.1. Example Approved Scope Collection Statement (continued)

Destructive analysis is a legitimate use of museum collections for approved research purposes when the impact is minor or when the object is common, in which case approval by the superintendent is required. If an object is rare or significant, a request for destructive analysis should be reviewed by the regional/SO curator and may be approved only by the regional director, as outlined in Director's Order #24: NPS Museum Collections Management, Director's Order #28: Cultural Resource Management (1998) and *Cultural Resource Management Guideline* (1997).

Objects may be loaned out to qualified institutions for approved purposes in accordance with NPS *Museum Handbook*, Part II, Chapter 5: Outgoing Loans. Institutions must meet accepted museum standards for security, handling, and exhibition of NPS museum objects. Sensitive materials may require additional conditions prior to a loan commitment. Expenses related to loans of museum objects, including shipping and insurance, will normally be assumed by the borrower.

Photographs of museum objects are made available to the public to provide an indirect use of the museum collection through publications and exhibits (including exhibits on the park website). Many of the park's artifacts have been illustrated in publications.

All exhibits containing museum objects must have proper security, appropriate environmental controls, and proper mounts to ensure the long-term preservation and protection of the objects.

VI. RESTRICTIONS

Restrictions in addition to those applying to the use of the museum collection outlined in Section IV of this statement are as follows:

In accordance with NPS *Management Policies* (2001) 7.5.5. "Consultation" and 5.3.5.5 "Museum Collections," and DO #24: NPS Museum Collections Management, curatorial staff should consult with traditionally associated peoples and other cultural and community groups for whom the collection has significance. Archeological objects in the museum collection shall be made available to persons for use in religious rituals or spiritual activities in accordance with 36 CFR 79, Section 79.10(c), "Curation of Federally-owned and Administered Archeological Collections." Requests to borrow non-archeological material for religious ritual or spiritual activities will be addressed on a case-by-case basis.

The park will not approve research on human remains and associated funerary objects without the consent of the affected group(s).

In accordance with the National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.), the Archaeological Resources Protection Act of 1979, as amended (16 USC 470aa-mm), the National Parks Omnibus Management Act of 1998 (16 USC 5937), and NPS *Management Policies* (2001) 4.1.2. "Natural Resource Information" and 5.2.3 "Confidentiality," the park may withhold from the public sensitive information concerning: rare, threatened, or endangered species; commercially valuable resources; minerals; paleontological resources; archeological and other cultural resources; objects of cultural patrimony and sensitive ethnographic information; information provided by individuals who wish the information to remain confidential; the identities of individuals who wish to remain anonymous. Inquiries of this nature will be referred to the regional Freedom of Information Act (FOIA) and Privacy Act Officer for consultation and possible review.

Restrictions may be placed on the publication of images or manuscripts in the museum collection if these materials are subject to copyright, and the National Park Service does not hold the copyright.

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Figure E.1. Example Approved Scope Collection Statement (continued)

All endangered, threatened, or rare plants and vertebrate and invertebrate animals will be collected only when accidentally killed or when dead from natural causes. The collection of threatened, endangered, or rare plant and animal species will comply with NPS *Management Policies* (2001), be in accordance with the provisions of the Endangered Species Act of 1973, as amended, and will be strictly limited according to the applicable rules of the U.S. Fish and Wildlife Service.

Final disposition of type specimens will be determined at the Servicewide level and will adhere to recognized conventions established for specific disciplines.

The park will not knowingly be a partner to or encourage in any way the trafficking in illicitly collected materials.

VII. MANAGEMENT ACTIONS

This Scope of Collection Statement must be reviewed every five years, and be revised when necessary, to remain supportive of and consistent with any changes in the park's mission. Any revision to this document requires the approval of the superintendent.

The park has an approved Collection Management Plan. The plan was approved on August 2, 1996.

A number of objects from the collection are housed at repositories outside of the park:

1. 493 nitrate film negatives are stored at the Western Archeological and Conservation Center in Tucson, Arizona.

2. Twenty-nine paleontological specimens are located at Boise State University in Boise, Idaho.

3. Ninety-one mammal specimens (collected at the park in the 1930s and 1950s) are housed at the Utah Museum of Natural History, University of Utah, in Salt Lake City.

4. 200 lichen specimens collected in 1981 are stored at the Utah Museum of Natural History, University of Utah, in Salt Lake City.

5. Fifty-two fungi specimens collected in 1998 are housed at Stanford University, in Stanford, California.

The park staff is compiling data on collections in other institutions that were removed from sites within the park. Natural history collections and archeological materials were removed from sites presently within the park boundaries before its creation in 1928 and during the first two decades of the park's existence. The list of institutions in the United States that have important collections from the park include: the Idaho Museum of Natural History in Pocatello, the Smithsonian Institution, the University of Colorado in Boulder, and the University of Utah in Salt Lake City. These collections still contain a wealth of information that has not been fully analyzed to date.

Recall of objects loaned to the park is a possibility. The park needs to seek replacements for exhibited objects on long-term loan in order to prevent potential disruption of exhibits.

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Figure E.1. Example Approved Scope Collection Statement (continued)

National Park Service
U.S. Department of the Interior

Lewis Mountains
National Park

PO Box 100
Bear Valley, Idaho 83301
(208) 555-8142 phone
(208) 555-1767 fax

Lewis Mountains National Park

Scope of Collection Summary

The park's museum collection includes both natural history and cultural collections. The park's natural history collection includes: mammal and bird collections; the herbarium, which includes nearly all species of vascular plants that occur in the park; paleontological collections from the Bear Valley Shale Formation; geological specimens from the Bear Valley Shale and Lewis Granite Formations. Other natural history collections within the museum collection include: fungi; reptiles and amphibians; fish; insects and arachnids. At present, these collections are relatively small, as little research pertaining to these disciplines has been conducted in the park to date.

The cultural collection includes: archeological materials systematically excavated from within the park's boundaries and associated field records (circa 1000 BCE – circa 1940); an ethnology collection of Paiute and Shoshone basketry, watercolors, beadwork, and textiles; historic objects associated with the area's 19th century miners, railroad workers, and homesteaders, and items related to the Civilian Conservation Corps and President Franklin D. Roosevelt's 1938 park vacation; archival and manuscript collections such as the Joseph Jakes papers, oral histories, photographs, and scientific and resource management records.

For additional information on the museum collection contact:

Museum Curator
Lewis Mountains National Park
PO Box 100
Bear Valley, Idaho 83301
(208) 555-8142 phone
(208) 555-1767 fax
lemo_curator@nps.gov

EXPERIENCE YOUR AMERICA
The National Park Service cares for special places saved by the American people so that all may experience our heritage.

Figure E.2. Example Scope of Collection Summary

National Park Service
U.S. Department of the Interior

CHECKLIST FOR EVALUATING SCOPE OF COLLECTION STATEMENTS

Unit's Name:____

Draft ______ Approved ______ Date: __________________

Reviewed by: ____ Date: __________________
Name Title

	YES	NO	NA	Note*
A. Does the SOCS have TITLE PAGE?	_____	_____	_____	_____
1. Is Title Page format correct?	_____	_____	_____	_____
2. Does Title Page include all required signatures and dates?	_____	_____	_____	_____
B. Does the SOCS have INTRODUCTION section?	_____	_____	_____	_____
1. Does SOCS have an Executive Summary?	_____	_____	_____	_____
2. Is purpose of SOCS stated?	_____	_____	_____	_____
3. Are NPS legal authorities (laws) to acquire and preserve museum objects cited?	_____	_____	_____	_____
4. a. Is unit's mission stated?	_____	_____	_____	_____
b. Is unit's enabling legislation cited?	_____	_____	_____	_____
c. If applicable, is subsequent legislation cited?	_____	_____	_____	_____
5. If applicable, is there a statement indicating that a museum collection is mandated by the unit's enabling or subsequent legislation?	_____	_____	_____	_____
6. Unit's Interpretive Themes:				
a. Are interpretive themes listed?	_____	_____	_____	_____
b. Are interpretive periods listed?	_____	_____	_____	_____
c. If available, are appropriate planning documents (title/date) cited?	_____	_____	_____	_____
7. Unit's Resource Management Goals and Objectives:				
a. Are pertinent cultural and natural resource management goals and objectives listed?	_____	_____	_____	_____
b. Are planning documents (title/date) cited?	_____	_____	_____	_____
8. Mandated Collections:				
a. Is statement, citing 43 CFR 7.13 and NPS *Management Policies* (2001), made that archeo-logical collections are managed as part of the unit's museum collection?	_____	_____	_____	_____
b. Is there a statement citing permit conditions and curatorial requirements pertaining to 36 CFR 2.5g?	_____	_____	_____	_____
9. Is there a discussion of the significance and history of the collection?	_____	_____	_____	_____

***See additional notes pertaining to this question on attached pages.**

Page 1 of 5

Figure E.3. Checklist for Evaluating Scope of Collection Statements

	YES	NO	NA	Note*
10. Are other laws, regulations, conventions, and special directives relevant to acquisition of museum objects cited?	____	____	____	____
11. If applicable, are any special unit designations (e.g., Biosphere Reserve, National Historic Landmark, World Heritage Site) that may be pertinent to museum collection cited?	____	____	____	____
C. Does the SOCS have TYPES OF COLLECTIONS section?	____	____	____	____
1. Is there a brief profile of the unit's museum collection?	____	____	____	____
2. Is there an introductory statement indicating that the INTRODUCTION section states the purpose of collection?	____	____	____	____
3. Is section divided into two major categories: Natural History Collection and Cultural Collection?	____	____	____	____
4. Natural History Collection Category:				
a. If appropriate, is there a statement that the unit does not collect/maintain a natural history collection for its own purposes?	____	____	____	____
b. If unit collects/maintains a natural history collection is there an introductory paragraph that briefly outlines the purpose of this collection?	____	____	____	____
c. Is major category subdivided into disciplines (Biology, Geology, Paleontology) pertinent to unit?	____	____	____	____
d. Is each discipline subdivided into collecting categories that reflect unit's purpose for collection?	____	____	____	____
e. If appropriate, under each collecting category:				
1) Is current representation of object types described?	____	____	____	____
2) Are priorities established to fill identified deficiencies (gaps) in existing collection?	____	____	____	____
3) Are limits (quantities) defined?	____	____	____	____
f. Is there a collecting category for "associated records" under each discipline?	____	____	____	____
g. Does paleontology discipline include a statement relevant to uncontrolled surface collecting?	____	____	____	____
5. Cultural Collection Category:				
a. Does introductory paragraph include a statement that describes the purpose of this collection?	____	____	____	____

***See additional notes pertaining to this question on attached pages.**

NPS Checklist for Evaluating Scope of Collection Statements Page 2 of 5

Figure E.3. Checklist for Evaluating Scope of Collection Statements (continued)

	YES	NO	NA	Note*
b. Does introductory paragraph state that an object or archival/manuscript collection from site or directly associated to person(s) or event(s) commemorated by the unit is more desirable than a similar object without such primary association?	____	____	____	____
c. Is major category subdivided into disciplines pertinent to the unit (Archeology, Ethnology, History, Archives)?	____	____	____	____
d. Is each discipline subdivided into collecting categories that reflect the unit's purpose for collection?	____	____	____	____
e. If appropriate, under each collecting category:				
1) Is current representation of object or archival types described?	____	____	____	____
2) Are priorities established to fill identified deficiencies (gaps) in existing collection?	____	____	____	____
3) Are limits (quantities) defined?	____	____	____	____
f. Does archeology discipline include collecting categories for "artifacts and specimens" and "associated records?"	____	____	____	____
g. Does archeology discipline include a statement relevant to uncontrolled surface collecting?	____	____	____	____
D. Does the SOCS have MUSEUM COLLECTIONS SUBJECT TO THE NATIVE AMERICAN GRAVES PROTECTION & REPATRIATION ACT OF 1990 section?	____	____	____	____
1. Does section contain appropriate statement regarding the required summary of unassociated funerary objects, sacred objects, and objects of cultural patrimony?	____	____	____	____
2. Does section contain appropriate statement regarding the required inventory of human remains and associated funerary objects?	____	____	____	____
E. Does the SOCS have ACQUISITION section?	____	____	____	____
1. Is there a statement describing types of potential acquisition sources?	____	____	____	____
2. Does section include statement that acquisition of objects is governed by the unit's capability to preserve its museum collection in accordance with NPS *Management Policies* (2001), DO #28, and the NPS *Museum Handbook*, Part I?	____	____	____	____
3. Is there a statement that prohibits gifts with restrictions or limiting conditions?	____	____	____	____

***See additional notes pertaining to this question on attached pages.**

NPS Checklist for Evaluating Scope of Collection Statements — Page 3 of 5

Figure E.3. Checklist for Evaluating Scope of Collection Statements (continued)

	YES	NO	NA	Note*
4. Does section state that acquisition of firearms included on the Bureau of Alcohol, Tobacco, & Firearms (ATF) list of prohibited and restricted weapons requires concurrent review prior to acceptance by regional/SO curator and regional/SO law enforcement specialist?	____	____	____	____
5. Does section state that museum objects must be acquired, accessioned, and cataloged in accordance with NPS *Museum Handbook*, Part II?	____	____	____	____
6. Is there a statement regarding delegation of authority to the unit's superintendent to accept title to and responsibility for museum collections?	____	____	____	____
7. Does this section outline any park-specific acquisition procedures that supplement NPS policies?	____	____	____	____
F. Does the SOCS have USES OF COLLECTIONS section?	____	____	____	____
1. Is there a description of desired and acceptable uses?	____	____	____	____
2. Is there a statement regarding conservation as a primary consideration when determining uses?	____	____	____	____
3. In accordance with the NPS *Management Policies* (2001), Chapter 7, does section state that unit shall not place skeletal or mummified human remains, photographs of skeletal or mummified human remains, grave goods, or other objects considered sacred on display?	____	____	____	____
4. Is there a statement regarding access to museum collection?	____	____	____	____
5. Does section reference DO-24, DO-28, and DO-6 relevant to potentially consumptive uses of museum objects?	____	____	____	____
6. Does section reference DO-24, DO-28, and *Cultural Resource Management Guideline* relevant to research/destructive analysis of museum objects?	____	____	____	____
G. Does the SOCS have RESTRICTIONS section?	____	____	____	____
1. Does section include a statement regarding consultation with tribal governments, Native Hawaiian organizations, Alaskan Native Corporations, and traditional religious leaders?	____	____	____	____
2. Does section state NPS policy relevant to disclosure of information on location, nature, and character of cultural resources?	____	____	____	____

***See additional notes pertaining to this question on attached pages.**

NPS Checklist for Evaluating Scope of Collection Statements Page 4 of 5

Figure E.3. Checklist for Evaluating Scope of Collection Statements (continued)

	YES	NO	NA	Note*
3. Does section state NPS policy relevant to keeping confidential identities of community consultants and information about sacred and other culturally sensitive places and practices?	____	____	____	____
4. Is there a statement regarding use of objects subject to copyright?	____	____	____	____
5. If appropriate, is there a statement relevant to the collecting of endangered, threatened, or rare species?	____	____	____	____
6. Is there a statement concerning the disposition of type specimens?	____	____	____	____
7. Does section identify any legal restrictions on disposition or uses of the unit's museum collection?	____	____	____	____
H. Does the SOCS have a MANAGEMENT ACTIONS section?	____	____	____	____
1. Are there statements that require the following:				
a. Periodic review of SOCS?	____	____	____	____
b. SOCS remains supportive of and consistent with unit's mission?	____	____	____	____
c. Unit superintendent's approval of any revisions to SOCS?	____	____	____	____
2. Does section document existence of or need for a Collection Management Plan?	____	____	____	____
3. If any collections are located outside the unit's boundaries, is a brief description of each collection and name and location of each repository identified?	____	____	____	____

I. Comments/Recommendations (If needed, attach additional pages.):

____ See attached copy of unit's approved or draft Scope of Collection Statement for editorial comments.

____ Revise the SOCS to correct the deficiencies noted on this checklist. See NPS *Museum Handbook*, Part I, (*MH-I*) Chapter 2, Scope of Museum Collections (2003), Sections D-J, for guidance on writing a Scope of Collection Statement. You can also consult the sample Scope of Collection Statement in *MH-I*, Appendix E, Scope of Collection Statement (2003) for additional assistance.

____ See additional notes on attached pages.

***See additional notes pertaining to this question on attached pages.**

NPS Checklist for Evaluating Scope of Collection Statements Page 5 of 5

Figure E.3. Checklist for Evaluating Scope of Collection Statements (continued)

Appendix F: NPS Museum Collections Management Checklists

APPENDIX F: NPS MUSEUM COLLECTIONS MANAGEMENT CHECKLISTS

A. Overview

This appendix includes three Checklists that support the preservation of NPS collections.

- NPS Checklist for Preservation and Protection of Museum Collections
- NPS Collection Management Plan Team Site Visit Checklist
- NPS Collection Management Plan Team Reference Document Checklist

The NPS Checklist for Preservation and Protection of Museum Collections is submitted using the Automated Checklist Program (ACP) in the Automated National Catalog System (ANCS+). This Checklist is the responsibility of park museum employees. The information in Figure F.1 will assist you in estimating costs to correct deficiencies identified in the checklist.

The 1996 manual version of the Checklist (before it was incorporated into ANCS+) is in Figure F.2. This version is provided for easy reference to Checklist questions. Though the ACP questions are identical, the ACP allows you to track additional information. Parks and centers must submit their Checklist using the ACP.

The other two checklists (Sections C and D) in this Appendix are used by Collection Management Plan (CMP) teams and serve as outlines for the information that the CMP team collects, reviews, and distributes.

B. NPS Checklist for Preservation and Protection of Museum Collections

The NPS Checklist for Preservation and Protection of Museum Collections (Checklist) has gone through several revisions. It was first issued in 1986 as the Inspection Checklist for Museum Storage and Exhibit Spaces. The Department of the Interior adopted the checklist and in 1992 the NPS used a version entitled the DOI Checklist for the Preservation, Protection and Documentation of Museum Property, Part I: Preservation and Protection of Museum Property (as amended for use by the National Park Service, February 28, 1992). In 1996 it was automated in a DOS-based computer program and submitted by parks in electronic format for the first time. At that time it assumed its current name and the automated program was called the Automated Checklist Program (ACP). Since the issuance of ANCS+ in 1998, the Checklist is submitted using the Windows-based ACP, a utility in ANCS+.

1. *What is the purpose of the Checklist?*

Each unit (park, center, or office) is required to conduct a self-assessment in order to update progress on how well it is preserving and protecting the museum collections in its custody. The Checklist is designed as a tool to facilitate this self-assessment. It will assist you in identifying the preservation and protection needs of your unit's museum collection. The Checklist can help your unit to obtain funding from the servicewide Museum Collections Preservation and Protection Program (MCPP) and other funding sources to correct deficiencies in your:

- facilities
- equipment
- supplies
- planning

You also use the Checklist to report accomplishments regarding NPS Strategic Plan Goal Ia6 for the Government Performance and Results Act (GPRA).

2. *What additional tools do I need to address the ongoing (day-to-day) needs of the museum collection?*

The Checklist provides some data on managing the preservation of museum collections, but does not address all of the needs (including staffing) of your museum collection. The daily responsibilities include accessioning, cataloging, and inventorying; housekeeping; monitoring and controlling the environment and pests; storage; security; fire protection; conservation treatment; access; research; publication; and exhibits (both traditional and Web-based).

In addition to the Checklist, you need to use other planning and budgeting tools to identify the total base funding needs of the collection:

- Collection Management Plan (CMP)
- Resources Management Plan (RMP)
- Resources Management Assessment Program (R-MAP) – includes Natural Resources and Cultural Resources
- Performance Management Information System (PMIS)
- Operations Formulation System (OFS) – documents funding and staffing needs

3. *How do I complete the Checklist?*

To complete the Checklist you must use the Automated Checklist Program (ACP) included in the ANCS+ collection management package. The ACP generates the Checklist for your park, center, or office. Instructions for completing the Checklist using the ACP are in Appendix G: The Automated Checklist Program of the *ANCS+ User Manual* issued in 1998. The *ANCS+ User Manual* is issued to each park and center with ANCS+. You can download extra copies of the manual from the Museum Management Program website at <www.cr.nps.gov/museum/publications/ancs.html>.

4. *What data do I collect and record with the Checklist?*

The Checklist identifies basic preservation and protection deficiencies when you answer a list of questions for each facility in your unit.

A **unit** is defined as a park, center, or office with museum collections. You answer one group of questions (Section H. Professional Assistance and Museum Planning) just for the unit.

A **facility** is defined as a space that houses museum collections, for example, a visitor center, rooms in a historic structure, a barn, or park headquarters. A single building can have more than one facility (or space) where museum objects are located. For example, the exhibit area, the storage room, and the administrative office that houses museum objects or archives could each be a separate facility within one building.

You must answer "YES" or "NO" or "NOT APPLICABLE" to each question and record the following information where appropriate:

- description of the deficiency
- cost estimate to correct the deficiency
- description of the action that will be taken to correct the deficiency
- comments
- funding spent in the previous fiscal year
- previous estimates for cost that have been recorded in the Checklist
- percentage of the deficiency that has been corrected, if not complete

5. *How are NPS preservation and protection standards reflected in the Checklist?*

The NPS standards, or basic requirements, for managing museum collections are represented by each question in the Checklist. You complete this self-assessment to determine which standards your park meets. If the unit does not meet a standard (that is, you answer "NO" on the Checklist), then the unit has a deficiency for that standard. The Checklist has standards in eight categories:

- Administrative offices
- Museum collections storage
- Exhibits
- Museum environment
- Security
- Fire protection
- Housekeeping
- Professional assistance and museum planning

6. *How is the Checklist organized?*

The standards under each category (except professional assistance and museum planning) are organized under the following sub-categories:

- Operations (procedural)
- Museum facility
- Equipment and supplies

You will answer different questions on the Checklist depending on the type of facility (Unit, Administrative, Storage, or Exhibit). These questions will come up automatically in the ACP.

If type of space is . . .	***Then . . .***
Unit	answer Section H. Professional Assistance and Museum Planning
Administrative	answer Section A. Administrative Offices
Storage	answer Sections B. Museum Collection Storage D. Museum Environment E. Security F. Fire Protection G. Housekeeping
Exhibit	answer Sections C. Exhibits D. Museum Environment E. Security F. Fire Protection G. Housekeeping

7. *How do I determine costs for correcting deficiencies identified in the Checklist?*

The information in Figure F.1 will assist you in estimating costs to correct deficiencies identified in the Checklist. All categories and subcategories in the table correspond to the Checklist. The costs shown are average costs that may be increased or decreased in your cost estimates depending on your unit’s needs and geographic location.

With two exceptions, you must correct all deficiencies listed under the sub-category “Operations (procedural)” with base funding. Procedural deficiencies have minimal cost and can be corrected with changes in procedures. The two exceptions are under Category E. Security, question 1 (key issuance) and question 8 (Emergency Operation Plan).

Consult with park maintenance and protection staff as well as the regional/SO curator for assistance with estimating costs. If numerous deficiencies are identified, it may be necessary to rehabilitate an existing facility or to construct a new facility. Review programming documents for cost estimates. Look at documents such as the Project Management Information System (PMIS) projects and plans for new construction and repair/rehabilitation of museum collection storage and exhibit facilities.

Prices of equipment and supplies don't include shipping. Units should contact vendors for estimates of shipping to the site. Pricing, except where covered by contracts, is approximate and based on current prices from a range of acceptable models, types, or materials from several vendors. Refer to the NPS *Tools of the Trade* for descriptions and vendor sources of equipment and supplies.

Estimates should be calculated and as close to the real cost as possible. These estimates are important. Servicewide plans and long-range programming and budgeting are based on these data.

8. *How do I use the information in the Checklist?*

Use the reports generated in the Checklist to help you plan improvements to the preservation and protection of your museum collections. As you carry out projects that remove the deficiencies on the Checklist, you will:

- improve the care given to the collections
- meet NPS museum standards
- ensure the continued survival and accessibility of NPS collections
- enhance access and use of NPS museum collections

9. *How is the Checklist used for GPRA?*

The NPS has developed a Servicewide Strategic Plan in response to the Government Performance and Results Act (GPRA). Your park also has a Strategic Plan. The NPS tracks annual performance on the goals in these plans. Goal Ia6, "X% of preservation and protection conditions in park collections meet professional standards," uses Checklist data to track performance.

10. *Who else uses the information in the Checklist?*

The Museum Management Program (MMP) and regional and support offices use the information to:

- track conditions in spaces housing collections at servicewide, regional, cluster, and park levels
- measure strategic plan progress for GPRA goal Ia6
- help determine servicewide funding distributions for correcting identified deficiencies
- prepare budget justifications and develop funding requests
- prepare reports for park, cluster, and regional management; the Director, the Department of the Interior, Congress, and public inquiries

Regional and support offices may collect information from parks to help them organize more local strategies for support and funding.

C. NPS Collection Management Plan Team Site Visit Checklist

A Collection Management Plan is one of the primary planning documents for park museum collections. Each park must have a CMP. A CMP assesses a park’s museum collection management program to identify problems and makes recommendations to improve the care of the collection.

When a Collection Management Plan (CMP) team visits your site, it will consider a wide range of topics in evaluating your museum program. The checklist in this section provides a detailed outline of a typical CMP. The broad categories may include:

- history of park and museum collection
- scope of collection
- documentation, including records and information management systems
- archival and manuscript collections
- security
- environment
- storage
- exhibits
- housekeeping and cyclic maintenance
- access and use
- staffing
- planning, programming, and funding

Under each category the checklist provides details of the types of topics that may be addressed by the team members. Each park and its museum collections are unique. The topics and depth of detail addressed in each park's CMP depends on the size, content, and condition of the museum and archival collections.

The checklist may be provided to the park staff in advance of the CMP team's visit to the park. It serves to orient the park superintendent and staff on the types and depth of information that the team will require when preparing a plan that will be useful to the park. The team members use the checklist as a reminder of topics to cover.

A CMP team may include a variety of professionals depending on the types of collections in the park. Types of professionals who may be on a CMP team include:

- Archeologists
- Archival specialists and technicians
- Archivists
- Collections managers
- Conservators
- Curators
- Historians
- Natural scientists
- Registrars
- Security specialists
- Structure fire management specialists

See Chapter 3: Preservation: Getting Started, for more information on the CMP process and how the CMP relates to the Collection Condition Survey (CCS). See *Museum Handbook*, Part II, Appendix D: Museum Archives and Manuscript Collections, for guidance on incorporating a collection-level survey description of your archival materials into a CMP.

NATIONAL PARK SERVICE
COLLECTION MANAGEMENT PLAN (CMP) TEAM
SITE VISIT CHECKLIST

I. HISTORY OF PARK AND MUSEUM AND ARCHIVAL COLLECTION

___ Enabling legislation/authorization

___ Purpose of site/park

___ Cultural and natural significance of park

___ Provenance/source of collection

___ Significance of collection and relationship to the park

___ Size of collection

- ___ Numbers and types of objects and specimens in collection
  - ___ disciplines
  - ___ object classifications

- ___ Number and types of archival collections
  - ___ total number of separate archival collections (by provenance)
  - ___ linear feet of records
  - ___ types of documents (electronic? photos? films? audio/videotapes?)
  - ___ inclusive dates of archival collections

___ Visitation

- ___ Recent visitor statistics

- ___ Peak season/time

- ___ Visitor impact on collection (annual statistics)
  - ___ number of duplicates provided
  - ___ number of research requests (NPS and external) from Collections Management Report
  - ___ number of research room visits (individual visits), if available
  - ___ number of research room visitors (distinct visitors as opposed to visits), if available
  - ___ number of publications, exhibitions, interpretive sessions, films, etc. produced using collections, if available
  - ___ number of FOIA requests

II. SCOPE OF COLLECTION

___ Review the Scope of Collection Statement by theme, types of materials, historical era, and geographical coverage to ensure it covers all necessary materials. (Use NPS Checklist for Evaluating Scope of Collection Statements. See Appendix E: Scope of Collection Statement.)

___ Acquisition strategies

___ Gaps in collection by theme, type of material, association, historical era, geographical coverage

- ___ Collections development strategy (cooperative acquisition planning with other local/national organizations)

- ___ Priorities for collecting

___ Status of records management program in park

___ Disposition strategies

___ Objects outside scope of collection

___ Deaccession proposal(s)

___ Status of official records disposition, if relevant to collections

___ Identification strategies for park collections held outside the NPS

___ Where managed

___ How managed—preservation, arrangement, description, and access issues

III. MUSEUM DOCUMENTATION (RECORDS AND INFORMATION MANAGEMENT)

___ Records storage and preservation

___ Fire-rated, insulated file cabinet with lock
___ load limitation
___ need for back-up

___ Magnetic media safes, files, boxes
___ floor load
___ need for back-up
___ refreshing/migration needs

___ Location
___ physical and intellectual access
___ sensitive data
___ vital records security

___ Acid-free photocopies of one-of-a-kind records

___ Use of high-quality storage materials

___ Condition
___ reformatting needs
___ other treatment needs

___ Accession records

___ Accession Book
___ first and last entries/dates
___ consecutive entries and pages
___ catalog numbers
___ received from/how acquired
___ recording of multiple objects in single accession

___ Accession folders
___ proof of ownership (title documents and physical custody documentation)
___ correspondence on acquisition

- ___ correspondence on donor and legal restrictions, including copyrights, privacy, and publicity rights
- ___ correspondence on consultations with affiliated groups relating to potential cultural sensitivities
- ___ model releases, interview releases, permissions, and licenses relating to accessions
- ___ checklist
- ___ Accession Receiving Report (Form 10-95)

___ Source of accession file (optional)

___ Unaccessioned objects

- ___ Number and type

- ___ Official/non-official, active/inactive records

___ Catalog records

- ___ Copies
  - ___ electronic copy for National Catalog submission
  - ___ blue "working copies" in post binders (optional)
  - ___ classification and location files (optional)
  - ___ first and last catalog records (number/dates)
  - ___ backup copy of ANCS+ data stored off-site

- ___ Registration and catalog data in ANCS+
  - ___ all mandatory data complete and accurate
  - ___ classifications correct
  - ___ descriptions sufficiently detailed
  - ___ condition indicated and current
  - ___ locations current
  - ___ values current and updated periodically

- __ ANCS+
  - ___ percent of collection in ANCS+
  - ___ type of equipment

- ___ Retrievability of objects and information
  - ___ objects marked with catalog numbers correctly
  - ___ acronyms used
  - ___ NH labels

- ___ Cataloging backlog
  - ___ number and type of objects (available on CMR)

- ___ Catalog folders or ANCS+ supplemental records
  - ___ condition reports
  - ___ object treatment requests and reports
  - ___ appraisals
  - ___ research information
  - ___ restrictions
  - ___ routine maintenance
  - ___ location, status, and catalog history

___ Inventory records

- ___ 100% inventory, if applicable

___ Automated Inventory Program
    ___ Random Sample Inventory
    ___ Controlled Property Inventory
    ___ Accessions Inventory

___ Missing objects
    ___ Report of Survey (DI-103)

___ Collections Management Report

___ Accurate

___ Center records included

___ Non-NPS repository records included

___ Loans included and accurate

___ Loan records

___ Incoming (number, location, and renewal)

___ Outgoing (number, location, and renewal)

___ Loan agreements

___ Loan folders and files

___ Loan tracking

___ Deaccessions

___ Number and type

___ Disposition documents

___ Photographs

___ Object photos
    ___ room/exhibit installation photos
    ___ record photos
    ___ digital photos in ANCS+

IV. ARCHIVAL AND MANUSCRIPT COLLECTIONS

___ Archival collecting history

- ___ Synopsis should include:

  - ___ When and why archival and manuscript collecting began

  - ___ The focus (thematic, temporal, and geographic) of early archival collecting

  - ___ Names and titles of major records/archival manuscript collection creators/collectors

  - ___ The history of records management in the park, if known

  - ___ An abstract of the park archival and manuscript collections at the repository level, including:
    - ___ number of separate archival/manuscript collections
    - ___ number of collections with finding aids
    - ___ number of collections cataloged at the archival collection level in ANCS+
    - ___ inclusive dates of total archival holdings
    - ___ volume of total archival holdings
    - ___ major types and estimates of quantities of materials included (e.g., photographs, architectural drawings, sound and video recordings, maps, electronic media, and manuscripts)
    - ___ brief description of any exceptionally significant groups of materials
    - ___ major gaps in archival collections, if known (e.g., nothing on a particular era, theme, region, group, or entire categories of records, for example, diaries, maps, or photos)
    - ___ identification of the various buildings and spaces containing archival materials
    - ___ determination of whether an Archival Assessment has been done (all archival and manuscript collections and park records have been surveyed and described at the collection level with recommendations)
    - ___ attached copy of any archival assessment or other collection-level survey of park records and manuscripts

___ Records management

- ___ Does the park have the following:
  - ___ a clear file plan
  - ___ trained records management staff
  - ___ all official records located and labeled with clear disposition plan (to NARA) and cut-off dates
  - ___ all inactive non-official records located, compared to the SOCS, and materials for the museum collections transferred and cataloged or disposed of appropriately

___ Procedures

- ___ Archival processing plan indicating:
  - ___ prioritized lists of collections for arrangement, description, preservation, reformatting, and finding aid work
  - ___ documentation on major collection risks (preservation, legal, and theft/vandalism)
  - ___ definition of resource (staffing, supply, and funding) needs
  - ___ staff training needs
  - ___ archival storage, work, and reference room improvements necessary
  - ___ steps necessary to achieve better access to collections

- ___ Processing guidance including standard operating procedures for:
  - ___ archival collection preservation

___ archival handling
___ archival rehousing and storage
___ archival reformatting and/or treatment
___ archival description and cataloging (including ANCS+ cataloging and description in Collections Management and Archives Module):
  ___ descriptive rules (archives, personal papers, and manuscripts),
  ___ descriptive format (MARC format)
  ___ vocabularies (Library of Congress Subject Headings and AAT)
  ___ personal and corporate names (Library of Congress name authorities)
___ finding aid and guide creation, indexing, and production procedures
___ procedures for mounting finding aids on Web
___ procedures for sending guides and finding aids to National Union Catalog of Manuscript Collections (NUCMC).
___ archival arrangement, including
  ___ preparatory research work
  ___ identification of provenance and original order,
  ___ identification of restrictions
  ___ how to identify and arrange series
  ___ how to identify and arrange file units
  ___ when and how to weed
  ___ how to resolve problems

___ A collections documentation strategy identifying any gaps in collections and indicating how they will be filled

___ Access and use

___ Catalog records at the archival collection-level in ANCS+ Collections Management System
___ Collections processed (arranged and described) by a professional archivist
___ Major collections cataloged within the ANCS+ Archives Module at the series and/or file unit and/or item-level.
___ Item level records linked to an appropriate collection-level record in the ANCS+ Collections Management System
___ Indexed finding aids for each archival or manuscript collection in the park
___ Master guide to all collections with a single index to names, subjects, and formats (document types)
___ Entries in the NUCMC on park collections

___ Equipment

___ On-site freezer, or off-site storage for nitrate film
___ Book trucks to transfer materials to research room

V. MUSEUM SECURITY (Use Survey Checklist) See Chapter 9:"Security and Fire Protection" and Appendix G: "Museum Collections Protection."

___ Procedures

___ Risk assessments

___ Physical and electronic security

___ Fire prevention, detection, and suppression

___ Emergency management, planning, and response

VI. MUSEUM ENVIRONMENT

___ Temperature and relative humidity

- ___ Local climate
  - ___ mean/extreme temperature and RH
  - ___ frost season
  - ___ annual precipitation

- ___ Measurements
  - ___ room-by-room
  - ___ outside
  - ___ past logs/charts and analyses

- ___ Equipment
  - ___ psychrometer (sling/aspirating)
  - ___ hygrothermographs
  - ___ dial thermohygrometers
  - ___ dataloggers
  - ___ calibration frequency

- ___ Climate control
  - ___ HVAC system (type and location of air handlers, vents)
  - ___ portable humidifiers and dehumidifiers (location and number)

___ Light

- ___ Measurements (seasonal)
  - ___ ultraviolet
  - ___ visible

- ___ Light sources
  - ___ natural (doors, windows)
  - ___ artificial (fluorescent, incandescent)

- ___ Protection
  - ___ UV-filtering film on windows
  - ___ UV sleeves on fluorescent lights
  - ___ curtains, shades, shutters

___ Dust and air pollution

___ Local air pollution levels
  ___ monitoring in park (by EPA or other agency)

___ Source of dust air pollution
  ___ highways
  ___ industry
  ___ unexcavated basement
  ___ asbestos containing materials in building
  ___ visitors

___ Air filtration/purification system
  ___ HEPA filter
  ___ activated charcoal filters
  ___ portable air purifiers

___ Protective measures
  ___ entrance mats
  ___ weather-stripping

___ Biological infestation

___ Past infestation
  ___ pests identified (insects, birds and mammals, mold)
  ___ action taken
  ___ damage to collection
  ___ evidence of current infestation (frass and droppings, tunnels and holes, nests, mold)
  ___ staging area and freezer for dealing with infested materials

___ Park IPM Program
  ___ park IPM Coordinator involvement with museum collections
  ___ monitoring program
  ___ periodic inspections
  ___ written log and analyses

___ Potential attraction and harborage sites
  ___ kitchen (food storage)
  ___ appliances
  ___ plumbing/water source
  ___ cracks and gaps
  ___ trash removal (overnight)

___ Pesticides
  ___ unauthorized use of any pesticide
  ___ potential hazards from past pesticide use

___ Hazardous materials and response

___ Labeled hazards
  ___ cellulose nitrate film
  ___ collections with pesticide residues
  ___ firearms, armaments, edged weapons, ammunition
  ___ medical, dental, veterinary equipment
  ___ heavy metals in textiles
  ___ hazardous rocks/fossils
  ___ radiation

___ toxic materials used in construction of objects
___ asbestos
___ flammable supplies
___ moldy materials
___ pest residues

___ Safety equipment
___ rated breathing apparatus, for mold, hantavirus and asbestos fitted to staff who need them
___ smocks, neoprene gloves, goggles

VII. STORAGE

___ Existing storage condition

___ Location of storage
___ hazardous location (fault line, cliff, near water, near highway)
___ attic
___ basement
___ water pipes/roof leaks/open water source overhead/storm drain in or above space
___ available space (square footage)
___ 10 year expansion needs
___ additional space needed for current collection (compactor system, superinsulated building)
___ load limitations
___ space utilization (aisle widths, cabinet arrangement)
___ multiple building use
___ off-site storage
___ collections split, consider all locations

___ Dedicated storage
___ non-museum items or functions that don't belong in collections storage
___ restricted access

___ Exclusively curatorial functions
___ percent of collection in storage
___ type of museum objects
___ organization of storage (by material, provenience or object type)
___ range in size of objects stored

___ Storage equipment
___ number of cabinets/shelves
___ type of cabinets/shelves
___ standard/double specimen cabinets
___ wardrobe/jumbo GL-C cabinets
___ visual storage cabinets
___ entomology cabinets
___ herbarium cabinets
___ map cabinets
___ security gun vaults
___ art storage racks
___ mobile shelving-either bakers rack or installed
___ fire-insulated file cabinets
___ steel shelving
___ equipment needed
___ condition of cabinet gaskets seals
___ cabinet locks

___ Storage methods
  - ___ stored correctly using proper equipment
  - ___ elevated off floor >4"
  - ___ polyethylene drawer liners/shelf pads
  - ___ polyethylene foam cavity packing
  - ___ stacking/crowding
  - ___ dust covers made of stable materials, where appropriate
  - ___ labels

___ Curatorial workspace
  - ___ separate from storage area
  - ___ examining table
  - ___ other equipment
  - ___ no food or open water sources

___ Research room
  - ___ separate from storage and curatorial work areas
  - ___ totally and easily visible from the curatorial work space
  - ___ lockers or coat rack and storage space nearby
  - ___ ANCS+ terminal available
  - ___ adequate space
  - ___ good lighting at low levels using incandescent spot lights
  - ___ stable environment similar to storage space
  - ___ continuous staff supervision during operation

___ Off-site storage
  - ___ leased space for park collections
  - ___ regional NPS repositories
  - ___ non-NPS repositories (documented loans)
  - ___ cellulose nitrate and cellulose ester cold storage

___ Condition of objects, archival and manuscript materials and specimens in storage

___ Collection Condition Survey needed

___ Storage materials
  - ___ inert, archival quality
  - ___ acid-free, buffered or unbuffered
  - ___ cabinets vs. shelves
  - ___ specimen trays
  - ___ padding

___ Periodic inspection for deterioration
  - ___ frequency
  - ___ evidence of deterioration
  - ___ conservation treatment needed
  - ___ reformatting and retirement or treatment of original

___ Proper storage to maintain condition
  - ___ archeological bulk collections
  - ___ baskets
  - ___ books
  - ___ ceramics and glass
  - ___ costumes
  - ___ electronic records

___ entomology specimens
___ firearms
___ fossils
___ freeze-dried/taxidermy specimens
___ furniture
___ herbarium specimens
___ manuscripts and archival textual materials
___ magnetic media
___ maps
___ metals
___ motion picture film
___ paintings and framed graphics
___ phonograph records
___ photographic images
___ skins
___ textiles
___ unframed graphics
___ wagons, carriages, canoes
___ wet specimens
___ other

VIII. EXHIBITS

___ Evaluation of collection use in exhibits

___ Existing exhibit conditions

___ Locations
___ visitor center
___ other exhibits

___ Furnished historic structures
___ approved historic furnishing report
___ tour arrangements (average group size, guided/self-guided)
___ placement of objects away from vents/light and potential handling/touching

___ Exhibit cases and construction
___ UV glass or Plexiglas
___ UV shields on lights
___ inert materials
___ curatorial access
___ security (tamper-free)
___ air tight (gasket seals)
___ object mounts

___ Exhibit lighting
___ low-voltage, cool lights (see also Museum and Archival Environment)

___ Exhibit maintenance manual

___ Rehabilitation needed

___ Condition of objects on exhibit

___ Collection Condition Survey needed

___ Neutral barriers between objects of dissimilar materials (Mylar, acid-free matboard)

___ Neutral barriers between objects and audience

___ Park procedures limiting smoking, eating, and receptions in exhibit spaces

___ Evidence of deterioration
- ___ conservation treatment needed
- ___ weekly/daily inspections
- ___ objects that should not be exhibited

___ Exhibit maintenance
- ___ manuscripts and books (rotated/turned - copies used where possible)
- ___ textiles and costumes (refolded/rotated)
- ___ wood furniture (waxed)
- ___ silver (polished or lacquered)
- ___ iron and steel (microcrystalline wax)
- ___ other

___ Reproductions
- ___ cataloged
- ___ substituted for fragile original in exhibits and for reference

___ Objects accessible for visitors to touch
- ___ consumptive use approved

IX. HOUSEKEEPING AND CYCLIC MAINTENANCE

___ Existing conditions

___ Dust

___ Clutter

___ Written housekeeping manual

___ Cleaning methods

___ Cleaning materials

___ Schedule (documented in ANCS+ Maintenance Module)

___ Equipment

___ Vacuums (HEPA, backpack, portable)

___ Other equipment and supplies

___ Proper handling of museum and archival objects

___ Cyclic preventive building maintenance

___ Maintenance Management System (Facility Management Software system, effective FY2000)

___ Personnel

- ___ Maintenance staff (supervisor)

- ___ Curatorial staff

- ___ Training in curatorial housekeeping

___ Storage of cleaning supplies and equipment

X. ACCESS AND USE

___ Procedures for evaluating museum collections use

- ___ Forms
  - ___ access procedures and rules governing use statement
  - ___ researcher registration form
  - ___ copyright and privacy restrictions statement
  - ___ researcher duplication form
  - ___ researcher log
  - ___ Checklist: Evaluating a Request to Use Museum Objects

- ___ Standard operating procedures
  - ___ access procedures
  - ___ research and reference standard operating procedures
  - ___ handling procedures
  - ___ monitoring research space
  - ___ duplicating and reformatting

___ Research space

- ___ Conditions
  - ___ dedicated space
  - ___ security
  - ___ adequate space
  - ___ location adjacent to work and storage space
  - ___ adequate equipment and utilities
  - ___ disabled access

___ Restrictions and legal issues

- ___ Restrictions
  - ___ donor
  - ___ sensitive data

- ___ Legal issues and compliance
  - ___ copyright
  - ___ privacy and publicity
  - ___ Archaeological Resources Protection Act
  - ___ National Historic Preservation Act
  - ___ Endangered Species Act
  - ___ Public Law 105-391, Title II-National Park System Resource Inventory and Management
  - ___ Freedom of Information Act
  - ___ Native American Graves Protection and Repatriation Act

___ Publications

___ Forms

___ intellectual property permission request
___ assignment of copyright by contractor
___ cooperative publishing agreement
___ model release form
___ Memorandum of Agreement or contract with publisher

___ Standard operating procedures

___ publication project checklist
___ digital publications project checklist
___ Museum Management Program editing checklist

___ Reproductions

___ Forms

___ reproduction order notification sheet
___ permission to publish
___ agreements and contracts for reproductions
___ standard operating procedures for 2-D and 3-D reproductions

___ Special uses

___ Forms

___ special use permit
___ hold harmless or liability clause to be included in a special use permit
___ conditions included in special use permit for spaces housing museum collections

___ Procedures

___ filming and photography in spaces housing museum collections
___ special events in exhibit spaces
___ keeping objects in working order
___ museum objects used in performance, sound production or demonstration
___ museum objects used in educational and interpretive programs

___ Research

___ Staff knowledge of library research techniques

___ basic research
___ special sources on archives
___ special sources on museum objects

___ Staff knowledge of museum research techniques

___ Staff knowledge of archival research techniques

___ Staff knowledge of Web searching techniques

___ Staff knowledge of how to interview potential researchers

X. STAFFING

___ Archives Technician (1421 series)
___ Archivist (1420 series)
___ Curator (1015 series)

___ Museum and Archival Aid
___ Museum Technician (1016 series)
___ Park Ranger with collateral duty
___ Supervisor/park division (Interpretation/Resource Management)
___ Registrar (1001)
___ VIPs and student interns

___ Training and experience of incumbent(s)
  - ___ Training needs
  - ___ Basic curatorial training
  - ___ Archives management knowledge including: arrangement, description, handling, rehousing, deterioration and preparation for treatment, reformatting, reference services and research, cataloging in ANCS+ (including descriptive standards), finding aid production, archival guide production, intellectual property rights (copyrights, privacy, and publicity) and restrictions issues
  - ___ ANCS+ training
  - ___ Conservation management including identifying deterioration and treatment needs, project planning, working with a conservator, contract requirements for survey, treatment and analysis, using the Conservation Module in ANCS+

___ Adequate positions for workload

XII. PLANNING, PROGRAMMING, AND FUNDING

___ Park planning documents include collections

  - ___ General Management Plan (GMP)
  - ___ Park Strategic Plan
  - ___ Annual Performance Plan
  - ___ Resources Management Plan (RMP)

___ Funding sources

  - ___ Backlog Cataloging (BACAT)
  - ___ Cooperating associations
  - ___ Cultural Cyclic Maintenance Funds
  - ___ Cultural Resources Preservation Program (CRPP)
  - ___ Museum Collections Preservation and Protection (MCPP) Program
  - ___ ONPS (base funding)
  - ___ Recreational Fee Demonstration Program
  - ___ other

D. NPS Collection Management Plan Team Reference Document Checklist

The checklist in this section provides a list of park related documents (e.g., legislation, park-specific plans, general park information, park museum operational procedures, curatorial budget, curatorial position descriptions and performance standards) that the team members will need to review and evaluate. Some of these documents (for example, Scope of Collection Statement, General Management Plan, Park Strategic Plan, Annual Performance Plan, Resources Management Plan, NPS Checklist for Preservation and Protection of Museum Collections, Collections Management Reports) may be requested before the team's site visit.

NATIONAL PARK SERVICE
COLLECTION MANAGEMENT PLAN TEAM REFERENCE DOCUMENT CHECKLIST

Legislation

___ Enabling legislation, presidential proclamation, or executive order
___ Subsequent legislation
___ Congressional background reports
___ Other:

General Information

___ Brochure(s)
___ Handbook
___ Other:

General Park Plans

___ General Management Plan
___ Strategic Plan
___ Annual Performance Plan
___ Resources Management Plan (Cultural and Natural - including project statements related to collections and facilities housing them)

Plans and Documentation Specific to Museum Collections

___ Scope of Collection Statement
___ Collection Management Plan
___ Annual Inventory of Museum Property
___ Exhibit Plan(s) (including list of objects)
___ Historic Furnishings Report(s)
___ Collection Condition Survey(s)
___ Collection Storage Plan
___ Collections Management Report (Form 10-94)
___ Checklist for Preservation and Protection of Museum Collections

Other Pertinent Resource Management Plans

___ Historic Resource Study
___ Historic Structure Report(s)
___ Inventory and Condition Assessment Program (ICAP)
___ Ethnographic plans
___ Archeological plans
___ Other:

Park Museum Collection Management Procedures

___ Procedures for access and use of museum collection
___ Opening and closing procedures for museum exhibit and storage spaces
___ Housekeeping plans/schedules
___ Park's Emergency Operation Plan (including Structural Fire, Physical Security, Disaster/Emergency Plans)

___ Integrated Pest Management Plan
___ Building/facility cyclical maintenance manuals/schedules

Other Park Procedures and Documents Relevant to Collection Management

___ Construction drawings or blue prints for buildings housing museum collection (visitor centers, storage rooms, furnished historic structures, etc.)
___ Basic operating plan
___ Staffing/organization chart
___ Position description(s) for staff assigned curatorial responsibilities
___ Performance standards for staff assigned curatorial responsibilities and supervisor
___ Current budget
___ Cooperative agreements
___ Project Management Information System (PMIS) Statements
___ Current permits (36 CFR 2.5g), if expected to generate specimens for the museum collection
___ Performance Management Data System (PMDS) entries for collections-related Strategic Plan goals (Ia6, Ib2D, others)

E. List of Figures

Cost Estimates (2005)

NOTE: $/SF = costs per square foot

Administrative Offices (For costs, see appropriate categories below.)

Museum Collections Storage **Dollars**

Museum Facility

- Renovating an existing facility 68-113/SF
- Constructing a new facility (DSC designed and coordinated project, does not include site preparation)........ 248-363/SF
- Insulated Modular Structures (IMS) - recommended only for use inside an existing structure. (See *COG*s 4/7 and 4/8). Costs range from small structures without HVAC, security, and fire protection systems that are assembled by unit staff to large structures with HVAC, security, and fire protection systems that are assembled by a contractor. 60-145/SF
- IMS within an enclosing wood frame or masonry structure built specifically to accommodate the IMS. The cost includes climate control, security and fire protection systems. 106-220/SF
- Park-built structures, including climate control, security and fire protection systems 100-175/SF
- Contractor-built structures, including climate control, security and fire protection systems. 100-200/SF

NOTE: Construction costs vary with the type, size, and configuration of the structure; the locality (costs in Alaska could double those cited); the difficulties of site preparation; and the complexity of the HVAC, security, and fire protection systems. Costs for systems range from $4-15/SF for fire detection/suppression systems, $4-6/SF for intrusion detection systems, and $22-44/SF for HVAC systems. The cost for architectural and engineering planning such as facility preliminary design (Title I) and design and specifications (Title II) may be absorbed in the overall cost of the building (if contractor or park designed and constructed), cost up to $20/SF if obtained separately, or be 17% of the overall project cost if DSC designed and constructed.

Equipment and Supplies

- Retrofit gasket kit 40
- Sash lock 12
- Standard museum cabinet w/10 drawers 775-1,410
- Doublewide museum cabinet w/10 drawers 1,315-1,984
- Wardrobe cabinet w/specialized storage interiors (depends on interior) 1,700-3,300
- Herbarium cabinet, counter height (12 compartments)........ 567
- Herbarium cabinet, full height (26 compartments)........ 765
- Entomology cabinet, counter height (15 drawer openings)........ 680
- Entomology cabinet, full height (24 drawer openings)........ 1,185-2356
- Cornell drawers for entomology cabinets........ 41
- Security gun vault with acrylic museum assemblies 2,000
- High density moveable-aisle storage systems 125/SF
- Slotted metal angle for constructing large shelving units (bundles of 10 – 12’ angle pieces with 75 nuts and bolts) (2 bundles are needed for unit of 3 shelves measuring 4’ x 8’; 3 bundles are needed for unit of 5 shelves measuring 4’ x 8’) 160/Bundle
- 5/8” – 3/4” plywood sheets for shelving........ 40/Sheet

Figure F.1. Cost Estimates (2005)

	Dollars
• Steel shelving units	250/unit
• Map cabinet 5-drawer unit (need 2 units for counter height)	760
• Map cabinet base units	250
• Sanitary platform for standard museum cabinet	68
• Sanitary platform for doublewide museum cabinet	87
• Sanitary platform for wardrobe cabinet	128
• Safety stacking rim for standard cabinet	35
• Lumber, plywood and paint to construct wooden platform (labor not included) for	
Standard museum cabinet	45
Doublewide and wardrobe cabinet	55
• Flammable liquid cabinet (various sizes)	200-700
• GSA utility cabinet for forms and museum supplies	240

- Costs for polyethylene foam, specimen trays and specialized containers as listed in NPS *Tools of the Trade* vary greatly. Call vendors listed in *Tools of the Trade* for current prices. Units may order modest quantities of these materials through the Museum Supply and Equipment Program, Museum Management Program.

NOTE: The costs for equipment do not include shipping. Shipping costs can be as high as 1/3 of the cost of the equipment when shipped in the contiguous United States, higher when shipped to Alaska, Hawaii, Guam and other locations outside the continental United States.

Museum Exhibit

Equipment and Supplies

• Replacing an exhibit case	
Table top or pedestal exhibit case	2,800-11,000
Walk-in-style exhibit case	11,000-33,000
• Retrofitting existing exhibit case	
Retrofit of exhibit case, e.g., surfaces/paints, graphics/furniture replacement	2,200-5,500
Retrofit of exhibit case structure, e.g., physical security, lighting component	3,000-11,000
Retrofit of object mount, e.g., single mount, garment manikin	550-3,300

NOTE: Exhibit replacement and retrofitting costs vary with the size and complexity of the exhibit case. Factors affecting cost include whether or not there is a need for specialized humidity control, lighting, security and museum mount features; the availability of specialized contractors; and the proximity of contractors to the park.

Museum Environment

Museum Facility

HVAC System	24-46/SF

Equipment and Supplies

• Hygrothermograph	625
• Datalogger (temperature and RH recording)	55-565
• Remote probe for datalogger (for use in exhibit cases)	200
• Datalogger computer software for setting up instruments and analyzing data	95-140

Figure F.1. Cost Estimates (2005) (continued)

Dollars

- Electronic thermohygrometer (depending on brand and style)....325-1,000
- Sling psychrometer....25-125
- Aspirated psychrometer....423
- Hygrometer....30-100
- Portable dehumidifier (refrigerant type)....300
- Portable dehumidifier (desiccant type)....1,000
- Humidifier....300
- Portable air purifier with HEPA and activated carbon filters....450
- Visible light meter....150
- UV (ultraviolet radiation) meter....1,500
- Vacuum cleaner (HEPA)....600-1,100
- UV fluorescent filtering sleeves....7
- UV filtering acrylic (Plexiglas®, OP-2®, or similar)
  - 8” x 10” sheet....10
  - 20” x 24” sheet....45
  - 4’ x 8’ x 1/4” sheet....300
- UV filtering film professionally installed on windows....10/SF

Security

<u>Museum Facility</u>

Intrusion detection system (approximate minimum $2,000)....5-7/SF

<u>Equipment and Supplies</u>

- Recoring locks (contact locksmith or maintenance staff for costs)
- Locking key boxes....40-60
- Metal or solid core doors....275-450
- Deadbolt locks....50

Fire Protection

<u>Museum Facility</u>

- Fire detection system....5-7/SF
- Fire suppression system
  - Wet pipe system (includes smoke or heat detection system)....10-15/SF
  - Dry pipe system (includes smoke or heat detection system)....12-16/SF

NOTE: Costs increase if the system requires the installation of a new dedicated National Fire Protection Association (NFPA) approved 4" or 6" water line or if there is a need for a water storage reservoir. Specific estimated costs for installation of water line and storage reservoir include:

- Pipe installation....43/LF
- Backflow preventer....12,650
- Gate valve....1,330-2,100
- Water meter and box....11,400
- Connection to existing line....2,900
- 10,000 gallon steel on-grade storage reservoir....40,250

  (Prices vary with capacity and type of construction.)

Figure F.1. Cost Estimates (2005) (continued)

	Dollars
Equipment and Supplies	
• ABC fire extinguisher (20 pound unit)	70
• ABC fire extinguisher (10 pound unit)	50
• Flammable liquid cabinet (various sizes)	200-700
• Four-drawer insulated file cabinet	840
• Media vault	245
• Media safe (various sizes)	3,000-16,000
Professional Assistance and Museum Planning	
• Assistance with establishing optimum relative humidity and temperature levels	3,500-6,000
• Security Survey	9,000-12,000
• Fire Protection Survey	9,000-12,000
• Collection Management Plan	12,000-25,000
• Collection Condition Survey	10,000-20,000
• Collection Storage Plan	7,000-13,000
• Integrated Pest Management Plan	10,000-15,000
• Housekeeping Plan	10,000-15,000

Figure F.1. Cost Estimates (2002) (continued)

NATIONAL PARK SERVICE
CHECKLIST
FOR PRESERVATION AND PROTECTION
OF MUSEUM COLLECTIONS

National Park Service
National Center for Cultural
Resources Stewardship and
Partnership Programs
Museum Management Program

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections

____
(Park/Center Acronym)

NATIONAL PARK SERVICE
CHECKLIST FOR PRESERVATION AND PROTECTION
OF MUSEUM COLLECTIONS

CHECKLIST COVER SHEET

Please complete and attach this cover sheet to your completed checklist.

Unit Name: ____

Unit Address: ____
(Street Address)

____
(P.O. Box Number)

____
(City, State, Zip Code)

Telephone Number: ______________________Fax Number: ____

Completed by: ____ Date:_________________
(Name)

____
(Title)

____ Date:_________________
(Name)

____
(Title)

Reviewed/Approved by: ____
(Print/Type Park Superintendent/Center Manager Name)

____ Date:______________
(Park Superintendent/Center Manager Signature)

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

TABLE 1: UNIT FACILITIES HOUSING MUSEUM COLLECTIONS

Facility Code	Name and Type of Facility	Type of Museum Space

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

A. ADMINISTRATIVE OFFICES

Operations (Procedural):

1. Issuing keys to office spaces housing museum objects is strictly controlled by the use of a signed hand receipt.

Answer: ___________

Action:

Comments:

2. Opening and closing procedures are written, approved, and practiced.

Answer: ___________

Action:

Comments:

3. If time allows in a pending disaster (e.g., storm, flood, fire), there are instructions that provide guidance for the prioritized safe and secure evacuation of artwork.

Answer: ___________

Action:

Comments:

4. Smoking is prohibited in offices housing museum objects.

Answer: ___________

Action:

Comments:

5. Levels of relative humidity and temperature are monitored and recorded.

Answer: ___________

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

6. The placement of artwork is away from heating and air-conditioning vents. Answer: ___________

Action:

Comments:

7. The visible spectrum of light is monitored for illuminance level and duration, is controlled, and meets the standards outlined in the DOI Museum Property Handbook, Volume I, Chapter 5 or the NPS Museum Handbook, Part I, Chapter 4 (1999). Answer: ___________

Action:

Comments:

8. The placement of artwork is such that outside light does not directly fall on objects(s). (If there is no outside light source, respond NA indicating not applicable.) Answer: ___________

Action:

Comments:

9. Handling and dusting of museum property is performed only by staff who have received appropriate training. Answer: ___________

Action:

Comments:

10. Three-dimensional materials are displayed in areas that minimize accidental damage. (If there are no three-dimensional materials on display, respond NA indicating not applicable.) Answer: ___________

Action:

Comments:

Equipment and Supplies:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

______________ (Unit Acronym)

11. Ultraviolet (UV) radiation is controlled by a filtering material that has UV absorbing properties.

Deficiency:

Action:

Comments:

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

12. Artwork is properly framed and is securely hung on the wall.(If artwork is three-dimensional and not framable, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Professional Assistance and Museum Planning:

13. Through a Conservation Survery/Collection Condition Survey (CCS), conservators have provided the unit a condition assessment of artwork and other museum property in administrative offices and guidance on setting priorities for care and conservation treatment.

Deficiency:

Action:

Comments:

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

B. MUSEUM COLLECTIONS STORAGE

Museum Facility:

1. The museum storage area is used solely for storage of museum objects.

Deficiency:

Action:

Comments:

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

2. The curatorial office and research/reference and work areas are separated from the museum collections storage space.

Answer: __________

Cost: $ __________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

3. Flammable liquids and materials, audiovisual equipment and other interpretive materials, and curatorial forms and supplies are stored outside the museum storage space in an appropriate cabinet.

Answer: __________

Cost: $ __________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

4. The space is outside the 100-year floodplain.

Answer: __________

Cost: $ __________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

5. The space is in an area that will not flood if pipes break, or drains back up. (If there are no pipes or drains in space, respond NA indicating not applicable.)

Answer: __________

Cost: $ __________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

6. The space is appropriately insulated to help maintain environmental conditions. (If space cannot be insulated given the nature of the structure, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

7. If space has windows, they are blocked (e.g., covered with plywood sheets) and insulated. (If space has no windows, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

8. Space has as few doors as possible to enhance security and environmental control, but has enough to meet requirements for employee safety.

Deficiency:

Action:

Comments:

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

9. Space is as free of water, steam, drain, and fuel pipes as is practical.

Deficiency:

Action:

Comments:

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

10. Space is free of water, gas, or electric meters, electrical panels, and utility valves that require monitoring and servicing by non-curatorial personnel.

Answer: __________

Cost: $ __________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

11. Space is sufficient for the movement of staff, equipment, and objects in and out without hindrances (e.g., low ceilings; inadequately sized doors; or narrow, winding, or steep stairways).

Answer: __________

Cost: $ __________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

12. Space is large enough to accommodate the current museum collection and any anticipated growth.

Answer: __________

Cost: $ __________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

13. Space is organized in a way that allows for easy access to museum objects and use of proper storage equipment.

Answer: __________

Cost: $ __________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Equipment and Supplies:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

14. Sufficient equipment (e.g., quantities, sizes, and appropriateness of cabinets, shelving units, and specialized racks) is used to store and contain museum objects without crowding. (If object size or type doesn't require storage equipment (e.g. vehicles), respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

15. Museum storage cabinets are in good condition (e.g., are free of rust, have gaskets intact to provide good sealing action, have smoothly operating doors) and have working, keyed or combination lock mechanisms. (If object size or type doesn't require storage equipment, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

16. Museum cabinet drawers are not loaded beyond the manufacturer's recommended weight capacity. (If no cabinets with drawers are used in storage, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

17. Museum cabinets are stacked no more than two high. (If storage contains no cabinets that are stacked, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

18. Open shelving is free of burrs, splinters, exposed nails, screws, and bolts that can damage museum objects. (If there is no open shelving, respond NA indicating not applicable.)

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

19. Museum objects that are stacked are protected by appropriate containers or cushioning materials. (If no objects are stacked, respond NA indicating not applicable.)

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

20. Museum cabinets are raised off the floor at least 4 inches (preferably 6 inches) as a precaution against potential flooding and to facilitate cleaning of floors and inspection for pest problems. Bottom shelves of shelving units are raised off the floor 4 to 6 inches. (If facility has no cabinets or shelving units, respond NA indicating not applicable.)

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

21. Open shelving is stabilized to prevent it from tipping over. (If there is no open shelving, respond NA indicating not applicable.)

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

22. The unit is outside of an earthquake zone.

Answer: __________

Action:

Comments:

23. Restraining bars or cords are attached to edges of shelves to prevent objects from falling off shelves during an earthquake. (If your response to item 22 is YES, respond NA indicating not applicable.)

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

24. Closed cell polyethylene foam is used in museum cabinet drawers and on shelving to cushion objects. (Exception: If natural history specimens are to be used for analysis of organic chemicals, do not use any kind of plastic in storage containers and respond NA.)

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

25. Objects in museum cabinets are placed in specimen trays, padded or otherwise prevented from shifting when drawers are opened and closed. (If no cabinets with drawers are used, respond NA indicating not applicable.)

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

26. Museum objects and archival materials are housed in storage containers or on mounts (e.g., boxes, folders, envelopes, herbarium paper) that are made of museum/archival quality materials. (If there are no objects or archival materials that need such containers or mounts, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

27. Natural history specimens stored in fluids are housed in a space that provides appropriate ventilation. (If there are no specimens stored in fluids, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

28. Natural history specimens stored in fluids are housed separately from dry specimen collections. (If there are no specimens stored in fluids, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

29. Nitrate film is housed in buffered sleeves or envelopes, placed in Ziplock polyethylene bags, and stored in appropriate frost-free freezers in separate space from all other collections. (If there is no nitrate film, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Figure F.2. NPS Checklist(2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

30. Spaces and/or cabinets housing specimens stored in fluids, specimens treated with pesticides, rocks/minerals/fossils that are radioactive, or nitrate film are identified by appropriate health/safety sign. (If there are none of these materials, respond NA indicating not applicable.)

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

C. EXHIBITS

Operations (Procedural):

1. Exhibit plans and historic furnishings reports are reviewed by curatorial staff to ensure that the preservation, protection, and maintenance needs of museum objects are adequately addressed.

Answer: __________

Action:

Comments:

Museum Facility:

2. The space is outside the 100-year floodplain.

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

3. The space is in an area that will not flood if pipes break, or drains back up. (If there are no pipes or drains, respond NA indicating not applicable.)

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

4. Exhibit cases are designed and fabricated in a manner that ensures the security and preservation of museum property (e.g., uses tamper-resistant screws; minimizes heat build up; controls light, relative humidity, dust levels; and prevents access by insects). (If there are no exhibit cases, respond NA indicating not applicable.)

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

5. Exhibit cases are designed and fabricated in a manner that facilitates maintenance (i.e., ease of access for inspection, inventory, cleaning, rotation of sensitive materials). (If there are no exhibit cases, respond NA indicating not applicable.)

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

6. Where needed, mounts constructed of museum quality material are used to support objects and specimens. (If there are no mounts, respond NA indicating not applicable.)

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

7. Freestanding museum objects on exhibit are protected by physical barriers, alarm detection systems, or staff on duty. (If there are no freestanding objects, respond NA indicating not applicable.)

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

Operations (Procedural):

1. Levels of relative humidity and temperature in storage and exhibit spaces are monitored on a daily basis to provide an accurate and complete picture of all changes in both of these environmental factors during each year. (If response is NO and unit does not have monitoring equipment, include equipment purchase cost in item 11.)

Answer: ___________

Action:

Comments:

2. A record of daily observations, noting occurrences such as unusual exterior climatic conditions, leaky roof, re-calibration of equipment, or an unusual visitation pattern, is maintained to help explain any variations in relative humidity and temperature readings.

Answer: ___________

Action:

Comments:

3. Records of relative humidity and temperature readings and of daily observations are permanently retained in the unit's curatorial files.

Answer: ___________

Action:

Comments:

4. Records of relative humidity and temperature readings and of daily observations are reviewed and analyzed monthly to determine relative humidity and temperature highs, lows, and means; and the frequency and extent of fluctuations.

Answer: ___________

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

5. The visible spectrum of light is monitored and recorded for illuminance level and duration. (If response is NO and unit does not have a light meter, include purchase cost under item 11.)

Answer: ___________

Action:

Comments:

6. Levels of natural light (daylight) have been recorded quarterly for one year to establish seasonal variations. (If there is no natural light in facility, respond NA indicating not applicable.)

Answer: ___________

Action:

Comments:

7. The unit has a record of annual seasonal variations and periodically spot checks to ensure that levels do not exceed the upper limits for sensitive objects.

Answer: ___________

Action:

Comments:

8. UV filtering material is periodically monitored to ensure its continued effectiveness in meeting the standard in the DOI Museum Property Handbook, Volume I, Chapter 5 or the NPS Museum Handbook, Part I, Chapter 4 (1999).
(If there is no UV filtering material, respond NA indicating not applicable.)

Answer: ___________

Action:

Comments:

9. Monitoring (inspections) for evidence of insect, mold, and rodent infestations is conducted on an ongoing basis with especially close inspection of museum objects on a monthly basis.

Answer: ___________

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

10. The monitoring and control of pests is coordinated with the unit's Integrated Pest Management Program.

Answer: __________

Action:

Comments:

Equipment and Supplies:

11. The unit has appropriate equipment (e.g., hygrothermograph, datalogger, visible light meter, UV monitor) to implement and maintain an ongoing environmental monitoring program.

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

12. The park has installed equipment/system in each space housing museum collections to control relative humidity and temperature.

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

13. The visible spectrum of light is controlled to meet DOI Museum Property Handbook, Volume I, Chapter 5 or the NPS Museum Handbook, Part I, Chapter 4 (1999).

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

14. Ultraviolet (UV) radiation is controlled by a filtering material that has UV absorbing properties. (If the space has no source of UV radiation, respond NA indicating not applicable).

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______	$ ____________
Previous estimated cost to correct deficiency	$ ____________
% of deficiency corrected	____________

15. Dust covers are used on open shelving when objects are not otherwise protected from dust (e.g., in boxes). (If there is no open shelving, respond NA indicating not applicable.)

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______	$ ____________
Previous estimated cost to correct deficiency	$ ____________
% of deficiency corrected	____________

16. Particulates (dust) in museum storage and exhibit spaces are controlled.

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______	$ ____________
Previous estimated cost to correct deficiency	$ ____________
% of deficiency corrected	____________

E. SECURITY

Operations (Procedural):

1. Keys to museum storage spaces, exhibit cases, and work and research/reference spaces are issued to only those employees having direct responsibility for the collections.

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______	$ ____________
Previous estimated cost to correct deficiency	$ ____________
% of deficiency corrected	____________

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

2. Issuing of keys to museum storage spaces and exhibit cases is strictly controlled by the use of a signed hand receipt (e.g., DI-105 or equivalent form).

Answer: __________

Action:

Comments:

3. Written, approved procedures for controlling access to the museum collections by non-curatorial staff, outside researchers, and visitors are implemented.

Answer: __________

Action:

Comments:

4. All researchers, visitors, and non-curatorial staff who enter the storage area are escorted at all times by unit curatorial staff. (For exhibit spaces, respond NA indicating not applicable.)

Answer: __________

Action:

Comments:

5. A visitor/researcher sign-in log is used to record name and address of visitor, date of visit, time entered and time departed, and reason for visit. (For exhibit spaces, respond NA indicating not applicable.)

Answer: __________

Action:

Comments:

6. Opening and closing procedures for museum spaces are written, approved and practiced.

Answer: __________

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

7. Museum objects in exhibit spaces are given additional protection at times of high risk, such as during times of crowding or of special activities. (If there are no exhibits, respond NA indicating not applicable. For storage spaces, respond NA indicating not applicable.)

Answer: ___________

Action:

Comments:

8. The special needs of museum collections and records are incorporated into the unit's Emergency Operation Plan (EOP).

Answer: ___________

Cost: $ ____________

Deficiency:

Action:

Comments:

Funding spent (previous) FY _______	$ ____________
Previous estimated cost to correct deficiency	$ ____________
% of deficiency corrected	____________

9. Installed intrusion detection systems are inspected and maintained on a regular schedule to ensure that they are fully operational. (If there are no intrusion detection systems, respond NA indicating not applicable.)

Answer: ___________

Action:

Comments:

10. The unit has determined the extent to which museum collections and associated museum records are at risk from the threats listed in the DOI Museum Property Handbook, Volume I, Chapters 11 and 12 or NPS Museum Handbook, Part I, Chapters 9 (2002) and 10 (2000).

Answer: ___________

Action:

Comments:

Museum Facility:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

11. Entrances to museum spaces are equipped with metal or solid-core wood doors that have deadbolt locks.

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

12. Intrusion detection systems appropriate to the risks involved and to the nature of the museum collection are installed and operable in museum storage and exhibit spaces.

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Equipment and Supplies:

13. Small, highly sensitive and valuable museum objects, archival documents, and natural history type specimens housed in museum storage spaces are kept in locked cabinets with keyed or combination locks. (If there are none of these objects, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

14. Irreplaceable or particularly sensitive or valuable objects used in exhibits are protected in cases or by other means that provide protection from theft or vandalism, without making curatorial access impractical. (If there are none of these objects, respond NA indicating not applicable.)

Deficiency:

Action:

Comments:

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

Operations (Procedural):

1. Fire detection and suppression systems are inspected and maintained on a regular schedule to ensure that they are fully operational. (If unit has no fire detection of suppression systems, respond NA indicating not applicable.)

Answer: ___________

Action:

Comments:

2. Fire extinguishers are inspected annually to ensure that they are operational.

Answer: ___________

Action:

Comments:

3. Staff are trained annually in the use of fire extinguishers.

Answer: ___________

Action:

Comments:

4. Museum objects on top of shelving or museum cabinets do not obstruct the discharge heads for fire suppression systems and are not closer than 18 inches to the ceiling. (If there is no fire suppression system, respond NA indicating not applicable.)

Answer: ___________

Action:

Comments:

5. The special needs of museum objects and museum records are incorporated in the unit's Structural Fire Plan.

Answer: ___________

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

6. Orientation on the location, nature, significance, and specific needs of museum property has been provided to fire fighting entities who are responsible for responding to the suppression of a fire.

Answer: ___________

Action:

Comments:

Museum Facility:

7. Spaces housing museum collections and their structural components (e.g., walls, floors, ceilings, doors and windows) are made fire-resistant to the extent possible, given the nature of the structure.

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______	$ ____________
Previous estimated cost to correct deficiency	$ ____________
% of deficiency corrected	____________

Deficiency:

Action:

Comments:

8. Fire detection and suppression systems appropriate to the risks involved, to the nature of the museum collection, and to the structure housing the collections are installed and operable.

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______	$ ____________
Previous estimated cost to correct deficiency	$ ____________
% of deficiency corrected	____________

Deficiency:

Action:

Comments:

Equipment and Supplies:

9. An appropriate number and type of fire extinguishers are installed according to the anticipated types of fires, the nature of the collection, and the size of the protected area.

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______	$ ____________
Previous estimated cost to correct deficiency	$ ____________
% of deficiency corrected	____________

Deficiency:

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

10. Flammable liquids and materials are housed outside museum storage spaces and, regardless of where stored, such materials are housed in approved flammables storage cabinets. Cabinets are vented if required by local authorities. (For exhibit spaces, respond NA indicating not applicable.)

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

11. All paper museum records are kept in a locking, insulated safe, file, or vault with equivalent or better protection that will maintain an interior temperature of less than 350 degrees Fahrenheit during a one-hour exposure to exterior temperatures of at least 1700 degrees Fahrenheit. (If no paper museum records are stored in this facility, respond NA indicating not applicable).

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

12. If the container described in item 11 is housed on a level of a building above grade, the container also is rated to withstand a drop of 30 feet. (If there is no container or if the container is housed below grade, respond NA indicating not applicable.)

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

13. Media (disks and tapes) that back up ICMS data files and other collection data files are stored in a container (e.g., media safes, media files, mixed media files, and media boxes) that will maintain an interior temperature of not more than 125 degrees Fahrenheit during a one hour exposure to an exterior temperature of 1700 degrees Fahrenheit. (NOTE: Media boxes are acceptable only when inserted in an appropriately rated insulated records file as described in item 11. If no media are stored in this facility, respond NA indicating not applicable).

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

G. HOUSEKEEPING

Operations (Procedural):

1. Housekeeping in museum storage and exhibit spaces is performed according to a plan's established schedule.

Answer: __________

Action:

Comments:

2. Written rules and procedures are available to provide staff with guidance on the handling and moving of museum objects.

Answer: __________

Action:

Comments:

3. Smoking, drinking, and eating and displaying living plants, fresh flowers, and foodstuffs in museum storage and exhibit spaces and in research, working, and research/reference spaces are prohibited in writing.

Answer: __________

Action:

Comments:

4. Relative humidity and temperature monitoring equipment is calibrated quarterly. (If there is no monitoring equipment, respond NA indicating not applicable.)

Answer: __________

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

5. If a hygrothermograph is used to monitor relative humidity and temperature, it is regularly maintained (e.g., linkage is cleaned, ink is replenished). (If a hygrothermograph is not used, respond NA indicating not applicable.)

Answer: ___________

Action:

Comments:

6. The housekeeping plan for museum spaces is reviewed annually and is revised as necessary. (If there is no housekeeping plan, respond NA indicating not applicable.)

Answer: ___________

Action:

Comments:

H. PROFESSIONAL ASSISTANCE AND MUSEUM PLANNING

1. Working with museum environment specialists, the unit has established optimum relative humidity and temperature levels and acceptable highs and lows based on data recorded from ongoing monitoring program.

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $	____________
Previous estimated cost to correct deficiency $	____________
% of deficiency corrected	____________

Deficiency:

Action:

Comments:

2. The unit has conducted a security survey. (If the response is NO, and there is a need for this survey, complete the deficiency and cost blocks.) (If there is no need for a security survey, respond NA indicating not applicable.)

Answer: ___________

Cost: $ ____________

Funding spent (previous) FY _______ $	____________
Previous estimated cost to correct deficiency $	____________
% of deficiency corrected	____________

Deficiency:

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

CHECKLIST

____
(Unit Acronym)

3. The unit has conducted a fire protection survey. (If the response is NO, and there is a need for this survey, complete the deficiency and cost blocks.) (If there is no need for a fire protection survey, respond NA indicating not applicable.)

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

4. The needs of the museum collection are adequately addressed in project statements that are included in the unit's Resources Management Plan (RMP).

Answer: __________

Action:

Comments:

5. The unit has an approved Collection Management Plan (CMP).

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

6. Through a Collection Condition Survey (CCS) or multiple surveys, conservators have provided the unit with an assessment of the condition of material-specific object groups on exhibit and in storage and have provided guidance on setting priorities for conservation treatment.

Answer: __________

Cost: $ __________

Funding spent (previous) FY _______ $ __________
Previous estimated cost to correct deficiency $ __________
% of deficiency corrected __________

Deficiency:

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

7. The unit has an approved Collection Storage Plan (CSP). (If the response is NO, and there is a special need for this plan, independent of a CMP, complete the deficiency and cost blocks. If there is no need for a Collection Storage Plan, respond NA indicating not applicable.)

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

8. An Integrated Pest Management Plan for all spaces housing museum collections has been written.

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

9. A housekeeping plan has been written for museum storage, exhibit, work, and research spaces.

Answer: __________

Cost: $ ____________

Funding spent (previous) FY _______ $ ____________
Previous estimated cost to correct deficiency $ ____________
% of deficiency corrected ____________

Deficiency:

Action:

Comments:

A. ADMINISTRATIVE OFFICES

Are framed artwork or other museum objects (e.g. furniture) on display in this facility? If the response is YES, complete this section of the checklist.

Answer: __________

Action:

Comments:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

B. MUSUEM COLLECTION STORAGE

CHECKLIST

____
(Unit Acronym)

Are museum collections stored in a facility located within the unit? If the response is YES, complete this section of the checklist.

Answer: __________

Action:

Comments:

C. EXHIBITS

Are museum collections exhibited in this facility? If the response is YES, complete this section of the checklist.

Answer: __________

Action:

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

Unit: Page:

All Facilities

National Park Service
Checklist for Preservation and Protection
of Museum Collections

ESTIMATE OF TOTAL FUNDING NEEDED TO CORRECT DEFICIENCIES Date:

	Subtotals	TOTALS
A. ADMINISTRATIVE OFFICES		
Operations (Procedural)		
Equipment and Supplies		
Pofessional Assistance and Museum Planning		
B. MUSEUM COLLECTION STORAGE		
Museum Facility		
Equipment and Supplies		
C. EXHIBITS		
Operations (Procedural)		
Museum Facility		
Equipment and Supplies		
D. MUSEUM ENVIRONMENT		
Operations (Procedural)		
Equipment and Supplies		
E. SECURITY		
Operations (Procedural)		
Museum Facility		
Equipment and Supplies		
F. FIRE PROTECTION		
Operations (Procedural)		
Museum Facility		
Equipment and Supplies		
G. HOUSEKEEPING		
Operations (Procedural)		
H. PROFESSIONAL ASSISTANCE AND MUSEUM PLANNING		
ESTIMATED TOTAL COST:		

Figure F.2. NPS Checklist (2009) for Preservation and Protection of Museum Collections Exported from ICMS (continued)

APPENDIX G: MUSEUM FIREARMS, SMALL ARMS AMMUNITION, MUNITIONS, AND ARTILLERY

Page

Appendix Overview

Museum Firearms, Small Arms Ammunition, Munitions, Artillery, and Explosives Overview

Note: Overview summarizes key points from this appendix. See individual sections for detailed information.

Overview

Implement NPS Museum Standards for Firearms, Small Arms Ammunition, Munitions, Artillery, and Non-Combat Explosives.

Implement safe handling procedures at all times.

Do not accession loaded firearms and artillery, or live munitions and non-combat explosives into the collection. ***Only*** unloaded firearms and artillery, and inert munitions can be accessioned into the collection.

Stable live small ammunition may be accessioned into the collection without being inerted, but ***must*** be stored in a locking, fire-resistant magazine or anti-static box in accordance with nationally recognized fire codes.

NPS Historical Significance Contributing Factors Tool must be completed for munitions, artillery, and non-combat explosives, and included in Park Inerting Request Package(s). Submit Request Package(s) through regional curator to regional director for concurrence.

EOD unit, bomb squad, or certified blaster determines final disposition in consultation with NPS park, zone, or regional safety manager and curator.

Follow applicable federal, state, and local laws and regulations for firearms, small arms ammunition, munitions, and artillery.

Document actions in accordance with this appendix. Process and document deaccession and disposal actions in accordance with *MH* II.6: Deaccessioning.

Firearms in the Collection

An experienced specialist must evaluate firearms to determine status (loaded or unloaded), and unload and clear loaded firearms. Curator documents processes using the Museum Firearms Evaluation and Unloading Record.

Render modern firearms inoperable when exhibited. ***Do not*** exhibit loaded firearms, or modern firearms that cannot be rendered inoperable.

Store firearms separately from other objects in a secure, locking museum-quality cabinet or gun safe in a dedicated collections storage space.

Move modern firearms in accordance with applicable federal and state laws and regulations.

Do not load or fire museum firearms in demonstrations or store black powder used by the Historic Weapons Program in any space housing collections.

Small Arms Ammunition in the Collection

An experienced specialist must evaluate small arms ammunition to determine status (live, solid metal, or inert). Based on specialist determination of risk level, retain live in storage, *or* render inert if safe to do so. Document processes using the Museum Small Arms Ammunition Evaluation and Mitigation Record.

Store inert and solid metal small arms ammunition separately from firearms in a dedicated collections storage space.

Store stable live small arms ammunition in a locking, fire-resistant magazine *or* anti-static box within a locking cabinet in accordance with nationally recognized fire codes. Secure and label as “Live Small Arms Ammunition.”

Do not exhibit live small arms ammunition.

Munitions in the Collection

NPS museum staff ***must not*** handle, disturb, move, transport, or attempt to deactivate live munitions under any circumstance.

Implement Emergency Response Steps: Suspected Live Munitions in the Collection when observing a change in condition in a museum munition, such as new cracks or bulging, leaking, or ticking.

Department of Defense (DOD) (US Marine Corps or other) Explosive Ordnance Disposal (EOD) unit or accredited Public Safety Bomb Squad must evaluate munitions to determine status (live, solid metal, or inert).

On regional director concurrence of Park Inerting Request Package, US Marine Corps EOD unit renders live munitions inert and completes inert certification. Other DOD EOD units or bomb squads complete NPS Museum Verification Document. ***Inert munitions must be returned to the park museum collection***. Curator documents processes using the Museum Munitions and Artillery Evaluation and Inerting Record. If not safe to inert, process in accordance with *MH* II, Chapter 6: Deaccessioning.

Do not accession or exhibit live munitions.

Store inert munitions in a dedicated, secure, museum-quality storage space. File inert certification or verification document in accession and/or catalog folder.

Artillery in the Collection

A DOD EOD unit (US Marine Corps or other) or accredited Public Safety Bomb Squad must evaluate artillery to determine status (loaded or unloaded) and unload loaded artillery if safe to do so. Curator documents processes using the Museum Munitions and Artillery Evaluation and Inerting Record.

Securely store and exhibit artillery. ***Do not*** exhibit loaded artillery.

Non-Combat Explosives in the Collection

An accredited Public Safety Bomb Squad or trained and licensed certified blaster must evaluate non-combat explosives to determine status (live or inert), and render live explosives inert if safe to do so. Curator documents processes.

Store inert non-combat explosives in a secure, dedicated collections storage space. ***Do not*** exhibit, handle, move, transport, or attempt to deactivate.

APPENDIX G: MUSEUM FIREARMS, SMALL ARMS AMMUNITION, MUNITIONS, AND ARTILLERY

A. Overview

Firearms, small arms ammunition, military munitions, artillery, and non-combat explosives in National Park Service museum collections are potentially dangerous and must be managed with extreme caution. Implement standards and best practices in the text and figures of this appendix to prevent injury or death of staff and visitors.

This is an appendix of Chapter 11: Curatorial Health and Safety.

Section I. Overview

1. What is included in this appendix

This appendix provides standards and procedures for safe management of museum firearms, small arms ammunition, munitions, artillery, and non-combat explosives. It includes:

- NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives, and other relevant laws and regulations.
- Handling, storage, and exhibit guidance for life safety and preservation of firearms, small arms ammunition, military munitions and artillery, and non-combat explosives in collections. Each object type is defined and discussed separately.
- Park Inerting Request Package(s) for munitions, artillery, and non-combat explosives for regional director concurrence, including the NPS Historical Significance Contributing Factors Tool.
- Working with US Marine Corps (USMC) Explosive Ordnance Disposal (EOD) or other Department of Defense (DOD) Explosive Ordnance Disposal unit, and/or accredited Public Safety Bomb Squad to evaluate status (live or inert, loaded or unloaded) and inert or unload live or loaded munitions and artillery. Process objects not safe to inert in accordance with MH II.6: Deaccessioning.
- Working with an experienced specialist to evaluate status of firearms and small arms ammunition, and unload loaded firearms.
- Working with a trained and licensed certified blaster to evaluate status of non-combat explosives and render live explosives inert. Process objects not safe to inert in accordance with MH II.6: Deaccessioning.
- Shipping and transportation.
- Documentation.
- Forms and figures, including Emergency Response Steps for suspected live munitions in the museum collection.

For terminology for objects covered in this appendix, see individual sections below, *Museum Handbook*, Part II: Museum Records (*MH* II), and *Nomenclature for Museum Cataloging* website for classifications. See also Chapter 11: Curatorial Health and Safety, and NPS *Conserve O Grams*, Section 2: Security, Fire, and Curatorial Safety.

2. *Levels of risk*

Museum collections may include firearms, small arms ammunition, military munitions (referred to as "munitions" in this appendix), artillery, and/or non-combat explosives. *Each object type presents a different level of risk* to life and safety.

- Munitions pose a ***high safety risk***, as they were designed to explode, maim, and kill.
  - ***Live*** munitions (containing explosive material) pose the ***highest safety risk***, particularly if unstable.
  - ***Immediately implement Emergency Response Steps: Suspected Live Munitions in the Collection (Figure G.14) if instability is noted***. This includes new cracks, bulges or dents, leaking fluid or powder, corrosion, smoking, odor, or ticking.
  - A DOD EOD unit (USMC or other) or accredited Public Safety Bomb Squad will determine if these are "Munitions and Explosives of Concern (MECs)" such as unexploded ordnance (UXO) during evaluation.
    See Sections E.I.1: How are munitions defined in this appendix and E.1.3: Who can evaluate munitions, render live munitions inert, and dispose of munitions.
  - Munitions certified as inert do not pose an explosive safety risk.

- Artillery poses a ***high safety risk if loaded*** with munitions. Unloaded artillery does not pose an explosive safety risk.

- Certain non-combat explosives such as blasting caps or dynamite pose a ***high safety and explosion risk if live***, as they are highly unstable.

- Small arms ammunition ***pose a low safety risk***, as they are designed to be ejected from a firearm rather than explode. There is an ***increased structural fire risk*** *if* the ammunition is outside a firearm *and* exposed to fire or sparks, *or* percussion if the primer is directly contacted.

  Mitigate risk by safely storing in a locking, fire-resistant magazine or anti-static box,[1] for a net explosive weight of 50 pounds or less.

- Loaded firearms *do not pose an explosion risk*. However, they do pose a risk of injury or death if fired. Unloaded firearms do not pose a safety risk.

---

[1] Guidance for mitigating small arms ammunition risk was developed in consultation with the NPS WASO Office of Risk Management, and updates the NPS Safety Alert: Discarded Military Munitions and Unexploded Ordnance (Feb 10, 2022).

A *DOD* (USMC or other) *EOD unit* or *accredited Public Safety Bomb Squad* ***must*** identify live munitions and loaded artillery in accordance with Museum Standard for Firearms, Small Arms Ammunition, Munitions, Artillery, and Non-Combat Explosives (2) (G.B.1.2). USMC or other DOD EOD units will be referred to as "DOD EOD units", and accredited Public Safety Bomb Squads will be referred to as "accredited bomb squads" in this appendix unless otherwise indicated.

An *experienced specialist* ***must*** identify lower-risk objects, including live small arms ammunition and loaded firearms in accordance with Museum Standards for Firearms, Small Arms Ammunition, Munitions, Artillery, and Non-Combat Explosives (3) and (5) (G.B.1.3, 5). See Sections C.I.4: Experienced specialist for firearms and D.I.4: Experienced specialist evaluation of small arms ammunition for detailed information.

Objects evaluated and determined to be inert, unloaded, and/or solid metal are managed as regular museum objects. *If* proposed for deaccessioning, *then* all deaccessioning actions must be processed in accordance with *MH* II.6: Deaccessioning.

There are currently few training options for identification and safe management of these types of objects. Contact the regional curator, WASO Museum Management Program, and/or regional or WASO Office of Risk Management for information. Parks with similar collections should pursue joint training.

3. *Responding to risk*

Advanced planning, evaluation, and taking appropriate action based on risk level are critical for life safety and protection of collections and structures.

Take safe and appropriate action(s) based on risk level, as determined by the DOD EOD unit, accredited bomb squad, or experienced specialist.

Arrange for evaluations and determine the safest course of action for munitions in consultation with the DOD EOD unit, accredited bomb squad, *and* the park, zone, or regional safety manager, regional curator, park structural fire coordinator, and park or regional Chief Ranger. Actions will vary by object type, condition, number, location, and other factors. They range from restricting access to storage or exhibit areas, to building evacuation, to contacting the DOD EOD unit or accredited bomb squad to transport a live munition away from the building for inerting or disposal.

Note that USMC EOD units are experienced in working with and preserving museum munitions if safe to do so. If a USMC or other DOD EOD unit is not immediately available to respond to a discovery of live munitions, then work with an accredited bomb squad.

Consult with the park, zone, or regional safety manager to determine if Job Hazard Analyses (JHAs) are needed.

See Sections E.I.3: Who can evaluate munitions, render live munitions inert, and dispose of munitions and E.I.6: Accredited bomb squad procedures for live munitions (MECs), as well as Chapter 10: Emergency Planning for additional planning guidance. See also Marine Corps Order 3571.2G: Explosive Ordnance Disposal (EOD) Program.

4. Phased approach for managing museum firearms, small arms ammunition, munitions, artillery, and non-combat explosives

Use a *phased approach based on level of risk*. Address high-risk categories such as munitions, artillery, and non-combat explosives first, followed by lower-risk categories such as small arms ammunition and firearms. Curator takes the following steps.

- **Know the collection**
  Review accession and catalog records and generate a safety data list of *all* munitions, artillery, non-combat explosives, small arms ammunition, and firearms in the collection. Include uncataloged and misidentified or misspelled items. Record legacy USMC EOD unit inert certifications or written verification documents that the munitions are inert from other DOD EOD units or accredited bomb squads. Update safety data as steps below are completed.

- **Visually inspect all munitions, artillery, non-combat explosives, small arms ammunition, and firearms**
  Verify presence or absence of objects within each type and note condition.

  Limit access until evaluated.

  For munitions, if a condition change such as leaking fluid or new bulging is noted, see Section E.I.2: Potential safety risks of munitions and when an emergency response is needed.

DO NOT touch, handle, move, or attempt to inert munitions.

- **Assess historical significance of munitions, artillery, and non-combat explosives**
  Complete the NPS Historical Significance Contributing Factors Tool (“Tool”) (Figure G.6) to assess historical significance of munitions, artillery, and non-combat explosives that will be proposed for inerting, in consultation with the Collections Advisory Committee (CAC).

  Submit completed Tool as part of a Park Inerting Request Package (“Request Package”) for regional director concurrence through the regional curator to inert munitions and non-combat explosives and unload artillery with historical significance.
  See Section A.6: Park Inerting Request Package for regional director concurrence.

- **Evaluate munitions and artillery status (live, loaded, solid metal, unloaded, or inert) and determine appropriate action**
  Contact a DOD (USMC or other) EOD unit or accredited bomb squad to evaluate and determine if munitions in storage and on

exhibit, or loaded in artillery, are live or inert once the regional director has concurred with Park Inerting Request Package. See Section E.I.3: Who can evaluate munitions, render live munitions inert, and dispose of munitions.

The DOD EOD unit or bomb squad takes appropriate action, such as implementing render safe procedures until final disposition of the munition is determined, in consultation with the NPS park, zone, or regional safety manager and curator. USMC EOD unit renders live munitions inert *if safe to do so*, and returns to park collection. See Figure G.1: Munitions Retention or Deaccession Decision Matrix.

- **Evaluate status (live or inert) of non-combat explosives and determine appropriate action**
  Contact a trained and licensed certified blaster to evaluate and identify if non-combat explosives are live or inert, *and* determine if safe to render inert. If not safe to inert, then dispose in accordance with certified blaster recommendations, in consultation with the park, zone or regional safety manager and curator. Process and document deaccessioning actions in accordance with *MH* II.6: Deaccessioning.

  Certain stable non-combat explosives such as fireworks pose a lower safety risk. To be retained live in the collection, these objects *must* be stored in a locking, fire-resistant magazine in a collection storage space.

- **Assess and evaluate small arms ammunition and determine appropriate action**
  After addressing munitions and artillery, address small arms ammunition.

  Arrange for an experienced specialist to evaluate and identify small arms ammunition status (live, solid metal, or inert), *and* determine if it is safe to:

  – *Retain* live small arms ammunition and store in a locking, fire-resistant magazine or anti-static box in a collection storage space.

  or

  – *Inert* unstable small arms ammunition that cannot be safely stored live, *if* safe to do so. If not, then follow procedures in *MH* II.6: Deaccessioning.

  Curator documents evaluation and inerting or safe storage using the Museum Small Arms Ammunition Evaluation and Mitigation Record (Figure G.10). Submit the completed Record to the regional curator, and include copies in park museum and central files. A Park Inerting Request Package is *not* required for small arms ammunition.

- **Evaluate and unload firearms**
  After addressing small arms ammunition, work with an experienced specialist to evaluate and identify loaded firearms, *and* unload loaded firearms.

- **Safely house objects**
  Safely store unloaded firearms and artillery, inert or solid metal small arms ammunition, and inert munitions and non-combat explosives in dedicated, secure storage in a stable environment. Safely store stable live small arms ammunition and lower-risk non-combat explosives such as fireworks and flares in a fire-resistant magazine or anti-static box in accordance with this appendix.

- **Deaccessioning considerations**
  Objects evaluated and determined to be inert, unloaded, and/or solid metal are managed as regular museum objects. *If* proposed for deaccessioning, *then* determine if the objects may be deaccessioned under the categories authorized by law and in accordance with *MH* II.6: Deaccessioning. The park submits the Tool (Figure G.6) together with evaluation, status determination, and deaccession documents to the regional curator for review of the proposed action. Regions may convene a committee to consider the proposed actions. The committee should include a curator, archeologist, historian, and/or other subject matter experts as appropriate.

- **Update information**
  Keep assessment and evaluation information current. Update safety data on munitions, artillery, non-combat explosives, small arms ammunitions, and firearms. Include annual updates in the Collections Management Report (CMR), in Section IV "Noteworthy Accessions, Deaccessions, & Other."

See *MH* I Chapters 4: Museum Collections Environment, 6: Handling, Packing, and Shipping, 7: Museum Collections Storage, and 9: Museum Fire Protection.

5. NPS Historical Significance Contributing Factors Tool

The NPS Historical Significance Contributing Factors Tool (Figure G.6) includes factors relating to park purpose, context, values (associational, evidential, intrinsic, informational), rarity, and documentation that supports the significance of an object to the park, its mission, and the museum collection. The Tool cannot be modified.

The Tool ***must*** be completed to assess the historical significance of each object or lot of munitions, artillery, or non-combat explosives included in the Park Inerting Request Package. The CAC must concur with the Tool.

6. Park Inerting Request Package for regional director concurrence

The *park curator* must convene the *Collections Advisory Committee* (CAC) to complete the Tool to determine which objects have historical significance and should be rendered inert or unloaded for retention in the park collection if safe to do so. See *Museum Handbook* Part II, Appendix B: Collections Advisory Committee for CAC composition, and include a historian, interpretive ranger, and/or archeologist with relevant subject matter expertise as appropriate.

The CAC must concur with the Park Inerting Request Package for each object or lot of munitions, artillery, and/or non-combat explosives proposed for inerting. The curator submits each park Package to the superintendent for approval.

Parks must submit the completed Park Inerting Request Package(s) to the regional director through the regional curator. Inerting requests must be concurred by the regional director.

- Each park Request Package includes:

  - cover memo and signature page (Figure G.5: Park Inerting Request Package Cover and Signature Page)
  - completed NPS Historical Significance Contributing Factors Tool (Figure G.6)
  - list of objects with historical significance proposed for retention in the collection
  - inerting justification (Figure G.7: Park Inerting Justification (Sample)), with CAC concurrence and superintendent approval

The *regional curator* compiles park submissions and coordinates a *regional review panel* comprised of subject matter experts such as an archeologist and historian. The panel reviews each Request Package and makes an inerting recommendation. The panel documents recommendations using a Regional Panel Inerting Request Review (see Figure G.8: Regional Panel Inerting Request Review (Sample)). Submission, review, and contact processes may vary by region.

If the panel concurs with the Park Inerting Request, the regional curator forwards the Request Package and Regional Panel Inerting Request Review to the regional director for review and concurrence. Panel concurrence *does not* ensure regional director concurrence.

If the regional panel *does not* concur with the Park Inerting Request, the Request Package is returned to the park for revision and resubmission.

If the regional director concurs with a Park Inerting Request, the regional curator notifies the park and returns a copy of the completed Package to the park. The *park and/or region* then contacts and coordinates with a DOD EOD unit or accredited bomb squad to schedule an evaluation of munitions, artillery, and non-combat explosives, to determine if they can be safely rendered inert.

If the *regional director does not concur* with a Park Inerting Request for historically significant munitions, artillery, and non-combat explosives, the Associate Director, Cultural Resources, Partnerships, and Science Directorate and Associate Director, Visitor and Resource Protection should convene a panel to review the Request Package and make a recommendation. The panel should include a curator, archeologist and/or historian, safety manager, park structural fire coordinator and/or regional structural fire manager (marshal), solicitor, USMC EOD unit representative, and/or other subject matter experts.

As regional director concurrence is not required for inerting small arms ammunition, a Park Inerting Request Package is *not* required for these objects.

Section II. Documentation

1. *Scope of Collections Statement*

The Scope of Collections Statement (SOCS) must include language that establishes an appropriate number, range, or representative sample of firearms, small arms ammunition, munitions, artillery, and non-combat explosives for inclusion in the collection. Make this determination in consultation with the CAC that includes a historian and an archeologist with relevant subject matter expertise.

2. *Accessioning*

Do not accession live munitions or non-combat explosives, loaded artillery, or loaded firearms into the collection. The potential source of accession (such as donor or field collector) is responsible for arranging the following processes.

- Firearms and artillery ***must*** be unloaded and munitions ***must*** be inerted ***before*** being considered for accessioning into the collection.

- Obtain a USMC EOD unit inert certification *or* other DOD EOD unit or accredited bomb squad verification document for munitions, in consultation with the regional curator, park or regional archeologist, historian, park or regional Chief Ranger or law enforcement, and park, zone, or regional safety manager.

- Schedule evaluations for new accessions, and take appropriate action as determined by the DOD EOD unit, bomb squad, or experienced specialist.

- Small arms ammunition being considered for accessioning ***must*** be stored in a locking fire-resistant magazine or anti-static box until the decision to accession is made. If accessioned, live small arms ammunition ***must*** be stored in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (5) (G.B.1.5).
  See Section D.II.2: Safe storage of small arms ammunition.

- Fieldwork permit and/or authorization needs to follow guidance in NPS Archeology Guide: Developing Explosives Field Safety Response Plans for Military and Commercial Explosives Encountered in National Park Units (*under development*) and include the following language:

  – *Munitions* recovered during fieldwork that will be considered for inclusion in the collection are to be rendered inert and artillery unloaded by a USMC EOD unit *before* accessioning. If recovered live munitions *cannot* be rendered inert by USMC, they ***will not*** be accessioned into the collection, and ***cannot*** be

stored in a structure housing collections.
(NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (4) (G.B.1.4)).

- *Small arms ammunition* that will be considered for inclusion in the collection ***must*** be evaluated by an experienced specialist to identify if live or inert *before* accessioning. Store in a locking fire-resistant magazine or anti-static box until evaluated.
- *Guidance on representative sampling* for firearms, small arms ammunition, munitions, artillery, and non-combat explosives to be included in the collection.

See Sections C.II.2: Safe storage of firearms and D.II.2: Safe storage of small arms ammunition.

3. *Retention and deaccession considerations for munitions*

Make every effort to retain inert munitions in the collection ***if safe to do so***, particularly if rare, unique, novel, or limited in production. These objects are important for education, interpretation, and research. Ensure that all NPS "museum objects are treated in a careful and deliberate manner that protects the public interest", in accordance with the Museum Properties Act of 1955 (54 USC 1025.102504).

If the DOD EOD unit or accredited bomb squad determines that a munition *cannot* be safely inerted and retained in the collection, ***then*** deaccession and dispose in accordance with *MH* II.6: Deaccessioning.

Complete the following before taking any deaccession and disposal actions.

- Submit Park Inerting Request Package, including the completed Tool, and obtain regional director concurrence.
- DOD EOD unit or accredited bomb squad evaluates and determines that a munition is live and *cannot* be safely inerted.
- Park curator consults with regional curator about the proposed deaccession and disposal actions.
- Process and document in accordance with *MH* II.6: Deaccessioning, and NPS Personal Property Handbook #44 Section 8: Survey Procedures. For archeologically recovered materials, see 43 CFR 7: Protection of Archeological Resources and 36 CFR 79: Curation of Federally Owned or Administered Archeological Collections as amended May 2022.

Then, take action in accordance with Figure G.1: Munitions Retention or Deaccession Decision Matrix below.

If the munition…	*Then…*
Does not pose an explosion risk, *and* is within the park's Scope of Collections Statement,	Retain in the collection (do not deaccession).
Does not pose an explosion risk, *and* is outside the park's Scope of Collections Statement,	Deaccession by transfer, exchange, or conveyance in accordance with *MH* II.6: Deaccessioning.
Poses an explosion risk and is within the Scope of Collections Statement, *and* EOD unit or bomb squad *can* safely render inert,	Render inert and return to the collection.
Poses an explosion risk and is within the Scope of Collections Statement, *and* EOD unit or bomb squad *cannot* safely render inert,	Deaccession and dispose in accordance with *MH* II.6: Deaccessioning.
Does not pose an explosion risk *and* is outside the Scope of Collections Statement *and* has "no scientific, cultural, historic, educational, esthetic, or monetary value" in accordance with The Museum Properties Act of 1955 (54 USC 1025.102503(i)),	Deaccession by transfer, exchange, or conveyance in accordance with *MH* II.6: Deaccessioning.
Poses an explosion risk and is outside the Scope of Collections Statement *and* has "no scientific, cultural, historic, educational, esthetic, or monetary value" in accordance with The Museum Properties Act of 1955 (54 USC 1025.102503(i)),	Deaccession and dispose in accordance with *MH* II.6: Deaccessioning.

Figure G.1. Munitions Retention or Deaccession Decision Matrix

4. *Other deaccessioning considerations*

Firearms, small arms ammunition, artillery, and non-combat explosives evaluated and determined to be inert, unloaded, and/or solid metal are managed as regular museum objects. *If* proposed for deaccessioning, *then* determine if they may be deaccessioned under the categories authorized by law and in accordance with *MH* II.6: Deaccessioning. The park submits the Tool (Figure G.6) together with evaluation, status determination, and deaccession documents to the regional curator for review of the proposed action. Regions may convene a committee to consider the proposed actions. The committee should include a curator, archeologist, historian, and/or other subject matter experts as appropriate.

5. *Documentation*

Update the accession and catalog records and safety data after completing actions in this appendix. Retain completed copies of the following in the accession and/or catalog folder and park central files, and create an inerting file as needed.

- Completed Park Inerting Request Package(s) and Regional Panel Inerting Request Review (Figure G.8), including regional director concurrence.
- Museum Firearms Evaluation and Unloading Record (Figure G.9).
- Museum Small Arms Ammunition Evaluation and Mitigation Record (Figure G.10).
- Museum Munitions and Artillery Evaluation and Inerting Record (Figure G.11).
- EOD unit or accredited bomb squad-generated documents such as:
  - Inert certification by USMC EOD unit, with photographs and description of inerting procedures.
  - Written confirmation by DOD EOD unit or accredited bomb squad that a munition was evaluated as inert or solid metal.
  - Render safe procedures documentation by accredited bomb squad.
  - Memorandum of record documenting destruction by EOD unit or accredited bomb squad if a munition cannot be safely inerted. See Section E.I.9: Inert certification and other verification documents for required information.
- Loan agreements such as for inerting away from the park, if applicable, in accordance with *MH* II.5: Outgoing Loans.
- Deaccession and disposal documentation, in accordance with *MH* II.6: Deaccessioning.
- Include a brief description of updates in the CMR, Section IV "Noteworthy Accessions, Deaccessions, & Other."

B. Museum Standards, Laws, and Regulations

1. NPS Museum Standards for Firearms, Small Arms Ammunition, Munitions, Artillery, and Non-Combat Explosives

Implement NPS Museum Standards for firearms, small arms ammunition, munitions, artillery, and non-combat explosives in collections storage and on exhibit.

1. Firearms, small arms ammunition, munitions, artillery, and non-combat explosives must be stored in a secure and dedicated museum collections storage space separated from curatorial office, research/reference, and work areas.

2. A US Marine Corps or other Department of Defense (DOD) Explosive Ordnance Disposal (EOD) unit or accredited Public Safety Bomb Squad must evaluate military munitions and artillery to determine if live or loaded with live munitions. An experienced specialist must evaluate firearms and small arms ammunition to determine if loaded or live.

3. Firearms
   (a) Loaded firearms must be unloaded or cleared of ammunition. Modern firearms must be rendered inoperable before exhibiting. An experienced specialist must complete these processes.
   (b) Firearms must be stored in locking museum-quality cabinets or gun safes separately from other objects.
   (c) Unloaded and inoperable firearms must be exhibited in secure, locking exhibit cases.
   (d) Loaded firearms must not be accessioned into the collection.

4. Military Munitions and Artillery
   (a) Live military munitions must be rendered inert and loaded artillery must be unloaded if safe to do so. USMC EOD unit renders munitions inert if safe to do so and provides inert certification. DOD EOD unit or accredited Public Safety Bomb Squad determines final disposition of the munition in consultation with NPS park, zone, or regional safety manager and curator.
   (b) Staff must not handle, move, transport, or attempt to deactivate or dispose of live munitions or loaded artillery. Restrict access to live munitions and loaded artillery until final disposition.
   (c) Inert munitions must be exhibited in secure, locking exhibit cases.
   (d) Live munitions and loaded artillery must not be accessioned into the collection.
   (e) Munitions that have been rendered and certified inert, and that are no longer hazardous, and any artillery that has been unloaded, remain NPS museum property. They must be returned to the NPS museum collection as they are historic objects that must be conserved (preserved) in accordance with the Organic Act, 54 USC 100101 and 100701, and, in some cases, the National Historic Preservation Act, the Archaeological Resources Protection Act or park-specific statutes, regulations, and executive orders.

5. Small Arms Ammunition
   (a) An experienced specialist must determine if live small arms ammunition may be safely retained live in the collection or rendered inert.
   (b) Live small arms ammunition must be stored in a fire-resistant magazine and/or anti-static box in a locking cabinet, separate from firearms and other objects.
   (c) Inert small arms ammunition must be exhibited in secure, locking exhibit cases. Live small arms ammunition cannot be exhibited.

6. Non-Combat Explosives
   (a) Live non-combat explosives must be rendered inert if safe to do so. A trained and licensed certified blaster must complete this process. Certified blaster determines final disposition of the explosive in consultation with NPS park, zone, or regional safety manager and curator.

(b) NPS museum staff must not transport live non-combat explosives under any circumstance. Restrict access to live non-combat explosives until final disposition.
(c) Live lower-risk non-combat explosives such as fireworks and flares must be stored in a fire-resistant magazine and/or anti-static box in a locking cabinet.
(d) Inert non-combat explosives must be exhibited in secure, locking exhibit cases. Live non-combat explosives must not be exhibited.
(e) Live non-combat explosives must not be accessioned into the collection. Lower-risk non-combat explosives such as fireworks and flares may be only be accessioned live if stored in a fire-resistant magazine and/or anti-static box.

7. Append Emergency Response Steps: Suspected Live Munitions in the Collection to the Museum Collections Emergency Operations Plan (MCEOP) and park Emergency Operations Plan.

8. Museum firearms, small arms ammunition, and artillery must not be loaded and fired in public programs, Historic Weapons programs, and demonstrations. Historic Weapons Program materials, including black powder, must not be housed in or near collections storage and museum exhibits.

2. *Federal laws and regulations for firearms, small arms ammunition, munitions, and artillery*

The following federal laws and regulations are pertinent to the management of museum firearms, small arms ammunition, munitions, and artillery.

- NPS *Organic Act of 1916* (54 USC 100101) "The Secretary, acting through the Director of the National Park Service, shall promote and regulate the use of the National Park System by means and measures that conform to the fundamental purpose of the System units, which purpose is to conserve the scenery, natural and historic objects, and wild life in the System units and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

- *Museum Properties Act of 1955* (54 USC Chapter 1025: Museums), as amended.

- *Gun Control Act of 1968* (18 USC Chapter 44) (GCA): The GCA regulates transportation, shipping, receipt, possession, and importation of firearms and ammunition.

  Federal (NPS) or state-owned firearms and ammunition are *not* subject to the GCA (18 USC 925). However, the GCA *does apply* to NPS museum firearms and ammunition when transported or shipped to or from non-federal or non-state entities, such as a non-federal museum or private conservation organization.

- *National Firearms Act* (26 USC 5841 – 5849) (NFA): The NFA regulates registration of certain types of items (referred to as "NFA items" or "NFA firearms" in this appendix), such as rifles and shotguns with barrels of certain sizes, machine guns, silencers, and destructive devices (which also generally include artillery) into the National Firearms Registration and Transfer Record (NFRTR).

  Federally (NPS) -owned firearms are *exempt* from NFA registration requirements. NPS collections can therefore include both registered and unregistered NFA items.

- Occupational Safety and Health Administration (OSHA) Regulations *(29 CFR 1910 Section 109: Explosives and Blasting Agents)* regulate storage of hazardous munitions and non-combat explosives.

- International Fire Code, Chapter 56: *Explosives and Fireworks* and National Fire Protection Association code, *NFPA 495: Explosive Materials Code* includes guidance for storage of small arms ammunition, hazardous munitions and non-combat explosives.

- Department of Transportation (DOT) *Hazardous Materials Regulations* (HMR) (49 CFR 171 – 180) regulates packing, transportation, and shipment of hazardous materials, including small arms ammunition, munitions and non-combat explosives.

  The DOT HMR *does not* regulate firearms and artillery, which are instead regulated by the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF).

- *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) (42 USC 9601 *et seq.*) governs releases and threatened releases of hazardous substances into the environment. See also 42 USC 9601(14)(C): Definitions.

- Defense Environmental Restoration Program, *10 USC 2701(c)(1): Responsibility for Response Actions* governs DOD responsibility to respond to the release of hazardous substances or pollutants and contaminants under the jurisdiction of DOD.

- *Resource Conservation and Recovery Act* (RCRA) (42 USC 6901 *et seq.*) gives the Environmental Protection Agency (EPA) the authority to control hazardous waste, including regulation of its generation, transportation, treatment, storage, and disposal.

- *EPA Military Munitions Rule: Hazardous Waste Identification and Management; Explosives Emergencies; Manifest Exemption for Transport of Hazardous Waste on Right-of-Ways on Contiguous Properties* (MMR) (40 CFR 266, Subpart M) specifically regulates DOD's responsibilities for response when military munitions must be managed as a solid waste or hazardous waste.

- *43 CFR 7: Protection of Archeological Resources* and *36 CFR 79: Curation of Federally Owned or Administered Archeological Collections* as amended May 2022.

- *Sunken Military Craft Act of 2004* (H.R. 4200) and *Final Rule 32 CFR 767* regulates the preservation and protection of sunken military craft that lie within U.S. waters.

3. NPS Policy

NPS Personal Property Management Handbook #44.9.2: Museum Collection Firearms and Ammunition
"Museum collection firearms and ammunition are managed in accordance with the NPS *Museum Handbook*. Firearms and ammunition, acquired for museum exhibits and research purposes, are not intended for use as operational firearms."

NPS Safety Alert: Discarded Military Munitions and Unexploded Ordnance, dated February 10, 2022
"No NPS employee or volunteer is authorized to inert a munition under any circumstance."

C. Museum Firearms

Section I. Evaluating and Unloading Museum Firearms

Implement procedures in this section in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (2) and (3) (G.B.1.2-3).

1. How firearms are defined in this appendix

Firearms are weapons designed to expel a projectile by the action of explosive and expanding gasses. See 27 CFR 447.11: Importation of Arms, Ammunition, and Implements of War and 27 CFR 478.11: Commerce in Firearms and Ammunition for definitions.

Museum firearms may include handguns such as derringers, pistols and revolvers, long arms such as carbines, muskets, rifles, and shotguns, and other similar small-caliber weapons or "small arms" carried and operated by an individual. They may include *machine guns* as defined in 27 CFR 279.11: Machine Guns, Destructive Devices and Certain Other Firearms.

Antique firearms are defined in 27 CFR 478.11 as: "(1) **Any firearm** (including any firearm with a matchlock, flintlock, percussion cap, or similar type of ignition system) **manufactured in or before 1898**; [*emphasis added*]" or "(2) any **replica** [*emphasis added*]…" of such a firearm.

Note that while "antique firearms" generally refers to any firearm manufactured in or before 1898, there are certain exceptions under the GCA. These include exceptions cited in paragraph (3) of 27 CFR 47.8.11, *and* those "designed or redesigned for using …fixed ammunition" (26 USC 5845(g)).

Antique firearms are considered regular museum objects for shipping and transportation, and *are not* subject to the GCA (18 USC Chapter 44) and NFA (26 USC Chapter 53).

"*Modern*" firearms are those manufactured **after 1898**. Modern firearms owned (title) by private individuals and/or entities are subject to the GCA and NFA for shipping and transportation.

A firearm is composed of *component parts* such as a barrel, trigger set, stock, lock, bolt, and firing pin. These parts are not generally considered firearms when disassembled. The "*frames* or *receivers* of such weapons" as per 27 CFR 278.12: Definition of Frame or Receiver (including those of machine guns), usually carry a serial number. Frame and receivers *are* considered firearms and are subject to the GCA (18 USC (a)(3)(b)) and NFA, (26 USC 5845 (b)) even when not attached to other component parts. This includes welded, corroded, and permanently inoperable frames and receivers.

GCA and NFA definitions of firearms do not distinguish between handguns or long arms. The NFA's more limited scope generally targets firearms larger than handguns.

2. *Potential safety risks of firearms*

Firearms do not pose an explosion risk. If loaded firearms are fired, they pose a risk of injury or death from expelled ammunition. Unloaded firearms do not pose a safety risk. For safety purposes, ***treat every firearm as though it is loaded***, even those identified as unloaded.

Firearms bayonets pose an injury risk if handled incorrectly.

Note that any firearm, loaded or unloaded, proposed for deaccessioning is subject to *MH* II.6: Deaccessioning and the laws and regulations outlined in this appendix.

3. *Steps to evaluate and unload firearms*

The curator takes the following steps:

- Establish and maintain safety data on firearms, including review of legacy documentation of status.

- ***Visually*** confirm presence of the firearm, but ***do not*** handle or touch. Restrict access until evaluated by an experienced specialist. (See Section C.I.4 below).

- Arrange for an experienced specialist to evaluate, identify and unload loaded firearms, *and* render modern firearms inoperable if going on exhibit. This evaluation will involve handling by the specialist, and must take place in a safe location away from the collection, staff, and visitors.

  – If work is done away from the park, process the loan in accordance with Section C.III: Moving Museum Firearms for

Accession, Transfer and Loan and *MH* II.5: Outgoing Loans. Return firearms to the collection after work is completed.

  – Consult with a conservator to determine an appropriate course of action if the process of unloading is likely to damage a firearm.

- Document processes on the Museum Firearms Evaluation and Unloading Record (Figure G.9). Update accession and catalog records and safety data list.

- Tag firearms and store and number removed parts in accordance with Section C.II.2: Safe storage of firearms.

See *MH* II.5, Sections C.9: Must I require insurance for outgoing loans to U.S. Government agencies?, 10: Should I require non-federal borrowers to insure the objects in an outgoing loan?, and 11: Should I require non-NPS conservators to have insurance?

4. Experienced specialist for firearms

Only a specialist with considerable experience and expertise in museum firearms, or in modern, antique and/or "historic" firearms, is considered qualified to evaluate and unload firearms and render modern firearms inoperable. The individual may be an NPS or federal employee, non-federal museum staff, contractor, or member of a private organization. At this time, there is no certification of expertise for museum firearms. Consult with a conservator if the firearm is not in good condition.

Consult with the regional curator and other parks and museums with firearms collections to locate a qualified experienced specialist such as:

- *Curator* with specialized knowledge and experience in museum firearms.

- *Park or regional Chief Ranger*, if a commissioned officer, or *park law enforcement* is required to complete NPS firearms qualification courses for operational firearms in accordance with RM-9.8: Firearms Training and Qualifications, and may be able to unload and render inoperable certain modern museum firearms.

- *Park, zone, or regional safety manager*, if a commissioned officer, may be able to unload and render inoperable certain modern museum firearms.

- *NPS Historic Weapons Program Regional Inspectors* are certified to identify and safely handle reproduction 18th, 19th, and 20th-century weapons, and manage black powder.

- *Armorers and gunsmiths*, defined in 27 CFR 478.11 as persons who engage in "trade or business with the principal objective of livelihood and profit," are licensed by ATF to engage in the firearms trade.

Note that the experienced specialist for firearms is likely to also be experienced working with small arms ammunition.

See Sections C.III.2: Licensing and D.I.4: Experienced specialist evaluation of small arms ammunition.

5. *Museum Firearms Evaluation and Unloading Record*

The Museum Firearms Evaluation and Unloading Record (Figure G.9) documents the processes of evaluating and unloading firearms. The curator completes the Record in collaboration with the experienced specialist, park or regional Chief Ranger, and park, zone, or regional safety manager. Include a completed copy in the accession and/or catalog folder and update the catalog record. File in the park central and museum files and provide a copy to the regional curator.

Section II. Managing Firearms in the Collection

1. *Safe handling of firearms*

Proper handling of firearms reinforces safe habits and reduces risk of negligent discharge, injury or death. Practice safe handling in accordance with Chapter 6: Handling, Packing, and Shipping and:

- **Practice safe handling *at all times*:**
  - treat *every* firearm as though it is loaded, even those identified as unloaded
  - *always* keep firearm muzzle pointed in a safe direction, away from individuals or objects
  - always keep finger *off* the trigger and outside the trigger guard
- Always wear nitrile gloves when working with firearms.
- Ensure adequate space is available *before* moving. Pad surface of cart or container to prevent shifting.
- Handle one firearm at a time. Hold with both hands.
- Provide support and cushion when moving.
- *Do not* hold a long arm solely by the stock wrist, as this may cause the stock to separate from the barrel.
- *Never* handle or hold a firearm by an attached bayonet.

See 29 CFR 1910.133: Eye and face protection and ATF Learn About Firearms Safety and Security website.

2. *Safe storage of firearms*

Store firearms in a locking, fire-resistant gun safe or cabinet in a secure, dedicated collections storage space separated from curatorial office, research/reference, and work areas in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (1) (G.B.1.1):

- Store *unloaded* firearms separately from other objects and:

- tag firearms and label cabinet "Unloaded Firearm(s)" for ease of identification and to reduce handling
- number removed parts (such as those removed when rendering inert) in accordance with *MH* II: Museum Records

- Store *long arms* such as muskets and rifles vertically or horizontally, depending on condition. Support and secure with foam-padded mounts to prevent tipping.

- Cavity pack or support *handguns* with museum-quality materials to prevent movement in drawers.

- Store firearms separately from leather cases, holsters, slings and other accoutrements, and bayonets. Number and tag each object in accordance with *MH* II Appendix J: Marking.

- Work with the experienced specialist to identify *loaded* firearms whose ammunition *cannot* be removed due to corrosion or damage. Store securely in a locking cabinet or gun safe and:

  - do not comingle if storing loaded firearms in the same cabinet or gun safe as unloaded firearms
  - tag loaded firearms and label the gun safe "Loaded Firearms" for ease of identification and to reduce handling
  - consult a conservator for treatment options

- To determine appropriate storage for firearms containing mixed materials such as inlaid bone or ivory, precious metals, or paint embellishments, see Chapter 4: Museum Collections Environment and Appendix N: Curatorial Care of Wooden Objects. For further information, consult with the regional curator.

3. Exhibiting firearms

Do not exhibit loaded firearms. Firearms can ***only*** be exhibited after evaluation and unloading. Modern firearms must be rendered inoperable before being exhibited.

Exhibit firearms in secure cases with hardware such as keyed locks and security screws that are fully functional and checked regularly. Display using secure mounts. Photograph rare historic firearms for research and education, and make available online.

4. Rendering modern firearms inoperable for exhibit

Modern (post-1898) firearms must be *rendered inoperable* before being exhibited, in addition to unloading. An experienced specialist ***must*** conduct this process.

Only use reversible procedures, such as removing component parts such as the firing pin to make the weapon incapable of firing. *Do not* weld cylinders shut, destroy the trigger mechanism, or make any other permanent and irreversible alteration to the firearm. Reassemble the firearm when returning to storage. In rare cases, rendering a modern firearm inoperable will irreparably damage or destroy the firearm. In these instances, *do not* exhibit the firearm or render it inoperable, and retain in storage.

5. Controlled property inventory of museum firearms

Museum firearms, including stripped (disassembled) frames and receivers, ***must*** be designated as controlled property and subject to an annual 100% inventory in accordance with *MH* II.4: Inventory and Other Special Instructions. Other loose (disassembled) component parts such as bolts or locks are not subject to controlled property requirements, as they are not considered firearms under the GCA and NFA.

6. Prohibition on firing museum firearms and ammunition in demonstrations

Museum firearms and ammunition ***must not*** be loaded and fired in programs and demonstrations such as the Historic Weapons Program, in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (8) (G.B.1.8) and DO 6.8.9: Museum Objects.

Section III. Movement of Museum Firearms for Accession, Transfer and Loan

In this appendix, "move" or "movement" of firearms encompasses physical movement for various purposes. It includes *receiving*, such as accession or loan. Movement may be completed via *transportation by NPS staff* or *mailing* or *shipping by a third party*. It is regulated by variables such as manufacture date, title (ownership), licensing of entities, and firearm registration requirements.

Consult with the local ATF field office to determine applicable federal, state, and local laws and regulations that may apply to movement of firearms. ATF can advise on whether the GCA and/or NFA applies to a specific firearm or disassembled parts. For example, a privately-owned World War I machinegun is subject to the GCA *and* the NFA, while a privately-owned pistol from the same era is *only* subject to the GCA.

See Local ATF Offices listing and ATF Firearms Industry Programs Branch (FIPB).

1. Movement of museum firearms

Antique firearms can be "moved" as regular museum objects, irrespective of ownership.

NPS, as a federal agency, can "move" *modern firearms* to and from federal agencies, state agencies, and private organizations (museums and conservation organizations), within state or out of state, for museum purposes.

Movement of modern firearms between federal agencies is *exempt* from GCA and NFA licensing and registration requirements, but is subject to certain other conditions. Follow all applicable federal, state, and local laws regarding movement of firearms.

See Figure G.2: Movement of Modern Firearms.

Movement:	***If*** a modern firearm is subject to the GCA…	***If*** a modern firearm is subject to the GCA *and* NFA (is a "NFA firearm")…
Can NPS send to a **federal agency** (NPS or other federal agency)?	*Yes* Neither federal agency requires a Federal Firearms License. (18 USC 925(a)(1))	*Yes* Registration of firearm in NFRTR is not required for federally owned firearms. (26 USC 5852(a))
Can NPS receive from a **federal agency** (NPS or other federal agency)?	*Yes* Neither federal agency requires a Federal Firearms License. (18 USC 925(a)(1))	*Yes* Registration of firearm in NFRTR is not required for federally owned firearms. (26 USC 5852(a))
Can NPS send to a **state agency**?	*Yes* Neither federal nor state agency requires a Federal Firearms License. (18 USC 925(a)(1))	*Yes*, if NPS-owned firearm is registered in NFRTR. "Only previously registered firearms may be lawfully transferred*." (ATF NFA Handbook 9.2) *If loaned*, state agency does not need to submit documentation to ATF. *If title is transferred*, state agency needs to submit documentation to ATF and a copy to NPS. (ATF NFA Handbook Section 9.4) *No*, if NPS-owned firearm is unregistered. Firearm cannot be loaned. If conservation is needed, the work must be conducted at the park. (See Section C.III.3: Registration in the National Firearms Registration and Transfer Record) (ATF NFA Handbook Section 9.2) *ATF defines "transfer" as "selling, assigning, pledging, leasing, loaning, giving away, or otherwise disposing of" (26 U.S.C. 5845(j)). NPS defines "transfer" as a "transfer [of] title and control" to another park or federal agency (MH II.2.L.1: What is a transfer?).
Can NPS receive from a **state agency**?	*Yes* Neither federal nor state agency requires a Federal Firearms License. (18 USC 925(a)(1))	*Yes*, if firearm is registered in NFRTR *and* sender submits documentation to ATF and a copy to NPS. If firearm is unregistered, state agency contacts ATF. (ATF NFA Handbook Section 9.4.3)
Can NPS send to a **private organization** (such as for conservation)?	*Yes* Private organization does not need Federal Firearms License, but it is recommended. (18 USC 923)	*Yes*, if NPS-owned firearm is registered in NFRTR. "Only previously registered firearms may be lawfully transferred*." (ATF NFA Handbook 9.2) *If loaned*, private organization does not need to submit documentation to ATF. *If title is transferred*, private organization needs to submit documentation to ATF and a copy to NPS. (ATF NFA Handbook Sections 9.4, 9.5.1, and 9.8) *No*, if NPS-owned firearm is unregistered. Per 26 U.S.C. 5845(j), unregistered NFA firearms cannot be transferred or loaned. If conservation is needed, the work must be conducted at the park. (See Section C.III.3: Registration in the National Firearms Registration and Transfer Record) (ATF NFA Handbook Section 9.2)

Can NPS receive from a **private organization**?	*Yes* Private organization does not need Federal Firearms License, but it is recommended. May be subject to applicable state and/or local licensing requirements. Contact local ATF field office for information.	*Yes* Sender must first submit documentation to ATF and copy to NPS. (ATF NFA Handbook Section 12.1)
Can NPS receive from a **private individual**?	*Yes* Private individual does not need Federal Firearms License. May be subject to applicable state and/or local licensing requirements. Contact local ATF field office for information.	*Yes* Sender must first submit documentation to ATF and copy to NPS. (ATF NFA Handbook Section 12.1)
Can NPS send to a **private individual**?	*Yes* if title is transferred. Private individual does not need Federal Firearms License. *No if loaned*, as NPS cannot make loans of any museum object to a private individual. (*MH* II.5.B.3)	*Yes,* if title is transferred. Private individual submits documentation to ATF and a copy to NPS. (ATF NFA Handbook Section 12.1) *No if loaned*, as NPS cannot make loans of any museum object to a private individual. (*MH* II.5.B.3)

Figure G.2. Movement of Modern Firearms

See Sections C.III.2: Licensing and 3: Registration in the National Firearms Registration and Transfer Record for additional information.

Consult with the local ATF field office if firearms are to be moved internationally.

***Note*:** NPS *cannot* send or receive any firearm from out of state that cannot be detected by metal detectors or X-ray detectors, as described in 18 USC 922(p). NPS cannot transfer firearms to an individual convicted of a misdemeanor crime of domestic violence as described in 18 USC 922(d)(9).

2. *Licensing*

ATF uses several types of Federal Firearms Licenses (FFLs) to regulate commerce in firearms, particularly for interstate commerce. Persons "engaged in the business of manufacturing, importing and/or dealing in firearms" must be licensed by ATF using an appropriate FFL. NPS should only make loans of firearms to private organizations such as *conservation labs* that have an appropriate FFL.

Some *private museums* with large firearms collections may maintain FFLs, as they are "engaged in the business" of firearms. If NPS makes a loan to a private museum that does not have a FFL, the museum must meet NPS outgoing loan conditions and all applicable laws and regulations. *Private individuals* (e.g., individual gun owners not in the firearms business) generally do not require FFLs. State and local firearms licensing requirements may vary.

NPS, other *federal entities,* and *state entities* are not "engaged in the business" of firearms and *do not* require a Federal Firearms License.

When a modern firearm subject to the GCA owned by a private organization or individual moves to the NPS, the private organization or individual must provide copies of appropriate federal, state, and/or local licenses to NPS for inclusion in the accession and/or catalog folder.

See ATF Types of Federal Firearms Licenses web page.

3. Registration in the National Firearms Registration and Transfer Record

The National Firearms Registration and Transfer Record (NFRTR) is "the central registry of all NFA firearms in the U.S. which are not in the possession or under the control of the U.S. Government. The registry includes (1) the identification of the firearm, (2) date of registration, and (3) identification and address of the person entitled to possession of the firearm (the person to whom the firearm is registered)" (ATF National Firearms Act Handbook, Section 3.1: The National Firearms Registration and Transfer Record).

NPS-owned NFA firearms *do not* need to have been registered in the NFRTR. For additional information, contact the local ATF field office.

NPS-owned (or other federally owned) NFA firearms

- NPS can "move" any NPS-owned NFA firearm, whether registered in the NFRTR or unregistered, to and/or from another NPS unit or another federal agency. For example, a park can send an unregistered NFA firearm to an NPS center for conservation work.

- When a private conservation organization or state agency returns a loan of an NPS-owned *registered* NFA firearm to NPS, the organization needs to complete ATF Form 5: Application for Tax Exempt Transfer and Registration of Firearm. Work with the contracting office to include this requirement in the Scope of Work.

- NPS *cannot* "move" *unregistered* NPS-owned NFA firearms to a non-federal entity (state agency or private organization). NPS museum firearms that have manufacturer's or importer's serial number removed, obliterated, or altered are subject to the same requirement (26 USC 5842).

  When NPS contracts with a private conservation organization or state agency to work on unregistered NFA firearms owned by NPS, work must be conducted at the NPS park or center, with an NPS employee present. The unregistered firearm must be housed in secure locking storage overnight if work exceeds one day. ATF Form 5: Application for Tax Exempt Transfer and Registration of Firearm is *not* required, as the firearm will not be "moved."

Non-federally owned firearms (private individuals and entities, and state and local governmental agencies)

- When offering an unregistered NFA item to NPS, the potential source of accession needs to consult with ATF before the offer can be considered. For NPS to receive (incoming loan or accession) an NFA item owned by a non-federal entity, the non-federal party must submit the forms listed below to ATF for approval and provide a copy of each approved form to NPS.

  – NFRTR proof of registration (ATF NFA Handbook Section 12.1: Maintaining proof of registration).
  – Application for Tax Exempt Transfer and Registration of Firearm, ATF Form 5 (5320.5).
  – Application to Transport Interstate or to Temporarily Export Certain NFA Firearms, ATF Form 5320.20, for interstate transport.
  – Owner needs to document each change of address as described in ATF Form 5: Application for Tax Exempt Transfer and Registration of Firearm. If the registered firearm is to be loaned to NPS, the owner must submit these forms to ATF *once* before sending to NPS, and then *a second time* when the loan is returned to the owner. If the registered firearm is donated to NPS, the owner must submit these forms to ATF *only once*.

- Work with park or local law enforcement to verify serial numbers of modern firearms against the National Crime Information Center Stolen Gun Database *before* accessioning.

See ATF National Firearms Act Division web page.

4. Safe transportation of firearms by NPS staff

Pack and ship museum firearms safely in accordance with Chapter 6: Handling, Packing, and Shipping.

NPS, as a federal agency, is exempt from most GCA provisions. ***For safety reasons***, NPS museum staff must transport firearms in accordance with 18 USC 926A: Interstate transportation of firearms. The firearm must be unloaded, and the firearm and ammunition must not be readily accessible from the passenger compartment of the vehicle. If the vehicle does not have a compartment separate from the driver's compartment, then the firearms or ammunition must be placed in a locked container other than the glove compartment or console.

5. Mailing or shipping unloaded firearms by a third party

Various commercial carriers have different requirements to mail or ship unloaded firearms. See USPS Publication 52.4.43: Firearms, United Parcel Service of America (UPS™) How to Ship Firearms or Ammunition, and FedEx How to Ship Firearms.

Do not mail or ship loaded firearms.

D. Museum Small Arms Ammunition and Mitigating Risk

Section I. Evaluating Small Arms Ammunition

Implement procedures in this section in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (2) and (5) (G.B.1.2, 5).

1. How small arms ammunition is defined in this appendix

Small arms ammunition in this appendix (referred to as "ammunition" in this section) includes bullets, cartridges and casings, shot, slug, and other ammunition such as Minié balls designed to be fired from the chamber of a firearm at high velocity. They may be present in cartridge boxes, bandeliers, and other containers, and may be intact or fired ("spent"). Note that commercial and military definitions of ammunition differ.

See 27 CFR 555.11: Definitions and 32 CFR 179: Definitions.

Intact cartridges or "rounds" of ammunition are made of paper, metal, or plastic. They contain a *bullet* (or "projectile"), usually made of metal-coated or solid lead. When the *primer* is struck by the firearm's firing pin, it ignites the black powder, smokeless powder, or other explosive propellant contained within the casing, causing the bullet to eject (see Figure G.3: Small Arms Ammunition Components). Certain types of antique ammunition such as musket balls were usually made of solid lead.

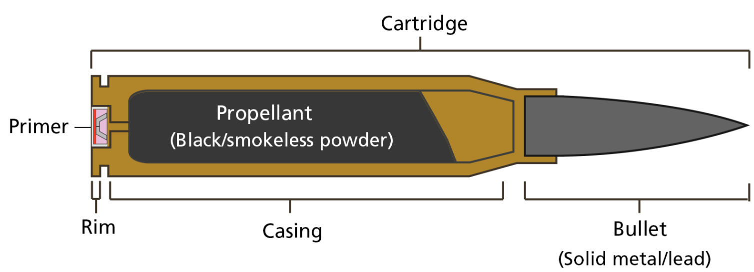

Figure G.3. Small Arms Ammunition Components

The components of an intact round of ammunition, such as black powder, may be used in scientific analyses to provide information on materials and compounds, processes and techniques, metallurgy, and others. For safety reasons, do not conduct chemical analysis on unstable and/or degrading black powder or similar components.

Modern (post-1898) ammunition over 0.50 caliber is generally regarded as a munition rather than small arms ammunition, based on the amount of explosive material and potential presence of a secondary explosive.

Antique (pre-1898) ammunition does not have a clear 0.50 caliber cutoff. For example, Civil War-era 0.69 caliber Springfield Model 1842 musket rounds do not pose an explosion risk despite their large size.

In *centerfire* ("fixed") ammunition, the primer, percussion cap, or other ignition source is separate from the cartridge or casing.

In *rimfire* ammunition, the ignition source is part of the casing.

Powder horns and other similar *containers* such as powder kegs that may contain black powder may be present in Revolutionary or Civil War collections.

Work with the experienced specialist, park, zone or regional safety manager and park law enforcement to determine if small arms ammunition and accessories such as powder horns containing black powder pose an explosion risk, and determine appropriate action(s).

2. *Potential safety risks of small arms ammunition*

Small arms ammunition does not pose a risk of self-detonation. If *loaded in and fired from* a firearm, it poses a risk of injury or death. Live ammunition stored by itself *outside a firearm and* directly exposed to fire will likely produce a loud "popping" sound and project at low velocity. This poses a *low safety risk* as well as a *fire risk*, both of which are mitigated by storage in a locking fire-resistant magazine or anti-static box.

Large quantities of small arms ammunition (net explosive weight over 50 pounds) pose an elevated risk due to the large quantity of explosive material present.
See Section D.II.2: Safe storage of small arms ammunition.

The following may pose additional risks:

- *Antique* (pre-1898) ammunition contains black powder and other compounds with the potential to combust if exposed to a spark or flame. Black powder in ammunition that has become damp and caked, or acclimated to high humidity or a submerged environment, poses an elevated ignition risk and may become volatile as it dries or is exposed to fluctuating humidity.

- *Modern* (post-1898) ammunition containing smokeless powder does not present an explosion risk. It may discharge at low velocity if exposed to fire or percussion if the primer is directly contacted.

- *Unstable* ammunition (antique or modern) may be corroding or leaking powder or fluid, and may pose a risk of injury when handled.

- *Primers* found separately from cartridges may combust if struck directly or exposed to fire or spark. The resulting heat and combustion may pose a fire hazard to adjacent objects.

- *Powder horns*, *powder kegs*, and other similar *containers* were not designed to explode. If these objects still contain black powder, they pose a combustion risk if exposed to fire or sparks.

- *Lead* and other toxic metals may be present in ammunition, even if inert or solid metal. Lead can corrode rapidly, forming a white powder that may be inhaled, ingested, or trapped in clothing. Consult with a conservator to determine an appropriate course of action.

See Chapter 11, Section E: Hazardous Objects in Collections and Appendix O: Curatorial Care of Metal Objects. See also NPS Submerged Resources Center, NFPA 495 Chapter 14: Small Arms Ammunition and Primers, Smokeless Propellants, and Black Powder Propellants, and Facts About Sporting Ammunition Fires.

3. *Steps to evaluate and mitigate small arms ammunition risk*

The curator takes the following steps:

- Establish and maintain safety data on small arms ammunition, including review of legacy documentation of status.

- Conduct an initial ***visual*** inspection of the ammunition. Note condition and photograph changes such as leaking powder or fluid or active corrosion.

- Limit access to ammunition until evaluated by the experienced specialist.

- Arrange for evaluation and appropriate action by an experienced specialist (See Section D.I.4 below). This process may involve handling by the specialist, and must be done in a safe location away from the collection, staff, and visitors. If work is to be done away from the park, process the loan in accordance with *MH* II.5: Outgoing Loans.

- *Experienced specialist evaluates* ammunition to identify status (live and stable, live and unstable, inert, or solid metal) and level of risk.

  Specialist determines *if safe to take appropriate action(s)* based on level of risk and potential to irreversibly damage the object, in consultation with the curator, park or regional Chief Ranger, and park, zone, or regional safety manager. These include:

  – Retain inert or solid metal ammunition.

  or

  – Retain stable live ammunition in a locking fire-resistant magazine or anti-static box (See Section D.II.2: Safe storage of small arms ammunition).

  or

  – Render unstable live ammunition inert *if* it will not cause irreversible damage, and return to collection.

  or

  – Deaccession and dispose of ammunition that *cannot* safely be retained in accordance with *MH* II.6: Deaccessioning, and arrange for safe disposal.

- *Curator* takes the following steps after specialist determination:
  - Documents processes using the Museum Small Arms Ammunition Evaluation and Mitigation Record (Figure G.10) and updates accession and catalog records.
  - Inspects regularly and includes an inspection schedule in the ICMS Condition and Maintenance Cycle field.
  - Manage small arms ammunition that has been evaluated and determined to be *inert* or *solid metal* as a regular museum object.
  - Manage small arms ammunition evaluated and determined to be *live and stable*, and not a life safety risk in accordance with NPS Museum Standard for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (5) (G.B.1.5).

4. *Experienced specialist evaluation of small arms ammunition*

Only a specialist with considerable experience in safe handling and identification of antique ("historic") and modern small arms ammunition is considered qualified to evaluate museum small arms ammunition, identify status, and determine if live ammunition may be safely retained in the collection or rendered inert.

Work with the regional curator, park, zone or regional safety manager, park or regional Chief Ranger, and local ATF field office to identify an appropriate specialist for small arms ammunition.

See also Section C.I.4: Experienced specialist for firearms.

5. *Rendering small arms ammunition inert*

In rare cases, the experienced specialist may determine that a round of ammunition is too unstable to retain live, with inerting the only safe option for retention. This procedure can be dangerous and *must only* be done by the experienced specialist in a safe location away from the collection, staff, and visitors.

Return the remaining inert casing and bullet or projectile to the collection, as they are not an explosion or fire risk. Dispose of the removed powder and/or propellants in accordance with *MH* II.6: Deaccessioning.

Small arms ammunition must be rendered inert *before* it can be exhibited. Inerting involves *permanently and wholly* removing explosive components such as black powder and primer. As this process is irreversible and may damage or destroy certain historic ammunition, inert reproductions may be exhibited instead.

See *MH* III.1.C.5: What do I need to know about consumptive use?

6. NPS Museum Small Arms Ammunition Evaluation and Mitigation Record

The Museum Small Arms Ammunition Evaluation and Mitigation Record (Figure G.10) documents the processes of evaluating small arms ammunition and determining if it can be safely retained live in storage or rendered inert. The curator completes the Record in collaboration with the experienced specialist, park or regional Chief Ranger, and park, zone, or regional safety manager. Include a completed copy in the accession and/or catalog folder and update the catalog record. File in the park central and museum files and provide a copy to the regional curator.

Section II. Managing Small Arms Ammunition in the Collection

1. Safe handling of small arms ammunition

Implement safe handling practices in accordance with Chapter 6: Handling, Packing, and Shipping, including:

- Restrict handling and movement of small arms ammunition and components such as black powder that are sensitive to static electricity.

- Always wear nitrile gloves when working with small arms ammunition.

- Check for new signs of active deterioration *before* handling. If degradation or corrosion is noted, consult with the park, zone, or regional safety manager, regional curator, and a conservator. *Do not* handle visibly degrading or corroding small arms ammunition. Photograph changes in condition.

- Handle one at a time. Support using both hands.

- Cushion to prevent shifting when moving.

- Wash hands thoroughly after handling ammunition containing lead or other toxic metals. Use decontamination soap designed to remove heavy metal residues.

See NIOSH workplace safety and health site for lead.

2. Safe storage of small arms ammunition

Safely and securely store small arms ammunition in a dedicated museum collections storage space separated from curatorial office, research/reference, and work areas in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (1) (G.B.1.1).

Inert small arms ammunition

- Store inert and solid metal ammunition separately from firearms, in locking museum-quality containers and cabinets.

- Store empty shells and casings and solid metal projectiles, individually or in groups, in boxes or polyethylene bags. Wrap individually to prevent damage if multiples are housed together. Cavity pack or support to prevent shifting in cabinet drawers.

Live small arms ammunition

If the specialist determines that live ammunition is stable and may be safely retained, then:

- Store live small arms ammunition, including separate primers, in a secure, locking fire-resistant magazine or anti-static box within a locking cabinet *or* a separate Type II magazine in a stable environment, depending on quantity, in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (5) (G.B.1.5). Select a magazine in consultation with the park, zone or regional safety manager, park structural fire coordinator and/or regional structural fire manager (marshal), and park law enforcement. It must meet construction, placement, and placarding specifications provided in:

  – International Fire Code Section 5604: Explosive Materials Storage and Handling
  – NFPA 495.9: Aboveground Storage of Explosive Materials, 14: Small Arms Ammunition and Primers, Smokeless Propellants, and Black Powder Propellants, and Annex D: Magazine Construction
  – OSHA 1910.109 (c)(4): Construction of Class II magazines and (j)(2): Small Arms Ammunition
  See ATF P 5400.17: Type II Indoor Magazines (chart).

- Keep the magazine away from sources of static electricity or sparks.

- Label "Live Small Arms Ammunition."

- Identify location of live ammunition during fire department tour of collections storage.
  See Chapter 9.D.4: What special considerations should be addressed with the local fire department?

- If stored in the same magazine, separate live ammunition containing smokeless powder from those containing black powder. *Do not* comingle in the same tray, bag, or box within the magazine.

- ***Do not*** store black powder and other materials used by the Historic Weapons Program in or near any space housing museum collections in accordance with NPS Museum Standard for Firearms, Small Arms Ammunition, Munitions, Artillery, and Non-Combat Explosives (8) (G.B.1.8).

Net explosive weight

Storage regulations for ammunition containing black powder and other explosive materials apply *only* to the *net explosive weight* of explosive material, *not* the weight of the projectile and casing. For example, a live "Brown Bess" musket ball weighs about 32 grams, but only has about 8 grams of black powder.

In accordance with International Fire Code 5604.5.1.3: Quantity limit, "Not more than 50 pounds (23kg) of explosives or explosive materials shall be stored within an indoor magazine." The net explosive weight of black powder in most park collections is likely below 50 pounds. If over 50 pounds, consult with the regional curator, regional safety manager, and regional structural fire manager (marshal) to determine appropriate storage, such as a dedicated munitions safe *or* consolidation at a regional center.

See Chapter 7: Museum Collections Storage, Chapter 9: Museum Fire Protection, Appendix O: Curatorial Care of Metal Objects, NFPA 495: Explosive Materials Code, and OSHA 1910.109 (c): Storage of explosives.

3. *Exhibiting small arms ammunition*

Only exhibit small arms ammunition that has been evaluated and rendered inert. Exhibit in secure cases with hardware such as keyed locks and security screws that are fully functional and checked regularly. Display using secure mounts.

Do not exhibit live ammunition or corroding inert small arms ammunition that may present a lead hazard. Exhibit inert small arms ammunition or inert reproductions in place of live or corroding ammunition. Retain rare live historic ammunition in storage, photograph for research and education, and make available online.

4. *Packing and transporting or shipping small arms ammunition*

Inert small arms ammunition may be packed, shipped, and transported as a regular museum object.

Live small arms ammunition may be shipped within the contiguous U.S. by certain commercial carriers, subject to limitations such as size and weight in accordance with the DOT HMR. DOT classifies live small arms ammunition as a Class 1 explosive material for purposes of shipment and transportation. See UPS™ How to Ship Ammunition webpage, and consult with the carrier's Dangerous Goods specialist for specific information. The US Postal Service does not permit shipment of live small arms ammunition.

Note that Federal employees are exempt from the provisions of the HMR when transporting hazardous materials in the course of non-commercial, official duties (49 CFR 171.1(d)(5)). However, ***for safety reasons***, museum staff must follow the HMR and requirements in NFPA 495.14: Small Arms Ammunition and Primers, Smokeless Propellants, and Black Powder Propellants when shipping or transporting live ammunition.

See 49 CFR 173.60: General packaging requirements for explosives, 173.63: Packaging exceptions, and 173.7: Government operations and materials. See also DOT The Facts on Small Arms-Related Hazmat.

E. Museum Munitions

Munitions may be present in collections storage, on exhibit, encountered in the park during archeological excavation, construction, or other approved ground disturbing activities, or brought into a park building by visitors. Advanced planning is essential to protect staff and visitors, and avoid confusion, delay, injury and loss of life or collections.

Section I. Evaluating and Inerting Munitions

Implement procedures in this section in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (2) and (4) (G.B.1.2, 4).

1. How munitions are defined in this appendix

Munitions in this appendix are defined as explosive devices designed to be fired (projected or launched), dropped, placed, or thrown for military purposes (US Army FM 4-30.51: Unexploded Ordnance (UXO) Procedures). They include artillery shells, bombs, canisters, cannonballs, grenades, land mines, mortars, rockets, shells, torpedoes, and similar objects. Munitions vary in size, shape, and appearance depending on manufacture date, location, and purpose. Munitions may be inert or live.

Munitions and Explosives of Concern (MECs) are live, hazardous military munitions that ***pose the highest level of risk***. They include:

- *Unexploded Ordnance (UXO)* (10 USC 101(e)(5)) is defined as "military munitions that have been primed, fused, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard or potential hazard…and remain unexploded either by malfunction, design, or other cause…" (PL 106-65.3031 (c)(5)(A)). UXO, whether intact or in fragments, presents a potential hazard.

- *Discarded Military Munitions (DMM)* (10 USC 2710(e)(2)) are "military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations" (10 USC 2710(e)(3)).

- *Munitions constituents* such as mercury fulminate are "[a]ny materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions" (10 USC 2710(e)(4)).

MECs will generally be referred to as "live munitions" in this appendix.

Munitions in the collection may be rare, unique, novel, or limited in production (such as Whitworth, Armstrong or Confederate Mullane projectiles). Make every effort to retain these objects *if safe to do so*, as they are important for education, interpretation, and research. Analysis of these objects provides information on materials and compounds, processes and techniques, metallurgy, and others.

Other types of *lower-risk military munitions* and *components* may also be present in collections. These include artillery fuses, including paper fuses, and sources of ignition such as percussion caps or friction primers, described in Section E.I.2 below.

Rendering inert involves removing all explosive compounds from a live munition so that it is no longer an explosion risk. The inerting process is ***extremely dangerous*** and must ***never*** be attempted by NPS staff.

Render safe procedures (RSPs) are defined as those procedures that prevent or mitigate functioning of a hazardous device until final disposition of the munition is determined. These involve interrupting or separating munitions components ("disarming" or "defusing") to prevent an explosion and make a munition safe to transport.

Note: RSPs are *not* considered inerting, and documentation of a RSP is *not* considered an inert certification. A "rendered safe" munition still must be rendered wholly inert to be retained in the museum collection.

See Section E.I.10: Who must transport or ship live munitions.

2. *Potential safety risks of munitions and when an emergency response is needed*

Munitions were designed to explode and maim or kill, and destroy structures. ***Restrict access to all munitions until evaluated and until final disposition.***

Live munitions (MECs) present the highest safety risk due to their high level of explosion risk, particularly if unstable. A USMC or other DOD EOD unit or bomb squad MUST determine if munitions are solid, live, or inert.

Do not accession or exhibit live munitions.

Identify the general risk levels for the different types of munitions in consultation with the park, zone, and regional safety manager and park or regional Chief Ranger, and arrange for evaluation and determination of safe and appropriate response(s). These range from evacuating the building and following Emergency Response Steps: Suspected Live Munitions in the Collection, to restricting access to the collections, to contacting a DOD (USMC or other) EOD unit to schedule an evaluation and transport live munitions away from the building for inerting.

Implement ***emergency response actions*** or a ***scheduled evaluation*** depending on risk level. Always err on the side of safety.

Emergency response to high-risk munitions

Live munitions contain hazardous chemicals that may become unstable and pose an ***imminent explosion risk***. Evidence of instability includes new cracks, bulges or dents; leaking fluid or powder; corrosion, smoking, odor, ticking; or noting a missing grenade pin or exposed fuse in a cannonball or shell.

If these conditions are observed, evacuate the building, ***immediately call 911, and implement Emergency Response Steps***: Suspected Live Munitions in the Collection (Figure G.14). Do not wait to arrange for a scheduled evaluation.

Other conditions of concern

Consult with the park, zone, or regional safety manager and park or regional Chief Ranger to determine appropriate response if a potentially live munition is subjected to any of the following:

- *Moved* and subjected to vibration or shock.
- *Exposed* to fire or sparks, or other emergency incidents such as a hurricane.
- *Environmental changes* such as substantial changes in moisture (such as wet black powder that has begun to dry and become unstable).

See Section E.III: Emergency Response for Suspected Live Munitions. See also Chapter 10.A.7: What is the Incident Command System (ICS)? and Figure 10.8: Explosion Emergency Response Steps.

Scheduled response for other munitions

For *all other munitions*, schedule an evaluation of status (live, solid metal or inert) by a DOD EOD unit or accredited bomb squad, as described in Section E.I.4: Steps to evaluate and render munitions inert. Restrict access to munitions until evaluated.

The following pose a ***lower safety risk*** than MECs:

- *Artillery fuses* (metal or paper) that contain black powder may be present in Civil War or earlier collections. The fuse was designed to burn at a steady rate when lit, causing an artillery projectile to explode. When outside artillery tubes, they are *not* inherently explosive. However, *they pose a safety risk if exposed to fire*.

  Note that paper artillery fuses *must* be housed in a stable environment (RH and temperature) to prevent the black powder from becoming unstable, as they cannot be rendered inert without being destroyed.

- *Ignition sources* such as percussion caps, friction primers, Bormann fuzes, and similar objects containing an explosive compound filling, chemical, or gas are *not* inherently explosive if found separately from munitions. They *only* pose a high risk if found inside intact live munitions and exposed to fire or sparks, as they can cause the munition to detonate.

Note that EOD units and bomb squads will generally *not* respond to isolated artillery fuses or ignition sources. Work with an experienced small arms ammunition specialist to determine appropriate action(s) for these objects.

Solid shot cannonballs (made of solid metal) and *canister rounds* filled with metal shot were designed to be ejected from artillery. They may be visually similar to live munitions. However, they do not contain explosive materials, *do not pose an explosion risk*, and are to be retained in the collection. The DOD EOD unit or bomb squad will identify these objects during evaluation.

See Sections D.I.4: Experienced specialist evaluation of small arms ammunition and D.II.2: Safe storage of small arms ammunition.

3. *Who can evaluate munitions, render live munitions inert, and dispose of munitions*

Different DOD services and non-military entities have different capabilities for evaluation, inerting, and disposal, as described below.

> "***No NPS employee or volunteer is authorized to inert a munition under any circumstance.***" (NPS Safety Alert: Discarded Military Munitions and Unexploded Ordnance, February 10, 2022)

USMC EOD units
USMC EOD units can *evaluate* munitions, *render* live munitions inert *if safe to do so*, and issue *inert certifications*. They can *dispose* of live munitions that cannot safely be rendered inert.

"DOD and joint issuances prescribe specific responsibilities for each Service (see Appendix A: Multi-Service Capability Matrix)." (DOD Joint Publication 3-42: Joint Explosive Ordnance Disposal Chapter 1.5: Explosive Ordnance Disposal). USMC EOD units are the only DOD service with the "capability" to inert munitions.

Note that *NPS Safety Alert: Discarded Military Munitions and Unexploded Ordnance* (Feb 10, 2022) states that, "The U.S. Marine Corps (USMC) EOD is the only DOD entity authorized to inert munitions."

USMC EOD units are generally more experienced with historical preservation activities and working with museum collections than other DOD EOD units. They are trained to inert *and* preserve live museum munitions, *if* safe to do so.

DOD EOD units
Other DOD EOD units can *evaluate* the status of museum munitions to determine and document if live, solid metal, or inert at the time of evaluation. They can implement *render safe/neutralize procedures* to transport live munitions until final disposition is determined, and

dispose of live munitions. Final disposition is to be determined in consultation with the NPS curator and park, zone, or regional safety manager.

See Joint Publication 3-42: Joint Explosive Ordnance Disposal Chapter 1.3: Function and Appendix A: Multi-Service Capability Matrix.

Accredited Public Safety Bomb Squads

Accredited bomb squads can *evaluate* museum munitions, and *transport* and *dispose* of live munitions. They include certified Public Safety Bomb Technicians who have completed training, such as Federal Bureau of Investigation (FBI) Hazardous Devices School (HDS) training. FBI HDS includes training on how to implement RSPs for improvised explosive devices (IEDs).

Accredited bomb squads are *not* authorized to render munitions inert. They can document that a munition was already inert at the time of evaluation (such as a solid shot cannonball), but this is *not* considered an inert certification. When responding to military munitions, bomb squads should request DOD EOD unit assistance or advice, and consult with the NPS park, zone or regional safety manager and curator to determine final disposition.

For additional information, contact the Special Agent Bomb Technician Coordinator in the nearest FBI Field Office.

See Marine Corps Order 3571.2G: Explosive Ordnance Disposal (EOD) Program.

4. *Steps to evaluate and render munitions inert*

The curator and DOD (USMC or other) EOD unit or accredited bomb squad take the following steps:

Step for Evaluation and Rendering Munitions Inert:	Completed by:
Establish and maintain safety data on whether munitions in the collection are live or inert.	Curator
Review collections documentation to determine which munitions, if any, have a legacy USMC inert certification *or* other DOD EOD or accredited Public Safety Bomb Squad document verifying munition as already inert during evaluation.	Curator
Conduct a visual inspection, but ***do not*** touch, handle, move, transport or ship, or attempt to deactivate. Consult with the park, zone or regional safety manager to determine how to safely inspect munitions in drawers or boxes. Note size, general description, and condition. Photograph from a safe distance.	Curator
Contact the park, zone, or regional safety manager ***immediately*** if there is a ***change in condition*** (such as leaking, new cracks or dents, or new corrosion) to determine safe and appropriate response. Follow Emergency Response Steps: Suspected Live Munitions in the Collection (Figure G.14).	Curator
Restrict access to munitions until evaluated.	Curator
Complete NPS Historical Significance Contributing Factors Tool (Figure G.6) as part of a *Park Inerting Request Package* to identify munitions proposed for inerting and retention in the collection. Submit Request Package to the regional director, through the regional curator.	Curator

Contact DOD EOD unit or accredited bomb squad to schedule evaluation to determine status and final disposition, if regional director concurs with Park Inerting Request Package.	Curator
Process the loan in accordance with *MH* II.5: Outgoing Loans if work is to be done away from the park.	Curator
Evaluate status of munitions to identify which are live and which are inert or solid metal. Evaluate munitions on exhibit first, then those in storage.	DOD EOD unit (USMC or other) or accredited bomb squad
Based on determination of status, take one of the following actions:	
Determine final disposition of museum munitions. *Restrict access* to munitions until final disposition. This may include cordoning off the area, or removal to a safe location by EOD unit or bomb squad may.	DOD EOD unit (USMC or other) or accredited bomb squad in consultation with curator and park, zone or regional safety manager
If *identified as already inert or solid metal during evaluation*, provide USMC inert certification *or* verification document (Figure G.13) with photographs to park. Return inert munitions to park collection.	DOD EOD unit (USMC or other) or accredited bomb squad
Retain identified solid shot cannonball or metal canister rounds in collection and manage as regular museum objects, as these do not pose an explosion risk.	Curator
If *identified as live,* render live munitions inert, if USMC EOD unit determines it is safe to do so in accordance with Explosives Safety Risk Assessment Process (DDESB TP-23). Complete process in safe location away from the collection, staff, and visitors. Complete an inert certification with inert number for tracking in DOD master inventory of inert munitions (maintained by USMC), and provide copy with photographs to park. Return inerted munition to collection.	USMC EOD unit
Document evaluation and inerting *processes* using NPS Munitions and Artillery Evaluation and Inerting Record (Figure G.11). *Update* accession and catalog records and file a copy of inert certification or verification document. *Tag* inert munitions as "Inert" in storage together with copy of inert certification or verification document.	Curator
If *live munitions cannot safely be rendered inert*, transport to EOD unit base or other safe alternate location away from collection, staff, and visitors for disposal. Return fragments to park collection if safe to do so.	DOD EOD unit (USMC or other) or accredited bomb squad
If inert or solid metal munitions are proposed for deaccessioning *after* evaluation, then determine if they may be deaccessioned under the categories authorized by law and in accordance with *MH* II.6: Deaccessioning. The park submits the completed Tool (Figure G.6), Record (Figure G.10), USMC inert certification or accredited bomb squad verification, *and* deaccession documents to the regional curator for review of the proposed action. Regions may convene a committee to consider the proposed actions. The committee should include a curator, archeologist, historian, and/or other subject matter experts as appropriate.	Curator
Deaccession munitions that have been disposed of in accordance with *MH* II.6: Deaccessioning.	Curator
Inspect regularly and include an inspection schedule in ICMS Condition and Maintenance Cycle field.	Curator

Figure G.4. Steps to Evaluate and Render Museum Munitions Inert

5. *Department of Defense responsibility for military munitions*

The Department of Defense has responsibility for the hazardous materials contained in live military munitions in accordance with CERCLA 42 USC 9601 *et seq.*; DOD's Defense Environmental Restoration Program, 10 USC 2701(c)(1); RCRA, 42 USC 6901 *et seq.*; and the EPA Military Munitions Rule, 40 CFR Part 266 Subpart M.

RCRA requires DOD to manage military munitions from "cradle to grave," meaning DOD is responsible under RCRA for the management of military munitions from identification of when a material is a solid or hazardous waste to management of hazardous waste through transportation, storage, treatment, and disposal, and corrective action including investigation and cleanup. Once inerted, munitions will generally cease to contain potentially hazardous substances, and inert munitions are not considered a solid or hazardous waste.

USMC EOD unit will determine inerting procedures and safety in accordance with Department of Defense Explosives Safety Board Technical Paper 23: Assessing Explosives Safety Risks, Deviations, and Consequences (DDESB TP-23).

- If a USMC EOD unit determines it is *safe to render munitions inert at the park*, then the process must be completed at a safe location away from collections storage, staff, and visitors.

- If inerting *cannot safely be completed at the park*, the USMC EOD unit will transport the munition to be inerted to a DOD location such as the responding EOD unit base or a local DOD Ammunition Supply Point. The inerted munition ***must*** be returned to the park museum collection.
  See Section E.I. 7: Return of inerted military munitions to NPS collections.

- If the *USMC EOD unit determines that inerting poses a safety risk*, the unit will destroy munitions at a safe location away from collections storage, staff, and visitors, such as at the EOD unit base. The DOD EOD unit will comply with National Environmental Policy Act and National Historic Preservation Act of 1966 if destruction is conducted at the park, in consultation with the safety manager and archeologist. Curator processes deaccession in accordance with *MH* II.6: Deaccessioning.

6. *Accredited bomb squad procedures for live munitions (MECs)*

If a USMC or other DOD EOD unit is not immediately available to respond to a discovery of live munitions (MECs), then the park should work with an accredited Public Safety Bomb Squad. Local police or fire departments without an accredited bomb squad should contact the nearest accredited bomb squad to respond.

In coordination with the curator and park, zone or regional safety manager, the accredited bomb squad may take the following actions based on DOD EOD response time and munition risk level:

- Move the munition into a bomb squad Ready Storage Locker (RSL) (deployable explosives magazine) at the park. The Incident Commander, park safety manager and law enforcement, if present, should work with the bomb squad to control access to the RSL until EOD unit arrival.

- Transport live munitions to a safe alternate location such as a DOD Ammunition Supply Point until it can be inerted by the DOD EOD unit or disposed.

Note that bomb squads are *not* trained to preserve these objects, and will likely dispose of suspected live munitions if an EOD unit is not available.

See FBI Critical Incident Response Group website and DOD Instruction 3025.21: Defense Support of Civilian Law Enforcement Agencies.

7. *Return of inerted military munitions to NPS collections*

Once a hazardous (live) munition is rendered inert, it is no longer subject to the EPA Military Munitions Rule, which states that "Military munitions do not include wholly inert items…" (40 CFR 260.10: Definitions). ***Unless otherwise hazardous, it must be returned to the NPS museum collection*** as it is a historic object that must be "conserved" [preserved] in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (4e) (G.B.1.4.e), the National Historic Preservation Act, the Organic Act, 54 USC 100101 and 100701, and, in some cases, the Archaeological Resources Protection Act or park-specific statutes, regulations, and executive orders.

Responsibilities under CERCLA or RCRA are not determinative of the ownership or administrative control of any historic objects from the site or collection.

Where a park area or collection therefrom are found to contain military munitions, then DOD may be responsible for ensuring or funding necessary response actions (clean-up) at that site (10 USC 2701).

Contact the Solicitor's Office through the regional curator and/or Museum Management Program should any questions arise.

8. *Museum Munitions and Artillery Evaluation and Inerting Record*

The Museum Munitions and Artillery Evaluation and Inerting Record (Figure G.11) documents the museum munitions evaluation process. The curator completes this record in collaboration with the DOD EOD unit or accredited bomb squad, park or regional Chief Ranger, and park, zone, or regional safety manager. Include a signed copy in the accession and/or catalog folder and update the catalog record. File in the park central and museum files and provide a copy to the regional curator.

9. *Inert certification and other verification documents*

USMC EOD units issue inert certifications. Other verification documents are issued by different entities noted below. The curator files a signed copy in the accession and/or catalog folder, and updates catalog records.

USMC EOD inert certification

USMC EOD units are authorized to issue an inert certification that documents "…that no hazards remain…. The examination may be visual or by nondestructive testing method such as an X-ray…" (Marine Corps Order 8020.10.2.5.f).

The USMC EOD unit permanently identifies the inerted munition with an inert number for tracking in the DOD "master inert inventory" maintained by USMC (Marine Corps Order 8020.10.2.5.i). The inert number is included in the inert certification and added to the catalog record. The USMC EOD unit may use the catalog number instead of a new USMC EOD inert number.
See Figure G.12: Completed US Marine Corps Inert Certification for Munitions (Sample).

Other DOD EOD unit and bomb squad verification of munitions identified as already inert during evaluation

Other DOD EOD units and accredited bomb squads can verify in writing that a munition or lot was identified as already inert or solid metal during evaluation. The document should include: park name, catalog number, object name, description, serial number (if present), verifying official's name and signature, date, verification method, object location, and final disposition. Include photographs. If the DOD EOD unit or bomb squad does not have a verification document, use the NPS Museum Munitions Verification Document (Figure G.13).

Legacy Documentation

Legacy documentation of activities such as conservation is *not* considered an inert certification. Museum munitions with this legacy documentation must still be evaluated and rendered and certified inert by a USMC EOD unit.

10. Who must transport or ship live munitions

Only a DOD (USMC or other) EOD unit or accredited bomb squad can pack and transport or ship live munitions (MECs).

Federal employees are generally exempt from provisions in the DOT HMR on transportation of hazardous materials in the course of official duties, (49 CFR 171.1(d)(5). However, for safety reasons, ***NPS staff must not transport live munitions*** (NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (4b) (*MH* I.G.B.1.4b) and NPS Safety Alert: Discarded Military Munitions and Unexploded Ordnance, dated February 10, 2022).

If live munitions are not inerted at the park, the DOD EOD unit will transport them away from and back to the park in accordance with 40 CFR 266.203: Standards applicable to the transportation of solid waste military munitions, MCTP 10-10D (Marine Air-Ground Task Force Explosive Ordnance Disposal, 2016), and TB 700-2/NAVSEAINST 8020.8C/ TO 11A-1-47 (Department of Defense Ammunition and Explosive Hazard Classification Procedures) Chapter 4-6: Hazard Classification of Unexploded Ordnance (UXO).

Accredited bomb squads may transport live munitions to a safe alternate location as described above in Section E.I.6: Accredited local bomb squad response to live munitions (MECs).

If the munition needs to be removed from the park, the curator processes the action as an outgoing loan in accordance with *MH* II.5: Outgoing Loans.

See Department of Transportation's Pipeline and Hazardous Materials Safety Administration (DOT PHMSA) for further information.

Section II. Managing Munitions in the Collection

1. Storing inert munitions and associated components

Store inert munitions, solid shot cannonballs, and similar objects as regular museum objects, as they do not pose an explosion risk.

- House in a dedicated, secure museum collections storage space separated from curatorial office, research/reference, and work areas in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (1) (G.B.1.1).
- Store in secure locking storage cabinets or heavy-duty metal racks that can accommodate heavy weight and are braced and secured.
- Support, pad, or separate to prevent movement or rolling.
- Label as "Inert Munitions." File a copy of the inert certification or verification document in the accession and/or catalog folder.
- Store paper artillery fuses that cannot be inerted without being destroyed and separate ignition sources such as friction primers separately from other objects in an anti-static box within a locking museum storage cabinet or fire-resistant magazine, as determined by the experienced specialist based on identified risk level.

See Section D.II.2: Safe storage of small arms ammunition and Appendix O: Curatorial care of metal objects.

2. Inventorying munitions

Do not handle, touch or move munitions during inventory until evaluated and until final disposition. ***Only*** visually confirm presence or absence.

Munitions that have been evaluated and inerted must be inventoried in accordance with *MH* II.4: Inventory and Other Special Instructions.

If a munition has been evaluated and determined to be live, but appropriate action cannot immediately be taken, *then* it should be considered controlled property and subject to a 100% inventory until inerted. ***Do not*** handle, touch or move during inventory; ***only*** visually confirm presence or absence. Note any changes in condition such as leaks or cracks. ***Immediately*** contact the safety manager and implement Emergency Response Steps: Suspected Live Munitions in the

Collection (Figure G.14) if changes are noted.

See *MH* II.4.I.C: Completing the Random Sample and Controlled Property Inventories.

3. *Exhibiting munitions*

Only exhibit munitions that have been evaluated and rendered inert. Exhibit in secure exhibit cases with hardware such as keyed locks and security screws that are fully functional and checked regularly. Display using secure mounts. Photograph rare historic munitions for research and education, and make available online.

Do not exhibit live munitions, artillery fuses, friction primers, percussion caps, or other ignition sources.

4. *Packing and transporting or shipping inert munitions*

NPS museum staff can only transport *inert* munitions. Inert munitions are considered regular museum objects, as they are no longer an explosion risk. They may be mailed via USPS in accordance with packing and labeling requirements in USPS Publication 52.4.43.434: Replica or Inert Explosive Devices. Include a copy of the inert certification or verification document in the shipping container.

See Section E.I.10: Who must transport or ship live munitions for information on transportation of live munitions by a DOD EOD unit or accredited bomb squad.

Section III. Emergency Response for Suspected Live Munitions

1. *Emergency Response Steps for suspected live munitions that pose imminent explosion risk*

Follow Emergency Response Steps: Suspected Live Munitions in the Collection (Figure G.14), comprised of the three "Rs": *Recognize, Retreat, Report*.

Work with the park or regional Chief Ranger and regional safety manager to determine what conditions constitute an ***imminent risk of explosion*** and necessitate implementation of Emergency Response Steps. Conditions include smoking, ticking, noting a grenade with a missing pin, and others.
See Section E.I.2: Potential safety risks associated with munitions.

Incorporate these Emergency Response Steps into the park Emergency Operations Plan in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (7) (G.B.1.7).
See Chapter 10.A.7: What is the Incident Command System?

The incident is documented in the Incident Management Analysis and Reporting System (IMARS) and Serious Incident Notification System. Include copies of the incident report and other documents in the accession and/or catalog folder.

2. *Planning documents*

Ground disturbing activities such as archeological investigations may yield discoveries of live munitions. The curator should collaborate with the archeologist, safety manager, park structural fire coordinator, law enforcement, and visitor services to:

- Incorporate Emergency Response Steps: Suspected Live Munitions in the Collection (Figure G.14) into the park:
  - Emergency Operations Plan (EOP)
    NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (7) (G.B.1.7)
  - MEC Field Safety Response Plan
    See NPS Archeology Guide: Developing Explosives Field Safety Response Plans for Military and Commercial Explosives Encountered in National Park Units

- Include language in the fieldwork permit and/or authorization requiring that munitions recovered during fieldwork that will be considered for inclusion in the collection are to be rendered inert by a USMC EOD unit and artillery unloaded *before* accessioning. If recovered live munitions *cannot* be rendered inert, they ***will not*** be accessioned into the collection and cannot be stored in a structure housing collections.
  NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (4) (G.B.1.4) and NPS Archeology Guide: Developing Explosives Field Safety Response Plans for Military and Commercial Explosives Encountered in National Park Units (*under development*).

- Develop procedures for frontline staff to safely respond to potential live munitions brought into park buildings by visitors or staff, in consultation with the park Chief Ranger and Chief of Interpretation.

- Determine appropriate course of action for materials subject to the Sunken Military Craft Act of 2004.

F. Museum Artillery

Section I. Evaluating and Unloading Artillery

Implement procedures in this section in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (2) and (4) (G.B.1.2, 4).

1. How artillery is defined in this appendix

Artillery in this appendix are weapons designed to fire munitions. These include cannon, Howitzers, mortars, anti-aircraft and anti-tank guns, sea-coast guns, swivel guns, and others. They are "heavy weapons that employ explosion or combustion to fire projectile munitions. [They] may be portable…but [are] typically … fired from a more or less stationary position" (*Nomenclature for Museum Cataloging*). Artillery may be operated by a single individual or a crew.

Antique artillery refers to certain artillery manufactured in or before 1898. It is exempted from the GCA and NFA as an antique (pre-1898) firearm and is treated as a regular museum object for shipping and transportation.

"*Modern*" artillery refers to artillery manufactured after 1898, unless subject to an exception. It is regulated as a "destructive device" under the definition of "firearm" in the NFA (26 USC 5845(f, g)). Generally, both the expelling device and the expelled object of an artillery set could qualify as destructive devices, with some exceptions – in particular, certain ordnance transferred by the Secretary of the Army. For additional guidance, consult with the regional curator and park, zone or regional safety manager.

2. *Potential safety risks of artillery*

Artillery in collection storage, exhibit, or on open display outdoors may still be loaded with munitions, and presents a ***high safety risk***. It may contain an explosive projectile, or the artillery tube may contain potentially explosive black powder used to fire solid metal projectiles.

Black powder in artillery displayed outdoors that has acclimated may present an explosion risk when moved, exposed to fire or sparks, or when subject to fluctuating relative humidity (RH) and temperature.

Do not accession loaded artillery into the collection.

Artillery that has been evaluated and confirmed to be unloaded does not present a safety risk, and is managed as a regular museum object.

3. *Steps to evaluate artillery*

The curator takes the following steps:

- Establish and maintain safety data on whether artillery is loaded or unloaded, including review of legacy documentation.

- Conduct a ***visual*** inspection of the artillery, but ***do not*** handle or touch. Note condition and photograph changes such as active corrosion.

- Restrict access to artillery in storage and on exhibit until evaluated by a DOD (USMC or other) EOD unit or accredited bomb squad. *If* appropriate action cannot be taken immediately, *then* restrict access until final disposition. This may include cordoning off the area, or removal to a safe location by the EOD unit or bomb squad.

- Complete the NPS Historical Significance Contributing Factors Tool (Figure G.6) for artillery proposed for unloading and/or inerting. Submit as part of a Park Inerting Request Package to the regional director, through the regional curator.

- If the regional director concurs with the park request, arrange for a DOD EOD unit or accredited bomb squad to evaluate the status (loaded or unloaded) of the artillery. This evaluation will likely involve handling, and must be done in a safe area away from collections, staff, and visitors.

- The DOD EOD unit or accredited bomb squad will determine if safe to unload and clear unloaded artillery and take appropriate action.

- If work is to be done away from the park, process the loan in accordance with *MH* II.5: Outgoing Loans.

- Document processes using the Museum Munitions and Artillery Evaluation and Inerting Record (Figure G.11), and update accession and catalog records.

- If artillery cannot safely be unloaded and must be destroyed, implement deaccessioning and disposal guidance in *MH* II.6.I.2: What is voluntary destruction or abandonment? If fragments remain, retain in the collection.

4. Who must evaluate artillery

Only a DOD (USMC or other) EOD unit or accredited bomb squad can evaluate artillery that may be loaded with munitions and/or explosive material such as black powder.

5. Unloading loaded artillery by DOD EOD unit or accredited bomb squad

The process of *unloading* loaded artillery is ***extremely dangerous*** and must only be completed by a DOD EOD unit or accredited bomb squad.

The DOD EOD unit (USMC or other) or accredited bomb squad can determine if artillery is loaded, but may not be able to determine the status (live, solid metal, or inert) of the loaded munition. The unit or bomb squad will determine if it is safe to unload loaded artillery, or take appropriate action(s) if unsafe to do so. These include removal from exhibit, implementing render safe procedures, rendering inert by a USMC EOD unit, and/or deaccessioning and disposal in accordance with *MH* II, Chapter 6: Deaccessioning. Determine final disposition in consultation with the NPS park, zone or regional safety manager and curator.

See Section E.I.4: Steps to evaluate and render munitions inert.

Artillery may be loaded with a solid metal projectile that *does not* contain explosive material, *but* the projectile cannot be removed without irreversible damage or destruction. Work with the DOD EOD unit or bomb squad to determine appropriate action in order to retain in the collection.

Unloaded artillery that is no longer hazardous ***must*** be returned to the park in accordance with NPS Museum Standard for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (4e) (G.B.1.4.e).

Section II. Managing Artillery in the Collection

1. Securely storing and exhibiting artillery

House inert artillery securely in collections storage and on exhibit as a regular museum object. Store artillery off the floor on moveable pallets for ease of handling and movement.

Work with the facility manager to ensure unloaded museum artillery such as cannon on outdoor exhibit are safely and securely displayed. Work with a conservator to protect artillery exhibited outdoors against the elements such as rain and severe weather to the greatest extent possible.

Do not exhibit loaded artillery.

2. Transporting or shipping unloaded artilery

Unloaded *antique* artillery can be packed and transported or shipped as regular museum objects.

As *modern* artillery is a destructive device, ship unloaded NPS-owned modern artillery in accordance with Section C.III: Moving Museum Firearms for Accession, Transfer and Loan.

NPS museum staff ***must not*** ship or transport loaded artillery.

G. Non-Combat Museum Explosives

Implement procedures in this section in accordance with NPS Museum Standards for Firearms, Small Ammunition, Munitions, Artillery, and Non-Combat Explosives (6) (G.B.1.6).

Section I. Evaluating and Inerting Non-Combat Explosives

Advanced planning is essential to protect staff and visitors, and avoid injury and loss of life or collections. Work with the park, zone, or regional safety manager, park or regional Chief Ranger, park structural fire coordinator and/or regional structural fire manager (marshal), and regional curator, and an appropriately trained and licensed certified blaster or accredited bomb squad to take appropriate action.

1. How non-combat explosives are defined in this appendix

Non-combat explosives in this appendix include blasting caps, charges, detonators, fireworks, flares, shock-sensitive compounds (such as nitroglycerin) and others used in mining, engineering, transportation, social history, and non-combat military activities.

2. Potential safety risks of non-combat explosives

Certain *live non-combat explosives* such as mining blasting caps were designed to destroy or excavate structures and geological features. They may deteriorate over time and be ***extremely volatile and dangerous***, particularly when leaking fluid, and can pose a *lethal* explosion risk if accidentally detonated due to exposure to fire, sparks, sources of ignition, or shock. These types of non-combat explosives must be rendered inert or disposed of.

Fireworks, *flares*, and similar objects that contain smokeless powder pose an explosion and fire risk if exposed to fire or sparks. They are designed not to spontaneously explode if exposed to shock. To mitigate risk, they must be stored in a locking fire-resistant magazine.

Inert non-combat explosives do not pose an explosion risk.

See Section D.II.2: Safe storage of small arms ammunition. See Director's Order #65: Explosives Use and Blasting Safety and National Park Service Handbook for the Storage, Transportation, and Use of Explosives for further information on storage, transportation, and other topics.

3. Steps needed on discovering suspected live non-combat explosives

Emergency response
If changes in condition such as leaking fluid are observed, ***immediately implement Emergency Response Steps*** in Figure G.14: Emergency Response Steps: Suspected Live Munitions in the Collection.

Scheduled response
For *other non-combat museum explosives*, such as fireworks and flares, schedule an evaluation by an appropriately trained and licensed certified blaster or accredited bomb squad.

Once the non-combat explosives have been rendered or verified inert, follow steps in Section G.II.1: Storing non-combat explosives below.

Do not accession live explosives.

4. Who must evaluate and render non-combat explosives inert

Only a trained and licensed certified blaster or, if not available, an accredited bomb squad is qualified to evaluate and render non-combat explosives inert. DOD EOD units generally do not respond to non-combat explosives. The certified blaster determines final disposition of the non-combat explosive in consultation with NPS park, zone, or regional safety manager and curator.

All work with non-combat explosives must be conducted "under the direct supervision of a qualified blaster who holds a current NPS-65 blasters certificate and/or equivalent." (NPS Handbook for the Storage, Transportation, and Use of Explosives Chapter 1: General Requirements). See DOI Office of Surface Mining Reclamation and Enforcement (OSMRE) for training and certification information.

NPS and EPA consider handling and disposal of deteriorated non-combat explosives to be hazardous waste activities, rather than blasting activities. To evaluate and determine final disposition of unstable historic non-combat explosives in the collection, the certified blaster must be *trained* and experienced in handling old and deteriorated non-combat explosives. Training may include specialized classroom and field training, and/or supervised experience specific to the disposal of unstable or deteriorating non-combat explosives. The certified blaster must also have a *license* to dispose of deteriorated non-combat explosives that is "acceptable to EPA" (NPS Handbook for the Storage, Transportation, and Use of Explosives Chapter 10: General Blasting).

The park SOW for blasting work needs to include a clause that work must be completed safely on site, *or* the non-combat explosives safely transported by the certified blaster for inerting.

See DOI Office of Surface Mining Reclamation and Enforcement Blaster's Training Modules webpage.

5. *Steps to evaluate and inert non-combat explosives*

The curator takes the following steps:

- Establish and maintain safety data on whether non-combat explosives are live or inert, including review of legacy documentation of status.

- Conduct an initial ***visual*** inspection of the non-combat explosives. Note size, general description, and condition.

- Limit access to non-combat explosives until evaluated by a certified blaster or accredited bomb squad. *If* appropriate action cannot be taken immediately, *then* restrict access until final disposition. This may involve cordoning off the area, or removal to a safe location by the certified blaster or bomb squad.
  See Section E.I.6: Accredited bomb squad procedures for live munitions (MECs).

- ***Immediately*** contact the safety manager and regional curator to determine appropriate response steps if a change of condition is noted (such as leaking, new cracks or dents, or new corrosion) during visual inspection. Document and photograph changes in condition from a safe distance.
  See Section G.I.3: Steps needed on discovering suspected live non-combat explosives.

- Complete the NPS Historical Significance Contributing Factors Tool (Figure G.6) to identify non-combat explosives that will be proposed for inerting and retention in the collection. Submit as part of a Park Inerting Request Package to the regional director, through the regional curator.

- If regional director concurs with the park request, arrange for evaluation by an accredited bomb squad or certified blaster. This process may involve handling, and must be done in a safe location away from the collection, staff, and visitors.

- If work is to be done away from the park, process the loan in accordance with *MH* II.5: Outgoing Loans.

- The accredited bomb squad or certified blaster determines if it is safe to render the non-combat explosives inert, implements this process if safe to do so, and returns to the museum collection with a memorandum documenting processes and verifying that the explosive is inert.

  Non-combat explosives that have been evaluated and determined to be inert or stable (not a life safety risk) are to be managed as regular museum objects. *If* proposed for deaccessioning, *then* determine if they may be deaccessioned under the categories authorized by law and in accordance with *MH* II.6: Deaccessioning. The park submits the Tool (Figure G.6) together with evaluation, status determination, and deaccession documents to the regional curator for review of the proposed action. Regions may convene a committee to consider the proposed actions. The committee should include a curator, archeologist, historian, and/or other subject matter experts as appropriate.

- If the explosive cannot safely be inerted, deaccession and dispose of in accordance with *MH* II.6: Deaccessioning.

- Document processes, and update accession and catalog records.

- Inspect fireworks and other lower-risk live non-combat explosives regularly and include an inspection schedule in the ICMS Condition and Maintenance Cycle field.

Section II. Managing Non-Combat Explosives in the Collection

1. Storing non-combat explosives

Live non-combat explosives such as blasting caps that pose an imminent explosion risk ***must*** be rendered inert or disposed. They ***must not*** be retained live in the collection. Store inert and live lower-risk objects as described below.

Inert non-combat explosives
Store inert non-combat explosives as regular museum objects, as they are no longer an explosion risk.

- House in a dedicated, secure collections storage space separated from curatorial office, research/reference, and work areas.

- Store separately from firearms and other objects.

- House in secure locking storage cabinets or heavy-duty metal racks that can accommodate heavy weight and are braced and secured as needed.

- Support, pad, or separate to prevent rolling or shifting.

- Tag containers housing non-combat explosives that have been rendered inert as "Inert Explosives." File copy of documentation verifying the explosive as inert in accession and/or catalog folder.

Live lower-risk non-combat explosives
Fireworks, flares, and similar objects containing smokeless powder may not be able to be rendered inert without irreversible damage.

Consult with the certified blaster or bomb squad, park, zone or regional safety manager, park structural fire coordinator and/or regional structural fire manager (marshal), and regional curator to determine safe and appropriate storage for these live objects.

House in a locking fire-resistant magazine and/or anti-static box in a locking cabinet, in accordance with International Fire Code 56: Explosives and Fireworks, NFPA 495: Explosive Materials Code, and 27 CFR 555, Subpart K: Storage.

See NPS Handbook for the Storage, Transportation, and Use of Explosives.

2. Exhibiting non-combat explosives

Only exhibit inert non-combat explosives. Exhibit in secure exhibit cases with hardware such as keyed locks and security screws that are fully functional and checked regularly. Display using secure mounts.

Do not exhibit live non-combat explosives. Exhibit inert reproductions in place of live non-combat explosives that cannot be safely rendered inert. Photograph rare historic non-combat explosives and those that cannot be rendered inert such as fireworks for research and education, and make available online.

3. Transporting or shipping non-combat museum explosives

Non-combat explosives that have been rendered inert can be transported or shipped as regular museum objects.

Federal employees are generally exempt from provisions in the DOT HMR on transportation of hazardous materials in the course of official duties, (49 CFR 171.1(d)(5)), and from 18 USC 40: Explosives, with certain exceptions relating to plastic explosives. However, to prevent injury or death, NPS museum staff ***must not transport live non-combat explosives under any circumstance.*** Only an accredited bomb squad or certified blaster should transport live non-combat explosives if safe to do so.

H. Selected Bibliography

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I. List of Figures

Park Inerting Request Package
Cover and Signature Page (Sample)

Park Name: ____

Package Description: ____

Package completed for (check one): ☐ Munitions ☐ Artillery ☐ Non-Combat Explosive
☐ Other (describe): ______________________

Package contains (check all that apply):
☐ Cover Memo
☐ Historical Significance Contributing Factors Tool
☐ List of Objects
☐ Park Inerting Justification

Completed by:	Name: Title:	Signature:	Date:
Concurred by Collections Advisory Committee Member 1:	Name: Title:	Signature:	Date:
Concurred by Collections Advisory Committee Member 2:	Name: Title:	Signature:	Date:
Recommended by Safety Manager	Name: Title:	Signature:	Date:
Recommended by Custodial Officer for museum collection:	Name: Title:	Signature:	Date:
Approved by Superintendent:	Name: Title:	Signature:	Date:

Figure G.5. Park Inerting Request Package Cover and Signature Page (Sample)

National Park Service
Historical Significance Contributing Factors Tool

Park Name: ____

Package Description: ____

Check off applicable factors for each object or group of objects and use to develop the Park Inerting Justification.

Park Purpose *(Factors relate to the specific reason(s) for the park's establishment or "park-defining" elements)*

- ☐ Object(s) directly connects to place where park-defining event occurred
- ☐ Integral to park's enabling legislation, legislative purpose, and interpretive and educational mission
- ☐ Component of resources identified in park Foundation Document
- ☐ Identified as mandatory or highly desired item(s) in the park's Scope of Collections Statement
- ☐ Critical component of why the park was established, and loss would significantly jeopardize park purpose

Context

- ☐ Made, used, or present at park during park-defining event
- ☐ Collected after park-defining event within historically significant period, *or* recovered from an archeological site with high assemblage integrity within the park
- ☐ Representative of events or significant period/era that took place at the park
- ☐ Systematically recovered under "authority of the Antiquities Act (16 U.S.C. 431- 433), Reservoir Salvage Act (16 U.S.C. 469-469c), section 110 of the National Historic Preservation Act (16 U.S.C. 470h-2), or Archaeological Resources Protection Act (16 U.S.C. 470aa-mm)" (36 CFR 79.1(a))
- ☐ Spatial relationship between objects informs or supplements record of park-defining events, activities, and/or people

Associational, Evidential, Intrinsic, and Informational Value

- ☐ Directly associated with event, activity, place, or use by people for which the park was established
- ☐ Tangible evidence of park-defining events, commemorative activities, people, and/or places
- ☐ Supports understanding of military or combatant tactics, strategies, and movements within the park
- ☐ Documents military technologies or other technical and manufacturing processes relevant to park and nation's history

Rarity

- ☐ No or few other examples of this kind of object exist in the park collection
- ☐ Only known example of this kind of object
- ☐ Limited or novel in production
- ☐ Design and/or manufacture method or materials are unique or distinctive
- ☐ Iconic representative of park-defining event, activity, person, or place
- ☐ One or few remaining objects from park-defining event, activity, person, or place within the park

Supporting Documentation

- ☐ Record of provenance is complete or free of gaps
- ☐ Scientific project documentation, including provenience, is comprehensive and well-supported
- ☐ Used in well-supported documented research or scholarly publication on historic events and people significant to park and nation's history
- ☐ Potential for scholarly research on historic events and people significant to park and nation's history
- ☐ Subject to the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA)

Concurred by Collections Advisory Committee Member 1:	Name: Title:	Signature:	Date:
Concurred by Collections Advisory Committee Member 2:	Name: Title:	Signature:	Date:
Submitted by Custodial Officer for museum collection:	Name: Title:	Signature:	Date:

Figure G.6. Historical Significance Contributing Factors Tool

National Park Service
Park Inerting Justification (Sample)

Park Name: ____

Package Description: ____

Justification for (check one): ☐ Munitions ☐ Artillery ☐ Non-Combat Explosive
☐ Other (describe): ______________________________

Historical Significance Contributing Factors Tool Attached ☐ Yes ☐ No

List of Objects
Include list of objects here or append. Include justification per object, or as narrative justification statement.

Catalog Number:	Object Name:	Justification:

Narrative Justification Statement
Provide information to support determination of Historical Significance and inerting request here or in List of Objects.

Completed by:	Name: Title:	Signature:	Date:
Concurred by Collections Advisory Committee Member 1:	Name: Title:	Signature:	Date:
Concurred by Collections Advisory Committee Member 2:	Name: Title:	Signature:	Date:
Recommended by Safety Manager	Name: Title:	Signature:	Date:
Recommended by Custodial Officer for the museum collection:	Name: Title:	Signature:	Date:
Approved by Superintendent:	Name:	Signature:	Date:

Figure G.7. Park Inerting Justification (Sample)

National Park Service
Regional Panel Inerting Request Review (Sample)

Region: _______________

Park Name: ____

Package Description: ____

Regional Panel Comments:

Regional Panel Recommends Inerting: ☐ **Yes** ☐ **No**

Curatorial representation on panel is required. Include subject matter experts as appropriate.

Curator:	Name: Title:	Signature:	Date:
Archeologist:	Name: Title:	Signature:	Date:
Historian:	Name: Title:	Signature:	Date:
Other:	Name: Title:	Signature:	Date:
Prepared by:	Name: Title:	Signature:	Date:

Concurred by Regional Safety Manager:	Name: Title:	Signature:	Date:
Concurred by Regional Curator:	Name: Title:	Signature:	Date:

Regional Director concurs with Regional Panel recommendation: ☐ **Yes** ☐ **No**

Concurred by Regional Director:	Name:	Signature:	Date:

Regional Director Comments (Complete if not concurred)**:**

Figure G.8. Sample Regional Panel Inerting Request Review (Sample)

National Park Service
Museum Firearms Evaluation and Unloading Record

Park Name: ____

Specialist	Name	Title
	Institution / Affiliation	
	E-mail Address	Phone Number
	Address	

Curator:	Name: Title:	Signature:	Date:
Concurred by Park, Zone, or Regional Safety Manager	Name: Title:	Signature:	Date:
Concurred by Park or Regional Chief Ranger	Name: Title:	Signature:	Date:
Approved by Superintendent	Name:	Signature:	Date:

Catalog Information					**Evaluation**		**Unloading**	
Catalog Number	**Object Name**	**Other Number(s)**	**Description**	**Storage Location**	**Evaluated?** (Yes/No)	**Status** (Loaded, Unloaded, or Indeterminate)	**Verified Unloaded?** (Yes/No)	**Describe Process**
					_Y _N		_Y _N	
					_Y _N		_Y _N	
					_Y _N		_Y _N	
					_Y _N		_Y _N	
					_Y _N		_Y _N	
					_Y _N		_Y _N	

Figure G.9. Museum Firearms Evaluation and Unloading Record

National Park Service
Museum Small Arms Ammunition Evaluation and Mitigation Record

Park Name: ____

Specialist	Name	Title
	Institution / Affiliation	
	E-mail Address	Phone Number
	Address	

Curator:	Name: Title:	Signature:	Date:
Concurred by Park, Zone, or Regional Safety Manager	Name: Title:	Signature:	Date:
Concurred by Park or Regional Chief Ranger	Name: Title:	Signature:	Date:
Approved by Superintendent	Name:	Signature:	Date:

Catalog Information					Evaluation		Mitigation	
Catalog Number	**Object Name**	**Item Count**	**Description**	**Storage Location**	**Evaluated?** (Yes/No)	**Status** (Live/Stable, Live/Unstable, Solid Metal, or Inert)	**Rendered Inert or Retained Live*?**	**Describe Inerting Process** (If not retained live in storage)
					_Y _N		_Inerted _Retained Live	
					_Y _N		_Inerted _Retained Live	
					_Y _N		_Inerted _Retained Live	
					_Y _N		_Inerted _Retained Live	
					_Y _N		_Inerted _Retained Live	
					_Y _N		_Inerted _Retained Live	

* Must be stored in a locking, fire-resistant magazine or anti-static box (in accordance with *MH* I Appendix G.D.II.2: Safe storage of small arms ammunition).

Figure G.10. Museum Small Arms Ammunition Evaluation and Mitigation Record

National Park Service
Museum Munitions and Artillery Evaluation and Inerting Record

Completed by curator to document evaluation by Department of Defense (DOD) Explosive Ordnance Disposal (EOD) unit (USMC or other) or accredited Public Safety Bomb Squad, *and* inerting by USMC EOD unit.

Park Name: ____

Submitted by Curator: ____
(Print Name) (Title) Signature

Organization:	☐USMC EOD	☐Other DOD EOD	☐Accredited Public Safety Bomb Squad
Unit Name (print)			
Responsible Individual (print)			
E-mail Address		Phone Number	
Address		Date	

Concurred by Park, Zone, or Regional Safety Manager	Name: Title:	Signature:	Date:
Concurred by Park or Regional Chief Ranger	Name: Title:	Signature:	Date:
Approved by Superintendent	Name:	Signature:	Date:

Object Information					Record of Evaluation			Record of Inerting (USMC use only)		
Catalog Number	**Object Name**	**Item Count**	**Storage Location**	**Description**	**Evaluated?** (Yes/No)	**Describe Process**	**Status** (Live, Inert or Solid metal)	**Inerted?** (Yes/No)	**Describe Process**	**USMC EOD Inert Number**
					_Y _N			_Y _N		
					_Y _N			_Y _N		
					_Y _N			_Y _N		

Figure G.11. Museum Munitions and Artillery Evaluation and Inerting Record

Completed US Marine Corps Inert Certification for Munitions (Sample)

INERT CERTIFICATION
MARINE CORPS EXPLOSIVE ORDNANCE DISPOSAL

a. **Item description:** 3 Inch, Hotchkiss, Case Shot, Type 1, Union	
b. **Assigned serial number:** M30004-21373	
c. **Certifying official's name:** Sgt Ord, Dan	d. **Verifier official's name:** GySgt Kanon, Robert
12/22/2022 X Dan Ord Signed by: ORDDAN 999999999	12/22/2022 X Robert Kanon Signed by: KANONROBERT 999999999
g. **Date certified:** 20221222	i. **Item location:** PARK National Park
h. **Method to verify inert:** Visual	j. **Disposition:** Transferred

Notes/history: Encyclopedia of Black Powder Artillery Projectiles Found in North America; 1759-1865 - Volume IV - p - (1121). Catalogue Number PARK 1074

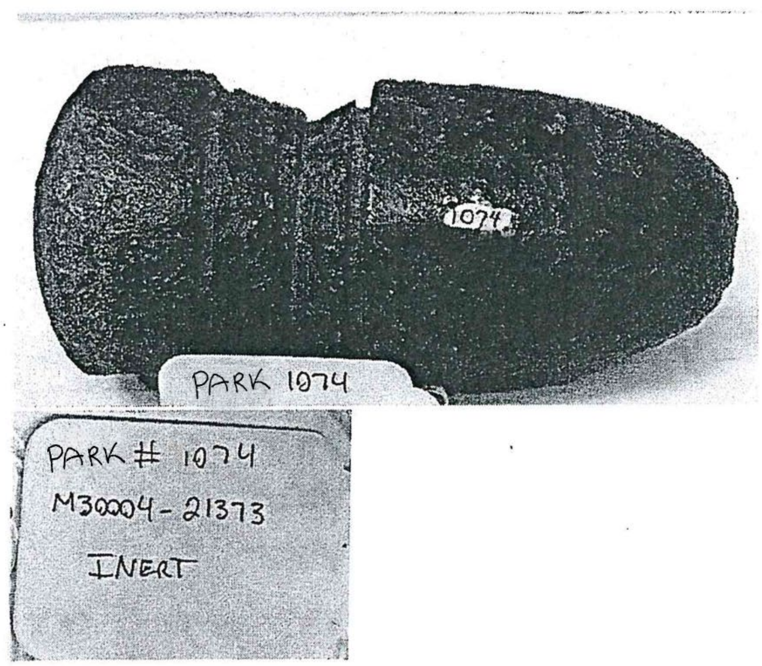

Figure G.12. Completed US Marine Corps Inert Certification for Munitions (Sample)

National Park Service
NPS Museum Munitions Verification Document

If Department of Defense Explosive Ordnance Disposal unit or accredited Public Safety Bomb Squad form is not available, use this document during evaluation. Place signed copy with photographs in the accession and/or catalog folder and with object in storage.

Park Name: ____

Section A: Object Information	
Catalog number	Object name:
Storage location:	
Serial or other number(s):	
Description:	

Section B: DOD EOD Unit or Accredited Public Safety Bomb Squad Information (Completed by EOD Unit or bomb squad)
Explosive Ordnance Disposal (EOD) Unit or Accredited Public Safety Bomb Squad Name (print):
Verifying official Name and Title (print):
______________________________ (Signature)

Section C: Verification of Munition as Inert or Solid Metal	
Verification Method:	
Date verified:	Date returned to park collection:

[Photograph(s)]

Notes:

Adapted from US Marine Corps Base Quantico Explosive Ordnance Disposal (EOD) Unit inert certification form.

Figure G.13. NPS Museum Munitions Verification Document

NATIONAL PARK SERVICE
EMERGENCY RESPONSE STEPS:
SUSPECTED LIVE MUNITIONS IN THE COLLECTION

Implement these Emergency Response Steps when observing a *change in condition** in a museum munition**.

Recognize:

- Assume the munition is live.
- ***Do not*** handle, touch, move, transport or ship, disturb, dispose, or attempt to deactivate suspected live munitions under any circumstance.
- Note type, size, and stability ***only*** if safe to do so.
- Photograph suspected live munition from a safe distance.

Retreat:

- Leave suspected live munition in place and note location.
- Stop all work.
- Cordon off cabinet and area.
- Vacate and secure the room.
- Evacuate building.
- Direct occupants to meet at designated assembly point.

Report:

- Call 911 and/or park dispatch to contact Department of Defense (DOD) Explosive Ordnance Disposal (EOD) unit (US Marine Corps or other) or accredited state or local bomb squad
  and
- Notify supervisor, law enforcement, and park safety manager.
- Superintendent issues Area Closed order.
- Building is secured and perimeter established.
- Meet at designated assembly point until cleared.

* *Changes in condition* include appearance of new cracks, bulges or dents; leaking fluid; new corrosion, smoking, odor, ticking; or noting a missing grenade pin or exposed fuse in a cannonball or shell.

** For *non-combat explosives*, if condition changes are noted then follow these steps and contact a trained and licensed certified blaster *or* accredited Public Safety Bomb Squad. ***Do not*** contact an EOD unit, as they do not respond to non-combat explosives.

Figure G.14. Emergency Response Steps: Suspected Live Munitions in the Collection

J. Index

Appendix H: Curatorial Health and Safety

APPENDIX H: CURATORIAL HEALTH AND SAFETY

A. Laws, Regulations, and NPS Policies and Guidelines

The following authorities and guidelines cover curatorial health and safety in the NPS:

- The Occupational Safety and Health Act of 1970 provides the requirements on which each federal agency's safety and health program is based. See <http://www.osha-slc.gov/oshAct_data/OSHACT.html>.

- The Comprehensive Drug Abuse Prevention and Control Act of 1970 establishes the mechanisms for reducing the availability of controlled substances and the procedures for bringing a substance under control.

- The Resource Conservation and Recovery Act (RCRA) of 1986 directs the Environmental Protection Agency to develop and implement a program to protect human health and the environment from improper hazardous waste management practices. See <http://www.epa.gov/epahome/laws.html>.

- Executive Order 12196 (1980) directs each federal agency to provide a safe and healthful working environment for its employees. See <http://www.nara.gov/fedreg/eos/e12196.html>.

- 29 CFR 1910.134 provides guidance regarding the use of respirators. See <http://www.osha.gov/comp-links.html>.

- 29 CFR 1910.1000, Subpart Z provides tables listing toxic and hazardous substances and maximum exposure levels. See <http://www.osha.gov/comp-links.html>.

- 29 CFR 1910.1200 (Revised 1987) provides specific guidance on implementing the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard. See <http://www.osha.gov/comp-links.html>.

- 29 CFR 1910.1450 (Effective 5/1/90) provides guidance relevant to occupational exposure to hazardous chemicals in laboratories. See <http://www.osha.gov/comp-links.html>.

- 29 CFR 1910.1047 (Revised 1985) regulates the use of the fumigant ethylene oxide. See <http://www.osha.gov/comp-links.html>.

- 29 CFR 1960 provides basic program direction for Federal Employee Occupational Safety and Health Programs. See <http://www.osha.gov/comp-links.html>.

- The *Department Manual*, Part 485, establishes the Department of the

Interior (DOI) safety and health program. See <http://elips.doi.gov/>.

- Director's Order #50B: Occupational Safety and Health, covers the occupational safety and health of NPS employees. The NPS Risk Management Program has been developed to establish and implement a continuously improving and measurable risk management process. See <http://www.nps.gov/refdesk/DOrders/index.htm#manuals>.

- Director's Order #83: Public Health, and *Reference Manual 83*, outline what the NPS will do to ensure compliance with prescribed public health policies, practices, and procedures. See <http://www.nps.gov/refdesk/DOrders/index.htm#manuals>.

B. Sources of Assistance

1. *Federal agencies and cooperators for health and safety*

The following federal agencies regulate aspects of the National Park Service health and safety program:

- The ***Occupational Safety and Health Administration (OSHA),*** part of the US Department of Labor, publishes and enforces safety and health regulations for most businesses and industries in the United States.

  U.S. Department of Labor
  Office of Public Affairs, Room N3647
  200 Constitution Avenue
  Washington, DC 20210

  Tel: 202-693-1999
  <http://www.osha.gov>

- The ***National Institute for Occupational Safety and Health*** (NIOSH) trains occupational health and safety professionals, conducts research on health and safety concerns, and tests and certifies respirators for workplace use.

  Hubert H. Humphrey Building
  200 Independence Avenue, SW, Room 715H
  Washington, DC 20201

  Tel: 1-800-35-NIOSH
  <http://www.cdc.gov/niosh/homepage.html>

- The ***Environmental Protection Agency (EPA)*** administers laws to control and/or reduce pollution of air, water, and land systems and regulates use and labeling of pesticides in accordance with the Insecticide, Fungicide and Rodenticide Act of 1972.

  1200 Pennsylvania Avenue, NW
  Washington, DC 20460

  Tel: 202-260-4048
  <http://www.epa.gov>

- The ***U.S. Department of Transportation (DOT)*** regulates the labeling and transportation of hazardous materials.

  Research and Special Programs Administration
  Office of Hazardous Materials Safety
  400 7th Street, SW
  Washington, DC 20590

  Tel: 202-366-8553
  <http://www.dot.gov>

- The ***National Pesticide Telecommunications Network*** provides objective pesticide information to any caller.

  333 Weniger Hall
  Oregon State University
  Corvalis, OR 97331

  Tel: 800-858-7378
  <http://www.ace.orst.edu/info/nptn/>

2. *Professional organizations for health and safety management*

In addition to the above federal agencies and cooperators, park staff should be aware of the following professional organizations that are involved in health and safety management:

- The ***American Conference of Governmental Industrial Hygienists (ACGIH)*** develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

  1330 Kemper Meadow Drive, Suite 600
  Cincinnati, OH 45240

  Tel: 513-742-2020
  <http://www.acgih.org/>

- The ***American Industrial Hygiene Association (AIHA)*** provides information on occupational and environmental health and safety issues and controls, anticipates, and evaluates environmental factors arising in or from the workplace that may result in injury, illness, or impairment, or affect the well-being of workers and members of the community.

  2700 Prosperity Avenue, Suite 250
  Fairfax, VA 22031

  Tel: 703-849-8888
  <http://www.aiha.org>

- The ***National Fire Protection Association (NFPA)***, a voluntary membership organization, promotes and improves fire protection and prevention. The NFPA publication *Standard No. 704*: *Identification of the Fire Hazards of Materials*, rates the hazard of a variety of materials

during a fire.
Batterymarch Park
Quincy, MA 02269

Tel: 617-770-3000
<http://www.nfpa.org>

- The ***National Safety Council*** educates and influences people to adopt safety and health policies, practices, and procedures to prevent losses caused by accidents and hazardous occupational or environmental exposures.

  444 North Michigan Avenue
  Chicago, IL 60611

  Tel: 312-527-4800
  <http://www.nsc.org/>

- The ***American National Standards Institute (ANSI)***, a voluntary membership organization, develops consensus standards nationally for a wide variety of health and safety devices and procedures.

  1420 Broadway
  New York, NY 10018

  Tel: 212-354-3300
  <http://www.ansi.org>

3. *Other organizations*

In addition to the Park Safety Officer, the Regional Safety Officer, the regional/SO curator, the WASO Risk Management Division, and the Museum Management Program, National Center for Cultural Resources, the following organizations have extensive experience in dealing with occupational health and safety issues/problems in museum environments:

- The ***American Institute for Conservation (AIC)*** Health and Safety Committee has produced information directly related to museum and conservation laboratory safety.

  1717 K Street, NW, Suite 200
  Washington, DC 20006

  Tel: 202-452-9545
  <http://aic.stanford.edu/health/>

- ***Arts, Crafts and Theater Safety (ACTS)*** is a not-for-profit corporation dedicated to providing health and safety services to the arts.

  Ms. Monona Rossol, President
  181 Thompson Street, #23
  New York, NY 10012

  Tel: 212-777-0062
  <http://www.caseweb.com/ACTS>

C. Sources of Health and Safety Equipment and Supplies

There are several sources for obtaining desk fans, fume hoods, portable fume hoods and fume scrubbers, laboratory protective clothing and gloves, respirators, chemical storage cabinets, health and safety publications, hazard warning labels, signs and charts, and other supplies. NPS parks and centers should contact the Museum Management Program for current sources of health and safety equipment and supplies. *Tools of the Trade* is periodically updated with new information on health and safety equipment and supplies.

Appendix I: Curatorial Care of Archeological Objects

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APPENDIX I: CURATORIAL CARE OF ARCHEOLOGICAL OBJECTS

A. Overview

1. *What is an archeological object?*

Archeological objects are the result or product of an activity in the past that has been recovered from an archeological site. Archeological objects may have originated in the ancient past or quite recently. Depending upon the soil and climate of the site, a wide variety of materials may be excavated.

- ***Inorganic*** artifacts include:
  - metal
  - ceramics
  - glass
  - stone
- ***Organic*** artifacts include:
  - leather
  - basketry
  - textiles
  - modern plastics and other synthetics
  - bone
  - teeth

Archeological collections may also contain non-artifactual samples, such as botanical material, soils, pollen, phytoliths, oxylate crystals, snails, insect remains, and parasites.

While some individual archeological objects are found in NPS collections, the majority have been recovered as part of systematic archeological excavation. Preservation and care of individual objects must also consider the impact on the collection as a whole.

An important part of archeological collections are the associated archival records (for example, field notes, photographs, maps, digital documentation). For information on managing and preserving these archival records see *Museum Handbook,* Park II (*MH-II*), Appendix D: Museum Archives and Manuscript Collections and *Museum Handbook,* Part I (*MH-I*), Appendix J: Care of Paper Objects, Appendix M: Management of Cellulose Nitrate and Cellulose Ester Film, and Appendix R: Curatorial Care of Photographic Collections.

2. *What does this appendix cover?*

This appendix provides guidance only on the care of objects excavated from the ground. For guidance on collections from marine excavations, consult an archeological objects conservator with experience in the treatment of waterlogged materials. See Chapter 3: Preservation: Getting Started, Chapter 8: Introduction to Museum Object Conservation Treatment, and Conserve O Grams 6/1-6/6 for more information.

This appendix does not cover field treatment of objects when first excavated. Good sources of information on this topic include Sease (1987) and Watkinson and Neal (1998) listed in the references.

3. *What makes archeological objects different from other materials commonly found in museum collections?*

What makes archeological objects different is that at some point they were lost or abandoned and buried underground or in water.

The condition of these objects depends entirely on their reaction with the environmental conditions to which they have been exposed through time. Underground the object reaches a kind of equilibrium with the surrounding soil. Then, when the object is excavated, it must adjust to a new and radically different environment. Reactions can involve both physical and chemical changes. Regardless of the condition of the object before excavation, the moment it becomes exposed it is vulnerable to rapid deterioration. Figure I.1 illustrates the deterioration rate of archeological objects through time.

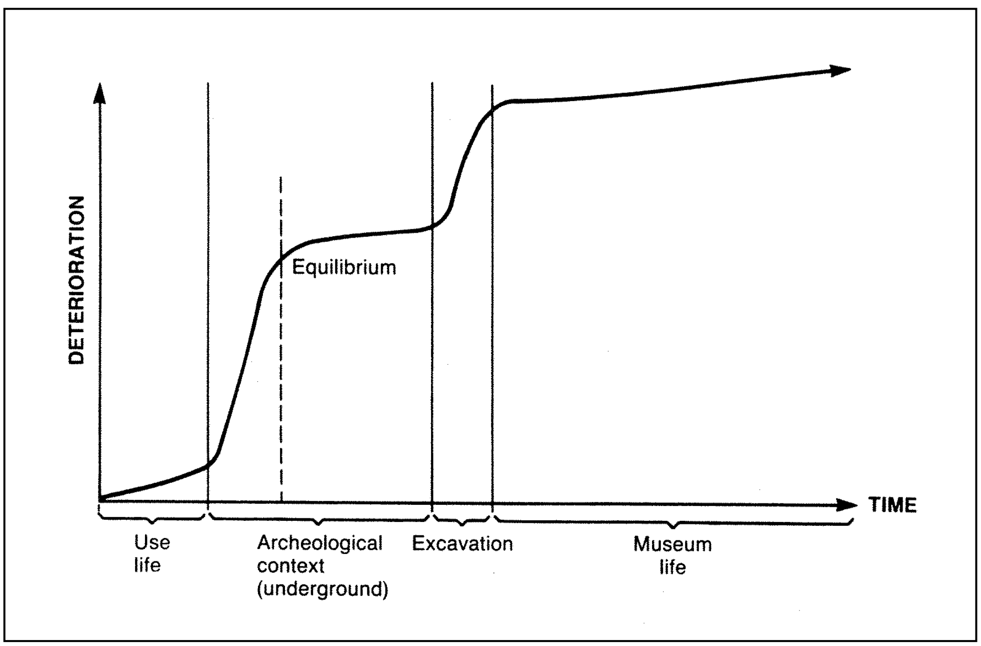


Figure I.1. Deterioration of Archeological Objects through Time

4. *How can I minimize deterioration of archeological objects?*

Preservation of archeological collections is a collaboration between archeologists, curatorial staff and conservators. Each person brings a different perspective and expertise to the problem. It is important to understand the concerns and needs of these other professionals when making decisions about how to care for archeological objects.

Preservation must begin in the field. Curatorial staff should work with archeologists depositing collections to make sure that preservation concerns are addressed during archeological procedures at the site and in the processing laboratory. Work with conservators both in the field and at the repository to ensure preservation choices are based on current research. Follow through with proper curatorial care in museum collections storage.

Refer to Director's Order #28 and Chapter 6: Management of Archeological Resources of the *Cultural Resources Management Guideline*, for guidance on the responsibilities of the archeologist before selecting a repository and depositing collections. See Director's Order #24, NPS Museum Collections Management, for park management's responsibility to ensure appropriate care and management of archeological collections.

B. Handling and Cleaning of Archeological Objects

1. *How should I handle the objects?*

Because the research value of archeological material may be lessened or destroyed by unnecessary handling and inappropriate treatment, preservation of these materials should be based on preventive care. Careful handling, packaging, and storing of archeological objects are crucial for the survival of the material as an artifact. Mishandling and storage will encourage deterioration and can reduce the material to nothing more than powder.

Archeological objects can have a deceptive appearance of strength when first uncovered. All excavated materials have undergone some form of alteration during the equilibration process underground and during the recovery process. This alteration has physically weakened the object. While underground, objects are supported by the surrounding soil, and when excavated, they may be unable to support their own weight. For this reason, archeologists and conservators often use specialized lifting techniques to excavate fragile and potentially fragile objects. During and after excavation, continue to support these objects on a tray or pallet or in a container that distributes weight properly.

An archeological object must always be fully supported. Use both hands, a tray, or a supporting container to lift and carry an object, whether it is large or small. Always assume that an excavated object is weak.

Review the guidelines for handling museum objects in Chapter 6: Handling, Packing, and Shipping Museum Objects.

2. *How should I clean the artifacts in museum collections?*

Cleaning of archeological material should be kept to a minimum. The cleaning process may destroy important archeological evidence such as surface decorations and composite or associated materials that often exist only as impressions on the surface of the object or in the surrounding soil. Original surfaces of metal objects may lie within layers of corrosion. Evidence of use (for example, food residue in containers, pigment traces on stone palettes, or blood traces on stone projectile points) may be removed by unnecessary cleaning.

Cleaning may also interfere with scientific analysis. For example, the use of acid to remove deposits on ceramics may also remove acid-soluble compounds in the ceramic paste and as a result, invalidate compositional analysis used to determine the prehistoric source of clay. See *Conserve O Gram* 6/6, "Long-term Effects of Acid-Cleaning Archeological Ceramics." Water can also remove amino acid traces used to date bone. Washing may also hasten deterioration of salt-contaminated material and can be disastrous to metal objects if they are not carefully and completely dried afterward.

Avoid any treatment that alters the chemical or physical integrity of the artifact. Don't risk losing valuable information or inflicting irreversible damage.

Once an object has reached the repository and is in curatorial care, remove only loose dust and dirt by dry brushing or vacuuming. ***Don't*** wash the object and ***don't*** apply pressure. The surface of an archeological object is often fractured or friable and may be easily dislodged by rubbing. Carefully assess an object's surface ***before*** you start to clean it. If additional cleaning, stabilization, or repair is necessary, consult an experienced conservator.

C. Storage Conditions for Archeological Objects

1. *How should I organize archeological collections in storage for best preservation?*

Archeological collections are often large and contain a variety of materials with different environmental storage requirements and with different research values. Physical organization of the collections by research values, such as source or cultural affiliation, will not necessarily meet preservation needs. It is better to organize the materials by environmental requirements and maintain the research integrity of the collection through good museum records.

Ideally, all archeological objects should be stored in climate-controlled areas, but this often is not practical. Most archeological collections are large and not all storage facilities have enough climate-controlled storage space to house entire collections. In such cases, it is possible to maximize preservation while minimizing utility costs by implementing a storage strategy based on the environmental requirements of various archeological materials.

2. *What are the environmental requirements?* See the chart below for a system to organize archeological material by environmental sensitivity.

Organization of Archeological Material	
Level I: Negligibly climate-sensitive materials	
Materials: • stable stone and fired ceramics • stable inorganic architectural materials (plaster, mud, daub, brick, and stone) • dry pollen, flotation, and unprocessed soil samples • faunal remains	***Required Climate***: Gradual daily and seasonal fluctuations of temperature and relative humidity can be tolerated. • ***Relative Humidity***: Above 30% and below 65%. Mold may become a problem above 65%. • ***Temperature***: Freezing to 100°F. Moderate and cool temperatures are preferred. High temperatures increase deterioration of all materials.
Level II: Climate-sensitive materials	
Materials: • stable metal • stable glass • worked bone, antler, and shell • botanical specimens • textiles • wood • skin, leather, and fur • feathers and horn • natural gums, resins, and lacquer • human remains	***Required Climate***: • ***Relative Humidity***: Determine a stable point based on the object's environmental history and current regional climate. If the materials will be stored near the collection site, you may follow these guidelines. 30-40%--semi-arid areas and deserts 40-50%--central and eastern plains and woodlands 45-55%--seacoast and lakeshore Keep conditions as stable as possible. Many organic materials are more sensitive to fluctuations of relative humidity than to any one unchanging level in the moderate range. Do not allow daily fluctuations of more than 3%. From summer to winter, keep the change to no more than a slow 10% drift. • ***Temperature***: Above 50° F and below 75° F. You may adjust the temperature slightly to control the relative humidity, but do not exceed changes of 5° daily.
Level III: Significantly climate-sensitive materials	
Materials: • unstable (salt-contaminated) ceramics, stone, and bone • unstable glass (glass that appears damp or "weeping") • unstable metal, particularly iron • mummified human and animal remains • composite objects (objects made of several different materials)	***Required Climate***: • ***Relative Humidity***: Keep the RH within the restricted range determined by the object's composition and condition. Follow these guidelines. – metal—under 30%. Unstable iron is best stored below 15%. – unstable glass—30% to 40% – naturally mummified animal remains—15% to 20% – unstable ceramics, stone and bone (salt contaminated)—below 50% (***Note***: Keep the RH as steady as possible to avoid damage by the hydration cycling of soluble salts.) • ***Temperature***: Choose a point between 60° and 72° and keep the temperature steady. Allow it to fluctuate only enough to keep the RH in check.

3. *What are the storage requirements for each of the three levels of climate sensitivity?*

Each level of climate sensitivity requires a different type of storage.

- ***Level I*:** General storage for Level I materials should meet the ***minimum*** overall standards for all NPS storage spaces as outlined in Chapter 7: Museum Collections Storage.

  – Store materials that do not need special attention in boxes on open shelves.

  – Store loose material, including the following, in bags within boxes:
    bulk botanical specimens
    unprocessed soil samples
    dry pollen and flotation samples
    slag
    unworked bone
    lithic cores and debitage
    ceramic sherds

  Make sure the bags are strong and will not tear or puncture. Bags made of Tyvek®, a strong spun polyethylene plastic that allows water vapor to escape, are a good choice. Canvas bags and resealable polyethylene bags can also be used.

- ***Level II*:** Climate-controlled storage for Level II materials should comply with the ***optimum*** standards for NPS storage areas as outlined in Chapter 7.

  If your park has no currently available area where the environment can be controlled, consider putting up a prefabricated, climate-controlled structure. See *Conserve O Gram* 4/7, "Museum Collection Storage Space: Is an Insulated Modular Structure Right for your Collection?" Consult your regional or support office curator, conservators specializing in environmental or preventive conservation, or the Museum Management Program for guidance in developing an acceptable storage area.

- ***Level III*:** Microclimate storage for some Category III materials can be created within the climate-controlled storage area used for Category II materials.

  – Place objects requiring an extremely stable environment within a closed well-gasketed museum cabinet that will shield them from even slight fluctuations in relative humidity.

  – Place metals and unstable glass, which require a relative humidity quite different from other objects in storage, in tightly sealed boxes with moisture-sensitive materials called *sorbents*. Sorbents, such as ***silica gel***, buffer the interior of the container against changes in the relative humidity of the enclosed objects.

D. Storage Techniques for Archeological Collections

1. *What type of storage container should I use to store archeological objects?*

There are many different types of standard boxes and bags that are appropriate for general storage. ***Note: These are not for microclimate storage.*** See Chapter 4 for information on microclimate storage.

- Use acid-free boxes with lids rather than self-closing boxes with flaps that will wear out over time.
- Store small objects like lithic points and nails in boxes manufactured for the storage of archival and photographic collections.
- Use small resealable polyethylene bags for individual specimens and stack them vertically within each section of the box. You can staple them to acid-free index cards to make them easier to stack. If the objects are not numbered, include an acid-free tag with an identification number inside each bag and also be sure to write the number on the outside of the bag or on the card.

See Figure I.2. Note the easy visual access and consistent packaging technique illustrated. Never wrap objects in padding material. Wrapping and unwrapping requires excessive handling.

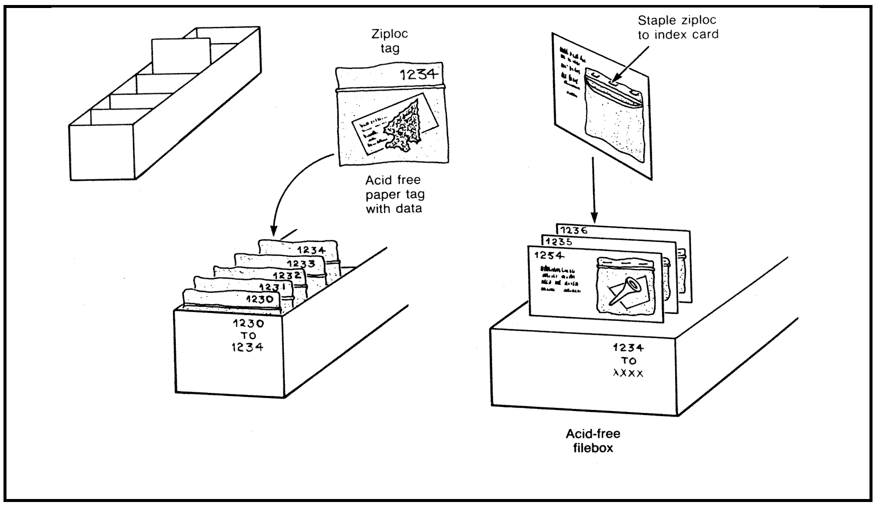


Figure I.2. Vertical Stacking of Small Objects within Standard Containers

2. *Why is silica gel often used in archeological storage?*

Archeological objects are often unstable and very sensitive to changes in relative humidity. Silica gel can moderate fluctuations in relative humidity within a closed container.

Silica gel is inert, amorphous silicon dioxide in a porous granular form that is able to adsorb moisture from the air. It can adsorb 30-40% of its dry weight and responds more quickly than other sorbents to variations in relative humidity. The gel rapidly senses, corrects, and stabilizes fluctuations in relative humidity by humidifying or dehumidifying the air around it to maintain its own preferred environment. See Chapter 4: Museum Collections Environment, for information on use of silica gel in microclimates.

3. *How should I cushion my objects?*

Use padding material to prevent the contents of a container from shifting when it is moved. Be careful not to overstuff the box with crumpled tissue or other padding material that could exert damaging pressure on fragile objects. Use either of these cushioning techniques:

- Make smooth pillows to place against the surface of the object by folding wadded acid-free *unbuffered* tissue paper within loose rolls of tissue. Wrapping the crumpled tissue will keep it from expanding and exerting pressure.

- Fill resealable sandwich-sized polyethylene bags with cotton.

Don't use cotton or polyester wool alone. Cotton is an excellent sorbent and may hold moisture directly against the object. Fibers from these materials may snag and damage delicate artifacts.

4. *How should I organize the box contents?*

Organize your artifacts so that each object can be easily retrieved without disturbing the rest. One technique is to layer your items. If they are small and lightweight, they can be organized into three or four layers separated by specimen trays within your storage box. Specimen trays make lifting safer. Cushion each layer with a sheet of stable polyethylene foam shelf liner. See Figure I.3. Museum supply companies manufacture acid-free boxes with fitted trays equipped with adjustable interior compartments. These are ideal for the storage of archeological material.

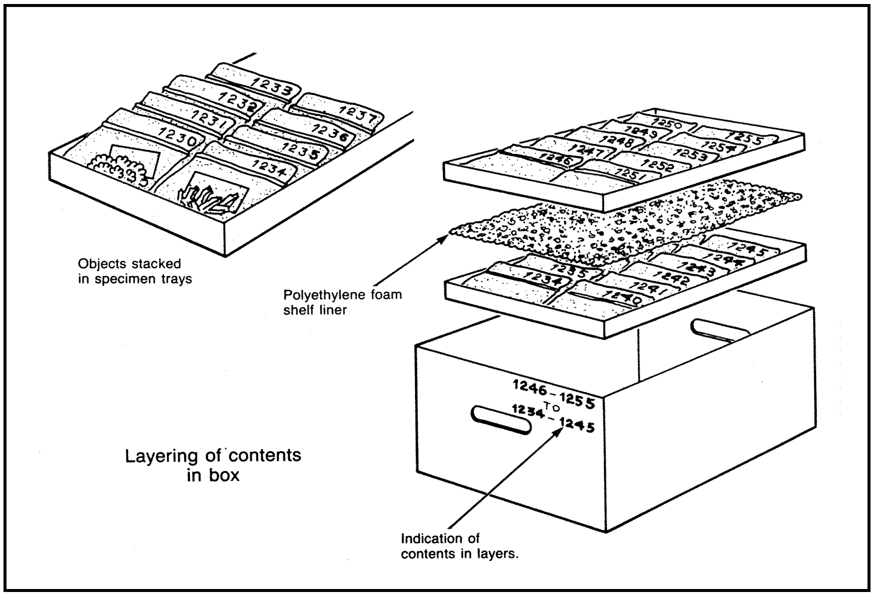


Figure I.3. Organization and Layering of Objects within a Storage Box

5. *How do I keep track of what's in the box?*

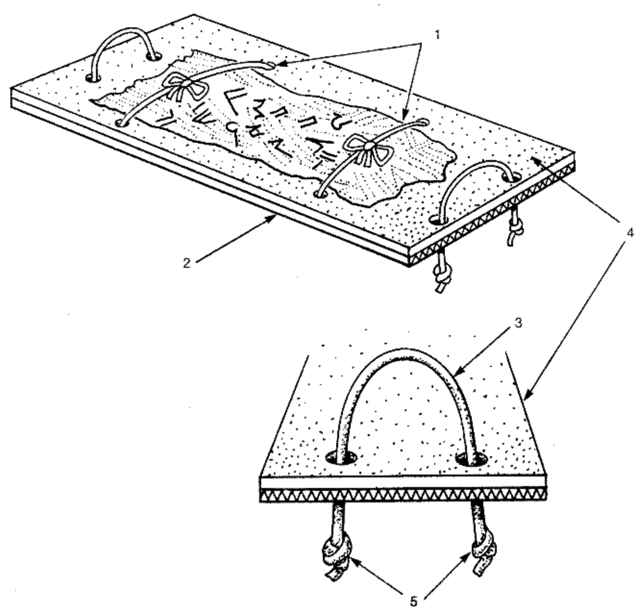
Make an inventory:

- First, make sure that the identification numbers you have written on each bag show clearly.
- Next, label the outside of the box with the numbers by layer.
- Prepare a more detailed list of the contents and place it in the box on top of the contents.

6. *How do I protect and store larger archeological objects?*

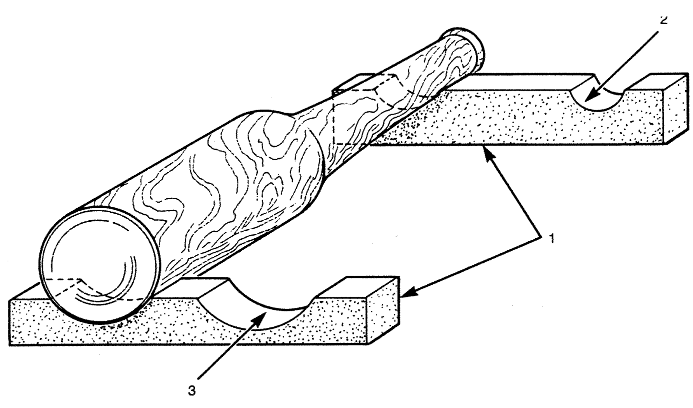
If the objects are too large for standard specimen trays, you can make custom trays from padded, acid-free board fitted with cotton twill-tape handles. See Figure I.4 for an illustration. There are many acid-free boards, including matboard, cardboard, foamboard, and honeycomb board, that can be used to make support trays. Make sure you select a board heavy enough not to bend under the weight of the object. Tie the object to the tray with cotton twill tape to keep it from sliding.

Use rigid polyethylene foam to make tray supports and trays with cavities for fragile three-dimensional objects. You can easily cut large blocks of foam with an electric carving knife and thin sheets with a sharp X-acto knife. Figure I.5 illustrates the use of rigid polyethylene foam blocks to support a fragile bottle. Figure I.6 shows the cavity-packing technique to restrict the movement of smaller, rounded items. Cavity-packing is an excellent way to store objects that are moved periodically for research. Make sure that the fit of the object in the cavity is not too tight and that the object may be safely removed from the tray. The cut edge of the rigid foam block can be abrasive so use thin, soft, polyethylene foam (like Volara®) for objects with fragile surfaces. If necessary, carve a finger grip on each side of the object to make grasping easier.



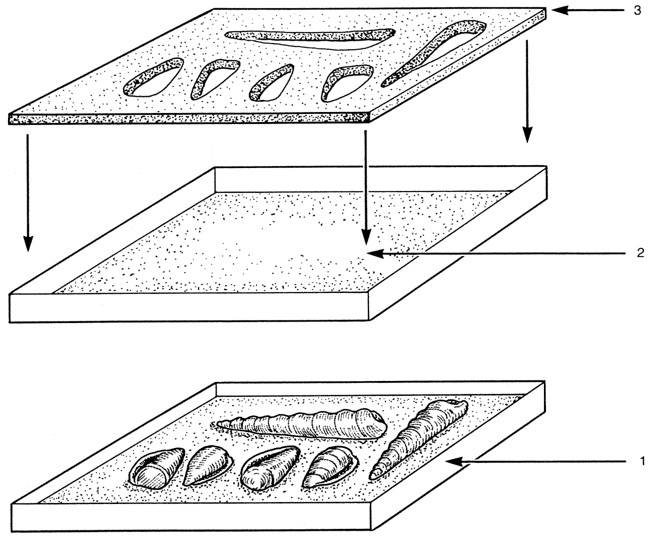
1. Tie twill tape loosely in bows over object to secure it to the tray. The method of attachment should be both obvious and easily unfastened.
2. Use acid-free cardboard, fluted plastic, Fome-cor®, or Tycore® for the tray.
3. Use twill tape or nylon rope for handles.
4. Line rigid board with polyethylene foam pad. Cover foam with washed muslin or unbuffered acid-free tissue. Attach the lining to the board with a good quality double-sided tape (e.g., Scotch 415) or with a hot glue gun. If the support tray is small, the twill tape ties should be enough to hold both the pad and the object in place.
5. Be sure to tie knots larger than punched hole.

Figure I.4. A Support Tray for Fragile Material



1. Use rigid blocks of polyethylene foam to support complete ceramic or glass bottles. The foam blocks can be placed in specimen trays on shelving or in museum specimen cabinet drawers.
2. Cut out wells in each block to fit the diameter of the neck and bottom of the bottle.
3. Because cut foam can scratch, line each well with strips of Tyvek® or smooth foam sheets to protect the surface of the bottle from possible abrasion. Remember that the surface of iridescent excavated glass is particularly fragile. The bottle should never be made to fit tightly in the foam support.

Figure I.5. Customized Support Blocks for a Fragile Glass Bottle to be Fitted in a Museum Specimen Tray



1. Isolating objects in separate cavities restricts movement and provides easy access. A number of small objects may be held in a museum specimen tray.
2. Line the bottom of a museum specimen tray with ¼"-thick polyethylene foam.
3. Mark the outline of the object on a second sheet of ¼"-polyethylene foam. Be very careful not to touch the object with the marking instrument. Avoid using a pen. With a sharp pencil, puncture the foam around the object and twist the pencil to make a clear mark in points about ¼" apart for small objects and 1" apart for larger objects.
4. Move the object out of the way, and cut out this shape by "connecting the dots" with an X-acto knife.

Figure I.6. Cavity Packing Technique for Small Objects

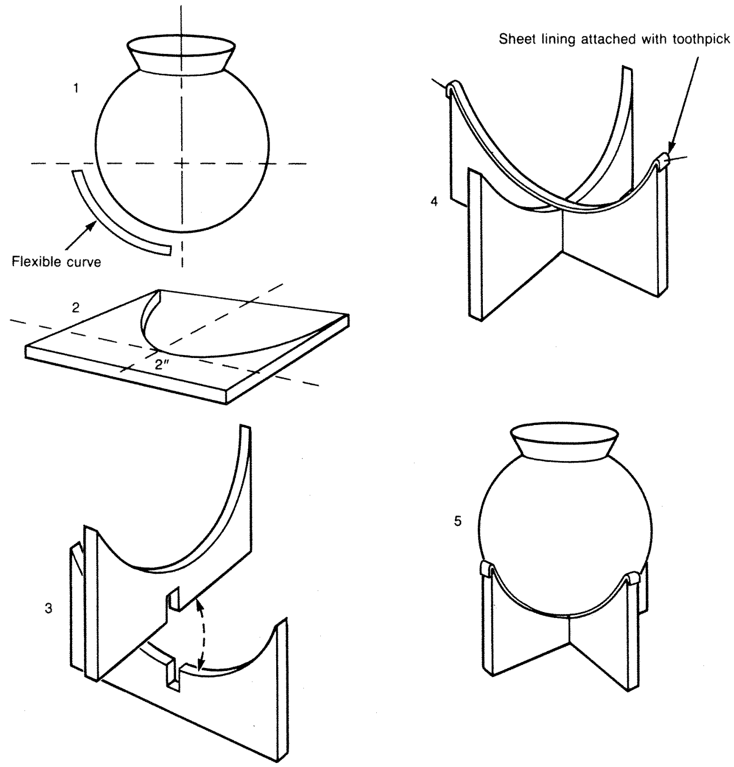
7. *How should I store very weak and fragile objects?*

Archeological objects that are weak from deterioration may require specialized supports to maintain their structural integrity. Before designing a special mount, evaluate the object's strong and weak structural points. Determine:

- what the object is
- how it was used or worn
- how it was made

For example, cone-shaped baskets, worn like backpacks, were used to carry heavy objects. Load stresses were distributed down the sides of the basket and concentrated in the bottom. Though the rim is the weakest part of these baskets, they are frequently, but incorrectly, stored upside down like traffic cones.

A good storage mount takes into account the ***form*** and ***function*** of the object and eliminates stress on the weakest parts. A cradle mount like the one illustrated in Figure I.7 will evenly distribute the weight of an object with an unstable base while keeping it upright as originally used.



1. Starting from the center of the vessel, measure the curve from its base up to 1/3 of its height with a flexible drafting curve.
2. Using a 1"- to 2"-thick piece of rigid polyethylene foam (depending on the size of the vessel to be supported), mark the profiles of a full cross-section of the object, leaving 2" at the bottom of the foam sheet. If the shape of the object is symmetrical, flip the measured curve on one side to the other side as illustrated. Cut the cross-section profile with a sharp knife. Repeat technique to produce another cross-section to be used to bisect the first one.
3. Cut a 1" by 1" notch in the center of the **base** of one cross-section as shown in 3A. Cut a matching notch in the center of the **top** of the curve in the other cross-section as shown in 3B.
4. Fit both cross sections together at the notches. Cut a thin foam sheet for lining the cradle surfaces. Pin foam buffering strips to cradle surfaces with toothpicks as shown.
5. Place vessel in the cradle.

Figure I.7. Construction of a Cradle Mount for Objects with Round Bases

8. *How and when should I design special containers?*

When making a special box or storage container for an archeological object, keep these things in mind.

- Protect the object from dust and light.
- Provide it with good support.
- Allow researchers maximum visual access.
- Discourage any handling of the object.

In the case of a textile fragment, for example, a researcher will want to examine both sides. The container must permit close examination of the contents, but minimize the need to actually handle the object. A portfolio mount, illustrated in Figure I.8, is a good solution to this problem. This technique can also be used to store other flat objects like basketry fragments, thick cordage, and other fragile materials. Adjust the thickness of the interior mat to accommodate the dimensions of the object, avoiding any unsafe pressure or crushing of brittle elements.

Boxes for other types of artifacts should have a drop front so that the tray supporting the item can be slid out onto a stable surface. An accident is more likely to happen if the object must be lifted up and out through the top.

You may need to provide special containers and mounts that will protect fragile, unstable, and top-heavy objects during an earthquake.

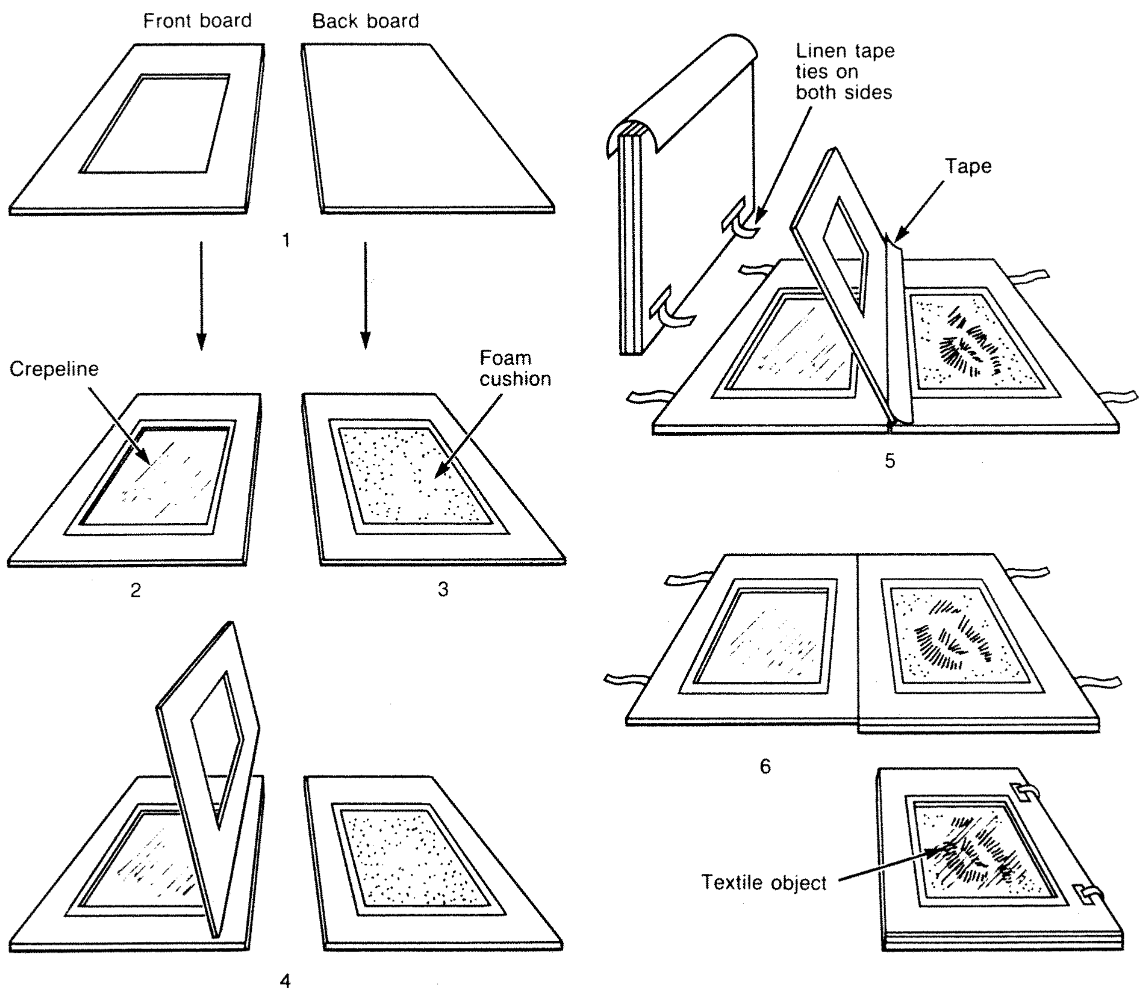
There is much published information containing instructions for building specialized storage mounts. Two very good references are *Storage of Natural History Collections: Ideas and Practical Solutions* (Rose and de Torres, 1995) and *Working with Polyethylene Foam and Fluted Plastic Sheet* (Schlichting, 1994).

To help you select stable materials for constructing containers and mounts for storage see *Materials for Exhibit, Storage, and Transportation and Packing* (Tétreault and Williams, 1992) and "Guidelines for Selecting Materials for Exhibit, Storage, and Transporation" by Jean Tetreault, available on the Web at <http://www.cci-iic.gc.ca/frameset_e.shtml> under Conservation Information.

9. *How should I store items subject to the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA)?*

Your park's archeology collection may contain NAGPRA-related items such as human remains, associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony. These collections should be housed and handled with great sensitivity. You may need to store NAGPRA items separately from other collections and limit access to them.

Consult with the lineal descendants, culturally affiliated Indian tribes, Native Alaskan villages or corporations, or Native Hawaiian organizations to ascertain their preferences related to storage techniques and materials. You may need to use alternative storage methods and materials in response to these consultations. See Chapter 7: Museum Collections Storage, for additional information concerning consultation and storage of NAGPRA collections.



1. Cut out front and back of portfolio from a sheet of museum quality mat board. Cut window out of one board. Make window ½" to 1" larger than the dimensions of the textile fragment.
2. Cover window with polyester crepeline (Stabiltex®). Pull taut over window opening and attach with water-activated acid-free linen tape.
3. Cut a piece of cushioning material (e.g. Sentinel Foam®, Volara®, Microfoam®) to the inside dimensions of the window. Place material on board. Cover the foam with a non-woven polyester fabric such as Reemay 2014 and attach with water-activated linen tape.
4. Prepare a third board identical to the window front board. Use this board as a spacer to protect textile specimen from being crushed.
5. Stack the three boards. Attach water-activated linen tape along the outside edge like a book-binding. Attach linen bias tape ties with water-activated tape to the front and back boards. Open portfolio and attach center spacer with water-activated tape.
6. Place textile fragment on cushion and close the portfolio. The polyester crepeline (Stabiltex®) window facilitates visual identification of specimen without having to open the mount and protects the textile specimen from dust.

Figure I.8. Construction of a Portfolio Mount for Archeological Textile Fragments

Recommended Storage Materials

Bags	
Use:	**Don't Use:**
• Resealable polyethylene bags (Ziploc®, Baggies®, Whirl-pak®) • Spun polyethylene bags (Tyvek®) • Bags made from heat-sealable clear plastic laminate film	• Kraft lunch bags • Waxed paper • Envelopes None allow visual inspection and all are made from unstable materials. Waxed paper may leave a coating on the object.

Padding	
Use:	**Don't Use:**
• Acid free tissue	• Loose cotton Brittle materials may snag on the loose fibers. Cotton will almost certainly leave lint on the objects.
• Cotton or polyester batting in plastic or muslin bags	• Paper towels or facial or toilet tissue Papers are not durable and contain impurities.
• Polyester felt	• Newspaper Newsprint smears easily and may leave ink on objects. Newspaper is also very acidic.
• Bubble-pak or air-cap	• Excelsior Material is very acidic. • Vermiculite Substance generates dust that not only is difficult to remove, but also hazardous to museum workers

Figure I.9. Recommended Storage Materials

Plastic Foams	
Use:	**Don't Use:**
• **White** polyethylene closed-cell foam (Polyfoam)	• Blue polyethylene foam (fire retardant) Fire retardant additives can migrate to materials. • Pink polyethylene foam (antistatic) Conductor in foam absorbs water from the air and can become soapy.
• Crosslinked polyethylene foam (Plastazote®, Volara®) • Ethylene/vinyl acetate copolymers (Evazote®, Volara®) • Extruded plank polystyrene (Styrofoam) • Polypropylene closed-cell foam (Microfoam)	• Chlorinated or nitrated plastic (for example, PVC–polyvinyl chloride) Plastic outgases hydrogen chloride, which can become hydrochloric acid. • Polyurethane This is unstable and may offgas harmful products.

Clear Plastic Sheets	
Use:	**Don't Use:**
• Polyethylene terephthalate clear polyester (Mylar®) • Clear polyester and fluorocarbon laminate (Film-O-Wrap®) • Clear polyester/polyolefin laminate (Scotchpak®)	• Polyvinylidene chloride (for example, Saranwrap®) PVC is unstable, chlorinated plastic. • Cellophane Sulphuric acid used in manufacturing process generates acidic by-products.

Figure I.9 Recommended Storage Materials (continued)

Boards	
Use	**Don’t Use**
• Acid-free mat board • Acid-free corrugated board • Acid-free Fome-Cor® (International Paper Co.); extruded polystyrene with polystyrene skin • Honeycomb boards – acid-free rigid paperboard (Tycore®) – aluminum-board (Hexcel Honeycomb®) • Corrugated polypropylene boards (Cor-X®,Coro-plast®) • Double-walled polycarbonate (Lexan®)	• Regular cardboard or matboard Non-archival cardboard and matboard are acidic. • Urea formaldehyde impregnated paper laminated panel board (Gatorfoam®)

Tape/Ties	
Use	**Don’t Use**
• Water-activated paper or linen tape • Cotton or polyester twill tape	• Pressure sensitive tapes, including: – cellophane – masking – strapping – duct – electrical The adhesive degrades and the carrier peels off leaving residues and stains. • Rubber bands Rubber degrades and sticks to the surface.

Figure I.9. Recommended Storage Materials (continued)

Fabric	
Use	**Don't Use**
• Polyester Stabiltex • Reemay 2014 • Washed muslin	• Wool fabric • Unwashed muslin Sizing may attract pests.

Figure I.9. Recommended Storage Materials (continued)

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Appendix J: Curatorial Care of Paper Objects

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APPENDIX J. CURATORIAL CARE OF PAPER OBJECTS

A. Overview

1. *What information will I find in this appendix?*

This appendix discusses the physical character of paper objects and provides guidance for their long-term preservation. The types of paper objects included in this discussion are:

- archival and manuscript materials (documents, letters, field notes, reports, and project data)
- prints and drawings
- maps
- architectural records

> ***Note: Archival and manuscript materials make up the largest part of NPS museum collections, so most NPS paper objects are part of an archival collection. Be sure to have your park's archival collections surveyed and appraised by an archivist before you give attention to individual items within a collection. This will help you set preservation and treatment priorities. See Museum Handbook, Part II: Museum Records (MH-II), Appendix D: Archives and Manuscript Collections, for additional information.***

The main topics covered in this appendix are:

- the nature of paper
- agents of deterioration
- preventive conservation (collections maintenance, handling, storage, and exhibition)
- working with a conservator when treatment is needed
- emergency procedures for paper objects
- glossary of terms used to describe condition

This appendix does not address the care of photographs (see Appendix R: Curatorial Care of Photographic Collections) or books (see *Conserve O Gram* 19/2, "Care and Security of Rare Books").

2. *Why is it important to practice preventive conservation with paper objects?*

The role of preventive conservation is to avoid, block, or minimize the ***agents of deterioration***. This practice will decrease the need for costly and time-consuming conservation treatments and irreparable harm to objects.

Poor environment, storage and exhibit techniques, and careless handling easily damage papers. Once the object is stained, embrittled, torn, or creased, it becomes even more fragile. Conservation treatment cannot reverse all damage to an object. Treatment can be expensive. It is unlikely that your park can afford to treat all objects, especially those with little exhibit or monetary value. Preventive conservation is cost effective because care is provided for the collection as a whole, rather than object-by-object.

3. *How do I learn about preventive conservation?*

Read about the agents of deterioration that affect paper objects so that you can create a preventive conservation plan. These agents are discussed in more detail in Section C. Understanding how to protect your collection from the agents of deterioration will lengthen the life of your paper objects. See Chapter 3: Preservation: Getting Started, and Chapter 4: Museum Collections Environment, for a complete discussion of the agents of deterioration.

4. *Where can I find the latest information on care of these types of objects?*

There are a variety of sources for up-to-date information about paper:

- Read the issues in the NPS *Conserve O Gram* series relating to paper.
- Review the references in the bibliography.
- Look up the World Wide Web sources that are listed at the end of this appendix.
- Consult a paper conservator.
- Consult a curator or archivist of a paper/archival collection.

5. *What should I know about the history of papermaking?*

Collections may contain a variety of papers that have been used in many ways to produce records and other paper objects. Objects predating the mid-19th century are fairly uniform in character. Paper objects produced after this period vary widely in structure and composition as well as in permanence. *Papermaking* by Dard Hunter provides an excellent history of the technology of papermaking (see Section K. Selected Bibliography). In short:

- Paper was invented in China more than 2,000 years ago. It was made by hand from naturally occurring plant fibers, and was for centuries a scarce and expensive commodity. Because the process was a closely guarded secret, papermaking technology was not imported to Europe until the Middle Ages.
- The first American paper mill was established in the late 17th century. By the early 19th century, there were almost 200 mills in the United States making handmade paper from rag fibers.
- Advances in technology during the Industrial Revolution made abundant, inexpensive paper possible. Handmade paper was replaced

by mass-produced, machine-made paper. The demand for fiber was met by adding wood pulp to rag fibers. The cheapest paper, made entirely of groundwood pulp, was used for printing newspapers, broadsides, and other commercial products. Groundwood pulp paper is inherently unstable chemically.

- Higher-quality machine-made papers include more extensively processed fiber and/or some rag fiber. Some applications, like photography, require truly high quality paper made entirely of rag fibers.

6. *What is the difference between paper and a paper object?*

Paper itself is only part of a paper object. It is often referred to as the *support*. Equally important are the media used on the paper to form a paper object, such as:

- inks
- graphite
- colored pencils
- wax crayon
- pigments and binders (watercolor, pastels)

These are hand-applied media. Media also can be applied mechanically or reprographically. Mechanical processes of reproduction using the medium of printer's ink include:

- letterpress
- engraving
- wood block
- etching
- lithography

Some modern reprographic processes are:

- mimeography
- xerography

Each one of these use a wide variety of inks, pigments, and binders.

B. The Nature of Paper Objects

1. *What is the structure of paper?*

A sheet of paper is actually a web of fibers held together by their physical entanglement and weak chemical bonds between the fibers. The fibers in paper are primarily cellulose. Materials are added to the fiber to control the properties of the paper, such as absorbency and smoothness. Those additional materials include:

- **Sizing**. Chemicals added to paper to make it less absorbent so inks will not bleed. Acidic sizings, such as alum-rosin, can cause paper to deteriorate.

- **Fillers**. Materials like clay are used to create very smooth and shiny surfaces for high quality illustration, such as glossy art book paper.

2. *What is cellulose?*

Cellulose is the basic chemical polymer of all plant fibers. The molecules have a long chain-like structure that is both strong and durable. At the same time, the structure is moisture-sensitive and vulnerable to acidic deterioration.

3. *What fibers have been used historically to make paper?*

Many different fibers have been used to make paper. These can be grouped into three types according to the source of the fiber:

- cotton and linen rags

- bast (flax, Japanese paper mulberry, hemp)

- wood

The common element of these fiber sources is cellulose.

In early paper, **cotton and linen fibers** were used to make paper by hand. As the need for paper exceeded the supply of fibers, recycled plant fibers were obtained from cotton and linen rags. The term "rag" paper applies to any paper made solely from cotton or linen cloth fibers. European-style paper objects dating from before the mid-19th century almost always are made of rag paper.

Other fibers like **grass** are quite rare, and are unlikely to be found in NPS collections.

Wood-pulp paper (or groundwood paper) is the most prevalent paper in NPS museum and archival collections dating after the mid-19th century, when technology was developed to extract fiber from lumber. This process made paper inexpensive and abundant. However, the **paper made from groundwood pulp is highly acidic and inherently unstable**.

4. *What causes groundwood paper to be unstable?*

Groundwood paper contains cellulose as well as other materials that occur naturally in wood. One of these, *lignin*, is a plant protein which is inherently unstable and generates acid as it deteriorates. Acid generated by the deteriorating lignin breaks the cellulose chains, making fibers shorter and weakening the paper. Groundwood paper begins to deteriorate as soon as it is made.

Some groundwood pulp is chemically treated to remove all but the cellulose fibers. This "chemical woodpulp" paper is not as strong or stable as rag paper because the fibers are short. However, it is not self-destructive like the groundwood paper because the acid-generating properties have been removed.

5. *How is paper quality judged?*

The quality of paper is determined by its durability and permanence. The degree to which paper retains its original strength during its history is called *durability*. The degree to which paper remains chemically stable and resists deterioration is called *permanence*. See Section C.10 for a discussion of permanence related to acidity and pH.

6. *How does the nature of some paper objects affect their preservation?*

Every paper object is a combination of fibers, adhesives, and media. If any of these elements are unstable, the paper object will be inherently unstable and will deteriorate. Common examples are:

- manuscripts with iron gall ink on rag paper sized with gelatin. The gelatin size originally served to control absorption of the watery ink, preventing the ink from bleeding into the paper. As the size degrades, any water applied will be quickly absorbed into the paper. Iron gall ink can contain sulfuric acid that eats into the paper, most severely where it was thickly applied. The iron gall ink also fades from its original black to brown. Although the rag paper is sturdy and durable on its own, the deterioration of the ink compromises the stability of the object.

- pencil drawings on tracing paper. Some tracing paper is rendered transparent by an impregnating resin. Over time, the resin oxidizes, darkens, and causes the paper to become brittle. The graphite is chemically stable, but may be lost by abrasion, rubbing, or smudging.

Even when all the paper object's elements are stable, they may not respond positively to environmental changes. Two examples are:

- a tightly framed print. The print paper may be a high quality rag paper and the printing ink a stable one composed primarily of carbon. However, if the print is housed in poor quality framing materials, it will be damaged. Wood backing boards can discolor the print. If the print is held tightly in the frame without a window mat to allow expansion and contraction of the paper with changes in humidity, wrinkles and even tears can result.

- paper repaired with a paper patch. Paper expands and contracts as the relative humidity rises and falls, usually more so in one direction than the other. This can be due to the *grain* of the paper. The dimensional change is less in the direction of the grain rather than across. If the grain of the paper patch is not parallel to the grain of the paper object, the patch and the object will expand and contract in different directions. Over time, this results in *cockles*, or warping of the paper object.

C. Agents of Deterioration

1. *What causes paper to deteriorate?*

The deterioration of paper may result from:

- inherent conditions (poor quality pulp, bleaching residues, unstable sizings, acidic inks)

- external conditions (fluctuating temperature and relative humidity, light exposure, air pollution, pests, contact with acidic materials, careless handling, improper storage, natural disasters, accidents)

Inherent and external conditions often reinforce each other to promote further deterioration. See Chapter 4: Museum Collections Environment for a discussion of the impact of external (environmental) conditions on museum objects, and Chapter 5: Biological Infestations for a discussion of pests.

Paper is fragile and susceptible to deterioration caused by ***inherent vice***. The nature of the materials and sometimes methods of manufacture, cause deterioration that may not be treatable. Good preventive conservation practice can minimize the effects of inherent vice and extend the useful "life" of a paper object.

2. *How does temperature affect paper objects?*

High temperatures cause brittleness, particularly in groundwood paper. Most of the chemical reactions that cause paper to deteriorate proceed twice as fast with each 10°F increase of temperature. Gelatin adhesives shrink and relax as temperature fluctuates.

3. *How does relative humidity affect paper objects?*

Cellulose is ***hygroscopic***—it has a physical attraction for water, making relative humidity (RH) one of the critical factors for paper preservation. Paper contains water within its chemical structure and water is also bound loosely to its surface. The water in paper is in equilibrium with the water (humidity) in the air. As the relative humidity (RH) drops, paper gives up water to maintain this equilibrium. It contracts physically, becoming smaller as it loses water.

Paper gives up the loosely bound surface water first. Once the surface water is gone, the paper is forced to give up structural water. While surface water can be regained after the humidity rises, the loss of structural water is permanent. This desiccation causes embrittlement. Some media, such as inks and gum-based watercolors, are similarly responsive to changes in RH.

Paper requires a certain amount of moisture to be flexible. Desiccated or brittle paper is:

- less flexible and more subject to damage from handling
- more easily torn during unrolling
- more easily broken when flexed

High relative humidity (above 68%) encourages insect infestation and mold growth. Fluctuating relative humidity:

- causes stress from continual expansion and contraction (particularly damaging to objects composed of more than one material)
- damages materials that are constrained (such as a tight binding, adhesive repair, or fastener)
- causes buckling and cockling to materials that are partially constrained (such as repairs or mounts)

4. *What are the appropriate temperature and humidity levels for storage of paper objects?*

Store paper objects in a stable environment at a constant temperature between 60°-65°F (+/-3°) and a relative humidity of 40% (+/-3%). Photographs should be stored at slightly cooler and drier levels. See Figure J.1. below.

	T (+/-3°)	RH (+/-3%)
Paper Objects and Human Occupants	65°	40%
Paper Objects Storage	60°	40%
Photograph Storage	50°	35%
Isolated Color Photograph Storage	40°	35%

These numbers are based on NISO TR01-1995 "Environmental Guidelines for the Storage of Paper Records."

Figure J.1. Suitable Temperature and Humidity Levels for Paper Storage

5. *How does light affect paper objects?*

Both visible light and ultraviolet (UV) radiation cause serious damage to paper objects. The degree of light-sensitivity depends on the nature of the materials and media. For example:

- Groundwood paper quickly turns brown and brittle because the damage from inherent acidity is accelerated by light exposure.
- Rag fibers are fairly stable, but may be stained or bleached by light exposure, depending on the properties of the sizing.
- Colored materials made of dyes (colored papers, colored pencils and crayons, ballpoint and felt-tip pen inks) fade quickly.
- Watercolors are particularly sensitive because the medium contains little dye or pigment.
- Certain photographically produced images (blueprints, sunprints) fade quickly with light exposure.

6. *How do I protect paper objects from light?*

To protect paper objects from light damage:

- Eliminate all sources of UV from exhibition, storage, and curatorial work areas.
- Keep exhibit area light levels below a **maximum** of 50 lux (5 footcandles).
- Control duration of exhibition to a **maximum** of 6 months. After a paper object has been exhibited for a total of 6 months, consult a conservator before each additional proposed exhibition. If the object is fragile, consult a conservator before the initial exhibition. See Section G. for alternatives to exhibiting original objects

  Note: Use the Exhibits Associated Module in ANCS+ to track the periods of time that an object is exhibited. You can then calculate the total time that the object has been exhibited. You will need to check individual loan records to determine whether an object was exhibited while on loan.

- Keep lights off in storage areas when they are unoccupied.

- Turn off lights when no one is in exhibit areas for extended periods of time.

Some design media are very stable when exposed to light. These include pure minerals such as:

- graphite
- most black printing inks

Where these media were used, the preservation of the object depends on the quality of the paper. For example, an 18th century broadside composed of black ink on rag paper can be exhibited using the maximum conditions stated above.

> ***The effect of light on paper objects is cumulative and irreversible. Do not exhibit original papers for more than six months (cumulative), except in consultation with a conservator. Maintain light levels at 50 lux (5 footcandles) maximum.***

7. *How can I tell if a paper object has been damaged by light?*

If a paper object has been exposed uniformly to light, fading or discoloration may be uniform and difficult to identify. If the object has been partially covered by a mat, check underneath the mat where the object has been protected, to see if the color is different.

Note: If the cover mat was of poor quality, the mat might have stained the paper object. It may be difficult to determine whether deterioration is a result of light damage, staining from the mat, or a combination of factors.

8. *What is the impact of gaseous pollutants on paper objects?*

Sulphur dioxide, nitrogen dioxide, and ozone are the primary gaseous pollutants that adversely affect paper collections (Wilson 1995). They are especially damaging when RH, temperature, and light exposure are high.

Oxides of nitrogen and sulfur combine with moisture from the atmosphere to form acids. Groundwood papers are especially vulnerable to acid attack (see Question 11. below, for sources of acid deterioration).

Other gaseous pollutants that may impact paper collections include:

- Acids
- Formaldehyde (used in plywood, particle board, certain foams and synthetic materials)
- Hydrocarbons
- Sulfides

Note: Most gaseous pollutants can be eliminated through the use of air purifiers (Wilson 1995). See *Tools of the Trade* for additional information.

Pollutant	Volume in parts per billion
Sulphur dioxide	5-10
Nitrogen Dioxide	5-10
Ozone	5-10

These recommendations are based on numbers from NISO TR01-1995 "Environmental Guidelines for the Storage of Paper Records."

Figure J.2. Suggested Maximum Levels of Major Gaseous Pollutants

9. *What is the impact of particulates on paper?*

Particulates come from several sources and can damage paper in many ways. For example:

- Sharp particles (sand, dirt) abrade paper and design media as they are dragged across the object's surface.
- Oily particles from engine exhaust, cigarettes, or cooking smoke may become embedded in paper fibers soiling the paper and providing food for mold and insects.
- Dust that is acidic or contains metal particles accelerates the chemical deterioration of paper.
- Dust contamination can cause irreversible deterioration because paper is fibrous and absorbent. Surface dust can usually be reduced, but rarely removed completely.
- Dust fibers can hold moisture in contact with objects and facilitate mold growth.

10. *How do I protect paper objects from dust and gaseous pollutants?*

Where practical, locate collections in storage and on exhibition away from:

- roadways
- loading docks
- parking lots
- outside doors
- photocopy machines
- woodworking and maintenance shops, and other sources of on-going pollution

DO....	*DON'T....*
remove paper from locations being painted	return paper to newly painted storerooms or exhibit cases until paint is thoroughly dry and fumes are gone
control dust through filters in ventilation systems, vacuuming, and dusting.	move dust around with brooms or redistribute dust by using vacuums that don't retain the dust in a filter

11. *What impact do acids have on paper objects?*

Acids are the primary cause of paper deterioration. They cause paper to become weak, brittle, and stained. The source of acids in paper include:

- materials used in the papermaking process, especially from 1850 to the present, such as alum-rosin sizing and lignin groundwood pulp
- residual bleaching chemicals, unstable iron gall ink, air pollutants
- direct contact with acidic materials (file folders, adhesives, mat boards, wood, unstable plastic sheeting)
- exposure to acidic vapors from closed document boxes or wooden storage drawers

Acids move from acidic materials (such as wood) to objects of reduced or no acid (such as rag paper). The rate of this *acid migration* is dependent on the moisture present. It is accelerated in humid conditions.

The concentration of acid is measured on the pH Scale, with numbers ranging from 0 to 14. The number 7.0 on this scale is neutral. All numbers below 7.0 indicate an *acidic* condition. All numbers above 7.0 indicate a basic or *alkaline* condition. The pH scale is logarithmic—a paper object with a pH 3.0 contains 10 times as much acid as an object with a pH 4.0, and 100 times as much acid as paper with a pH 5.0. **A desirable pH range for paper is 6.5 to 8.5**.

12. *How do molds and pests ffect paper objects?*

A complete description of the biological agents that affect museum objects can be found in Chapter 5: Biological Infestations.

Molds normally thrive in damp environments (RH levels over 65%) with still air. Molds:

- feed on fibers, sizings, coatings and adhesives
- grow on any material that provides moisture and organic nutrients
- destroy the sizing in paper

- cause patches of staining or discoloration
- leave paper structurally weakened and chemically altered

Insects consume parts of paper and leave damaging waste products on the surface. The types of insects that damage paper include:

- **bookworms** (the larval stage of the drugstore and cigarette beetle). Powder and small round holes in book covers or text block indicate an active infestation of bookworms.
- **silverfish** often eat partially through paper. Damage from silverfish can be found particularly in non-design areas of prints and watercolors.
- **cockroaches** feed on the ragged edges of paper and cardboard. Cockroach excrement also causes damage.
- **the common fly** seeks shelter in books or framed paper objects. Their acidic excrement is damaging to paper.

Mice can damage or destroy large collections of unprotected papers. Look for their nests by observing the concentration of droppings.

Your park should have an Integrated Pest Management (IPM) Plan, as well as a Housekeeping Plan and/or a Preventive Conservation Plan. These documents will provide you with important preventive conservation information for paper collections. In addition to regular monitoring, be sure to:

- inspect and isolate all incoming collections
- periodically monitor inside boxes, storage cabinets, exhibit cases, and other closed containers for evidence of pests and mold

D. Collections Maintenance

The park curator has primary responsibility for preventive care of museum collections. In addition to monitoring and controlling the environment, and recognizing symptoms of deterioration of collections, the curator needs to know appropriate techniques for:

- collections maintenance
- handling
- storage
- exhibition
- transportation of collections

1. *What is appropriate collections maintenance or a paper collection?*

The goal of preventive maintenance is to stabilize the collection and minimize the effects of deterioration. There are many non-interventive treatments that curatorial staff can undertake for preservation. For example:

- Remove dust from an item using an air bulb syringe.

- Use a soft artist's or cosmetic brush to gently remove loose dust before handling or storage of paper objects.

- Replace soiled or acidic folders with new, archival folders (acid-free or buffered depending on paper object). File names and other labels must be carefully copied onto the new folders. Retain old folders that contain any annotations that cannot be transcribed, such as sketches.

- Do not overfill folders.

- Remove original fasteners including staples, paper clips, string ties, rubber bands, brads, and straight pins (consult *Conserve O Gram* 19/5, "Removing Original Fasteners from Archival Documents"). Maintain the order and relationship of documents when removing fasteners. If a multi-page document cannot be feasibly stored without fasteners in its own acid-free folder, consult *Conserve O Gram* 19/6, "Attachments for Multi-Page Historic Documents."

- After removing deteriorated rubber bands from rolls of drawings, store the rolls in an acid-free tube. If the sticky residue from the rubber bands does not readily come off, interleave or cover the area with silicone release paper to keep it from sticking to other papers or the storage container.

- Remove stained prints from acidic mats. ***Note***: Do not attempt to remove the print if it is glued to the mat. Removing materials that are adhered to an object goes beyond stabilization. A paper conservator should treat this condition.

- Protect documents from acidic newspaper clippings. If the clippings must be left in place:

  - sleeve the clipping in a stable polyester folder (see Figure J.4., Types of Polyester Enclosures), or

  - interleave between the clippings and other documents with buffered paper

  If you can safely remove the clippings, photocopy the clippings onto archival paper and place the photocopies with the other documents. Store the original clippings separately. Some archives do not retain unannotated original clippings because of their acidity. The curator should make this decision based on the significance of the clippings, the park's storage capabilities, and other preservation and interpretive requirements, in consultation with the regional/SO curator.

- Unfold papers, such as correspondence, and store flat. Flat storage is preferable to rolling for all papers small enough to fit in map case drawers. Refer to *Conserve O Gram* 13/2, "How to Flatten Folded or Rolled Paper Documents."

> **Note: This procedure requires great care**. If the papers are damaged or brittle, and in danger of cracking, request the assistance of a paper conservator before attempting to unfold and flatten them.

You may sometimes need to separate objects, such as dissimilar materials that have different storage requirements. For example, photographic prints and negatives often are removed from a series of papers and stored with other prints and negatives in individual sleeves. In this case:

- Complete and insert an *Archival Separation Sheet* (see Figure J.6) in place of the removed item. Archival Separation Sheets are available in ANCS+.

- Enclose a photocopy on archival paper of the photographic print in place of the original

- Note the original and new locations of negatives and prints in both locations

You can isolate incompatible materials with barriers (sleeves, interleaving sheets), or by planned rearrangement, for preservation reasons. With careful notations, you can preserve the papers' proper relationships.

E. Handling Paper Objects

1. *What are appropriate handling guidelines for paper objects?*

Historic paper objects often are in fragile condition and require more than ordinary care to handle them safely. Require all collection users, be they outside researcher or park/center staff, to receive proper handling guidance before they are allowed to access collections. Review procedures in Chapter 6: Handling, Packing, and Shipping, and *Conserve O Gram* 19/17, "Handling Archival Documents and Manuscripts." **Damage from mishandling is preventable**.

To prevent mishandling of collections, be sure to:

- Prohibit food, drink, and live plants from all collection areas.

- Prepare a written set of procedures for handling (see the example in Figure J.7).

- Enforce the procedures; they only work if you consistently enforce them.

- Require all users to have clean hands and wear clean, white cotton gloves at all times while handling collections.

- Limit handling, and limit the number of people who handle objects.

- Provide a clean and uncluttered workspace.

- Provide each object with appropriate support.

- Ensure that staff with collections responsibility supervise handling by other staff and outside researchers.

- Use facsimiles or duplicates in place of rare or fragile originals (see *Conserve O Gram* 19/4, "Archives: Preservation Through Photocopying").

  The light and heat from repeated photocopying can damage original documents. Limit photocopying to the minimum needed for preservation, exhibit, and other use.

DO....	***DON'T....***
Wash your hands, remove all jewelry, and wear clean, white cotton gloves at all times	Hold an object by one corner
Always use both hands.	Grasp a rolled object; it can be crushed easily
Allow the weight of the paper or roll to rest in your hands	Flex the paper when placing it onto a support
Place the support on the same level as the object and slide the object onto the support	

2. *What are appropriate supports for handling paper objects?*

The types of supports necessary for safe handling depend on the format and condition of the paper object. The purpose of the support is to relieve the object of the strain of its own weight. **Always handle the object by its support**. Supports may be:

- **long-term**, such as housing or storage enclosures
- **short term**, such as a rigid sheet of paperboard to move the object from one location to another

Examples of appropriate supports for specific situations include:

- an acid-free folder for a manuscript letter on rag paper in good condition
- polyester encapsulation for a fragile architectural plan on tracing paper that has undergone conservation treatment and the pH is stable

Following are additional considerations for handling supports:

- Lightweight, rigid materials, such as archival corrugated cardboard are useful for moving single paper objects by hand.

- Closed supports (archival folders or portfolios) provide more protection than single sheets of cardboard, or open trays.

- Closed supports, such as boxes or portfolios on rolling carts, are good methods of transporting paper objects some distance, particularly if there are any tripping hazards or tight fits

3. *How do I handle rolled paper objects?*

Do not attempt to unroll brittle or desiccated papers. These require treatment by a conservator before viewing. Flexible rolls can be viewed even if the edges tend to curl. Small weights, such as squares of polished glass, weight bags (available from various archival supply companies), or 35mm film cans filled with lead shot can be used to hold down the object's edges. The weights must be smooth and clean to prevent damage to the paper.

If the object is too long for the available table space, it can be "scrolled." To scroll through a rolled object:

- Unroll only as much as can be supported by the examination surface.

- After examining the exposed part, re-roll from the free end (this gives you two rolls).

- Shift the position of the object carefully so that more can be unrolled.

- Proceed this way until the entire object has been viewed.

- Work slowly and cautiously. The edges of tears tend to spring apart and can cause the object to be torn further.

4. *How do I insert or remove an object from a polyester nclosure?*

Objects being inserted into or removed from polyester enclosures are extremely vulnerable to tearing because of the static charge on the polyester film. To insert a limp or very lightweight object into a polyester enclosure:

- Use a sheet of 20 lb. acid-free paper as a temporary support.

- Hold the enclosure open and insert the object on its support.

- Allow the enclosure to close, and lightly rub the film with a lint-free cloth (such as cheesecloth) to build up a charge directly over the object. The static charge should help keep the object in place. See also *Conserve O Gram* 13/3, "Polyester Encapsulation."

When removing an object from a polyester enclosure:

- Watch carefully and go slowly.

- Cut through the polyester if the enclosure is sealed on four sides. The least strain is placed on the object if the seals are cut.

- Remove the top layer of polyester by rolling it up if the enclosure is open on 3 sides.

- Separate the top sheet of polyester by lifting its free corner if the enclosure is sealed with an L-seal.

- Cut a second side, then separate the sheets of polyester on a single-opening enclosure by inserting a microspatula or other flat tool.

- If possible, insert a piece of acid-free paper under the object for support as you remove the object from the enclosure.

The static charge that holds the paper object in the polyester enclosure is a disadvantage when you want to remove the enclosure. If the paper does not release easily from the polyester, gently slide a microspatula between the paper and enclosure, following with the acid-free support paper. If the edges of a torn paper adhere to different sheets of the polyester film, also use the spatula to release one edge and hold that edge in place while you remove the film.

F. Storing Paper Objects

1. *What are the guidelines for storing paper collections?*

See Chapter 7: Museum Collection Storage, for standards and requirements, assessing needs, and planning spaces. You can find information on storage supplies and equipment in Chapter 7, *Tools of the Trade*, and *Conserve O Gram* 4/1, "Museum Storage Cabinets." For archival storage and handling information, consult *Conserve O Grams*:

4/1 "Museum Storage Cabinets."
19/15 "Storing Archival Paper-Based Materials"
19/16 "Housing Archival Paper-Based Materials"
19/18 "How to Care for Bound Archival Materials"

Like many other items, paper objects require housings for protection and safe handling in storage cabinets and on shelves. Within the storage environment, housings and enclosures provide the most immediate protection for paper objects. The purpose of the housing system is two-fold, it:

- facilitates the physical organization of the collection

- provides an environment that is as chemically and physically stable

Enclosures are in prolonged and direct contact with objects so it is critical that enclosure materials meet certain specifications. Products of this type are usually called *acid-free*, or *archival.* Scientists at the National Archives and Records Administration (NARA) and Library of Congress are actively engaged in developing standards and testing materials to be used near paper objects. The NPS Museum Management Program acts as a clearinghouse for information on appropriate museum collections storage materials. *Tools of the Trade* and the *Conserve O Gram* series provide updated information on appropriate materials. New developments are also posted to various conservation web sites (see Section L. below).

2. *What are acid-free and archival materials?*

Acid-free and *archival* are general names applied to a variety of plastic and paper products designed for use in proximity to museum objects. When used for the sleeves, boxes, and folders that store paper objects, these products must be free of acid, lignin, alum, and sulfur. The four most commonly used terms are as follows:

- **Archival quality** is a generic term indicating that the product is appropriate for use in contact with your collection objects.

- **Acid free** is also a general term indicating that the product is free of acids, or has a pH of approximately 7.0. This term is often used incorrectly to describe materials that contain alkaline buffers.

- **Alkaline-buffered** products contain an alkaline compound (such as calcium carbonate) designed to neutralize any acids that are present, or retard the evolution of acids in the future. Alkaline-buffered products are often used to interleave between paper objects that might transfer acids to surrounding objects, and generally are in the pH 8.5 range.

- **Unbuffered** or **nonbuffered** products have no alkaline reserve. Generally, they are a neutral pH (7.0) or acid-free material.

- **100% rag** paper products are made exclusively of cotton fibers. Although of good quality, 100% rag paper products do not meet the standards of permanence necessary for the long-term storage of museum collections.

- **Lignin-free** and **pure alpha-cellulose** are terms used to describe some manufactured storage papers, boxes and cardboards. These are made from woodpulp fibers that remain after the lignin is chemically removed.

Two other terms you may see are **neutral** and **inert**. *Neutral* applies to materials that have a pH of around 7.0. You may find this term applied to both paper and plastic materials. The term *inert* is most often applied to materials like polyester film and acrylic sheets like Plexiglas®. It means that the material will not react chemically with your paper objects.

3. *How do I know which archival paper products to use with the various types of paper objects?*

Buffered paper can prolong the life of an enclosure, and absorb excess acidity from the papers contained inside. Be sure to periodically check buffered enclosures and interleaving papers for acidity. Acids can migrate back to the original documents if you do not replace old enclosures and interleaving papers when necessary. Use a pH testing pen to test acidity levels of enclosures and interleaving papers.

Note: Alkaline buffering damages some paper objects. For example, the buffer alters blueprints.

The following chart lists various paper objects paired with appropriate enclosure papers. Contact a paper conservator for assistance if you are uncertain about appropriate products to use with your collection.

Store Using *Buffered* Materials	Store Using *Unbuffered* Materials
Flat documents	Leather albums and collages with wool or silk components
Manuscripts	Blueprints
Maps	Hand tinted materials (may include some maps, prints, and drawings)
Most papers (see exceptions under unbuffered materials)	Diazo reproductions
Posters	Friable media (especially charcoal and pastel) should be stored in shallow boxes
Prints and drawings (see exceptions under unbuffered)	Watercolors and photographs

Some products are not available in unbuffered form except by special order. Buffered stock can be lined with polyester film to prevent the object from contacting the buffered paper. *Tools of the Trade* contains information on many of the typical products used in NPS museums for storing paper objects.

4. *How do I know which plastic products to use with the various types of paper objects?*

All plastic materials used for collection storage must be chemically inert. Acceptable plastics are free of powders, coatings, plasticizers, and other additives. Information on the exact composition of plastics should be available from the distributor. See *Tools of the Trade*, Chapter IX: Equipment and Supply Sources, for a listing of vendors.

Common Plastic Products	
Use...	***Avoid….***
• stable polyester • polyethylene • polypropylene	• polyvinyl chloride (vinyl, PVC) • polystyrene

Archival polyester film is the housing material most commonly used for paper collections. It is one of the most dimensionally stable and chemically inert plastics available. However, this and other plastics can develop a static charge that can attract loose media. Do not use plastic housings for objects with:

- powdery or friable media (charcoal or pastel)
- drawings or documents in graphite pencil
- objects with cracking or peeling media
- very deteriorated iron gall ink

5. *Are there any other situations when I should not use plastic products for storage?*

Do not encapsulate papers or house them in polyester sleeves if you cannot maintain proper environmental levels in your storage and exhibit areas. An improper environment can cause moisture to become trapped inside polyester enclosures. Such moisture can damage the object.

6. *What are diazotype reproductions and how should I store them?*

Diazotype reproductions are the familiar white paper with blue print used to print plans, maps, and similar oversized documents. Diazotypes off-gas ammonia that can damage other documents; **be sure to store diazotypes separately in their own cabinet**.

7. *What specific types of enclosures are available for paper objects?*

There are a wide variety of commercially available enclosures for paper objects. See *Tools of the Trade* for descriptions and vendors. While commercial products will be appropriate for most materials in your collection, you may need to make custom enclosures for oversized or oddly shaped objects, and those in very fragile condition. Figure J.3. lists common enclosures, their uses, and cautions about their uses.

Figure J.3. Types of Enclosures

Enclosure type	*Sizes*	*Typical Uses*	*Cautions*
10 point paper folders	Standard (10" x 12") Legal (10" x 15")	Small, flexible objects in good condition	Do not use if paper object is brittle
20 point paper folders (map folders)	Sizes over 20" x 24"	Small to medium sized objects requiring more support than 10 point folders offer	
20 lb. paper folders	Standard and legal	Light-weight folders used within 10 point folders to protect fragile documents stored vertically in document boxes	These folders are suitable only for single sheets and sets of sheets in good condition
20 lb. paper interleaving sheets	Letter size (8 ½" x 11") Legal size (8 ½" x 14")	Placed between objects in a folder; segregating paper objects in good condition from newspaper clippings	
Polyester enclosures (also see Figure J.4., Types of Polyester Enclosures)	Various sizes; several weights and thicknesses (1, 3, 5 and 10 mil)	Housing fragile or torn objects that can be kept together by the static attraction of the enclosure	Can tear fragile paper if not opened carefully; not appropriate for powdery or flaking media (charcoal, chalks, pastels, desiccated paint and inks)
Matboard enclosures	Can be made to size (see *Conserve O Gram* 13/1, "Window Mats for Paper Objects"), 2, 4, and 8-ply thickness	Appropriate for objects being framed for exhibit; added support for objects in polyester sleeves; use thicker types as supports for carrying objects	Thinner boards are flexible and not appropriate for brittle objects; avoid covering edges or face of fragile media with matboard
Corrugated paperboard	Single or double-walled construction; available in sheets 24" x 48" and larger	Similar uses to matboard; very strong. Use to make customized supports, crease and fold to make wedges to fill space within document boxes	Single-walled boards tend to warp in larger sizes
Enclosure type	*Sizes*	*Typical Uses*	*Cautions*
Boxes (See also Figure J.5, Types of Boxes)	Variety of sizes and designs for vertical and horizontal storage	Appropriate for housing multiple objects in enclosures (mats, folders); three-dimensional objects	Do not overfill or allow to become too heavy to handle easily

Figure J.4. Types of Polyester Enclosures

Type	*Description*	*Uses*	*Cautions*
Folders	Sealed on one side (usually lengthwise)	Temporary housing for fragile single sheets being processed; protect single sheets during handling by researchers	Use care to prevent the document from sliding out the unsealed sides
L-seal pockets	Sealed on two adjacent sides	Appropriate for thin pamphlets, single sheets in fragile condition, single sheets of groundwood paper	Use care to prevent tearing the object as it is inserted into the folder

Type	*Description*	*Uses*	*Cautions*
Sleeves	Sealed on two opposite sides (usually lengthwise)	Used in conjunction with supports for thin objects that cannot be flexed (placecards, photographs)	
3-seal pockets	"Open-short" or "open-long", depending on which one of the 4 sides is left unsealed	Appropriate for thick pamphlets and bulky objects; used with rigid inserts for objects that cannot be flexed	Open-short format provides more support than an open-long pocket
Multi-pocket sheets	Various sizes with pockets that vary in size depending on the number per sheet	Minimize storage volume for smaller objects such as advertising cards, baseball cards, small photos	Only appropriate for single sheets in reasonably good condition
Encapsulation (see *Conserve O Gram* 13/3, "Polyester Encapsulation")	Enclosure sealed on 4 sides with ultrasonic or heat seal, or 3M Scotch Brand Double-coated Tape No. 415®	Used for fragile, brittle, or torn objects and objects subjected to frequent handling	Acidic papers should be treated by a conservator before encapsulation to avoid accelerated deterioration, or add a buffered sheet

Figure J.5. Types of Boxes

Type	*Description*	*Uses*	*Comments*
Document	Sizes from 3" x 5" to 10" by 15"; hinged lids	Used to store groups of objects in enclosures, such as folders; objects are removed by lifting the enclosures up and out	Do not use handles that protrude into the interior of the box that can catch on the enclosures and objects inside the box.
Card	Sizes range from 3"x3"x5" to 8"x5"x10" and may have hinged or separate lids	Prints, computer discs, postcards, stereocards	
Solander or Clamshell (also called Portfolio)	Sizes range from 8"x10" to 20"x24"; clamshell boxes are hinged and open completely flat	Used for horizontal storage of paper objects, usually in mats or folders; suitable for works of art on paper	Store objects of different dimensions in standard sized enclosures sized to the box to prevent shifting or sliding in the box
Garment, quilt, oversized	Lidded boxes ranging in size from 13"x15"x10" to 16"x58"x6" and made of heavy corrugated paper or polyethylene board	Suitable for oversized objects or groups of smaller boxes; can be fitted with compartment dividers	Do not overfill
Archival Records Storage	10"x12"x15" boxes with hand holes cut into either end for carrying; lift-off lid; corrugated paper or polyethylene board	Generally used for vertical storage of papers in good to fair condition that are housed in folders	Do not use to hold fragile archival materials or those of high intrinsic value

When choosing any of these products, keep the following in mind:

- have a modular system of standard sizes
- be sure that housings fit snugly inside boxes and drawers so that objects cannot shift or slide

- when storing paper objects together in boxes or drawers, house them in the same size enclosures. Choose the size of the enclosure based on the size of the largest object

8. *What kinds of equipment should I use to store collections of paper objects?*

Be sure to utilize appropriate storage equipment to physically support paper objects in their enclosures. Use storage equipment to:

- protect the collection from abrupt environmental changes
- protect objects from pest infestations
- maximize the available storage space

Only use storage equipment that is constructed of chemically inert materials. Modular storage units afford the most efficient use of space and retrieval of objects. Refer to Chapter 7: Museum Collection Storage and *Tools of the Trade*, for further guidance.

The most commonly used types of storage equipment for paper collections are:

- **map cabinets** (also called flat files)
- **shelving units**

Only store documents vertically in file cabinets if they are in very good condition and are well supported in their enclosures.

Use **flat files** or **map cabinets** to store objects too large for boxes.

- All objects should be in enclosures.
- Map cabinets with shallow drawers are more efficient than those with deeper drawers. Store objects of varying sizes in uniform folders that are the size of the drawer.
- Fill empty spaces with blocks of polyethylene foam.
- Separate stacks of enclosures or rolled papers within a drawer with dividers made of archival cardboard.

Stack objects in piles of 1" or less in flat file drawers.

Use **shelving** to store objects in boxes. Use adjustable shelves and place shelves close enough together that boxes cannot be stacked. Roll oversized paper objects around archival tubes and store on end supports.

G. Exhibiting Paper Objects

It's difficult to find an acceptable balance between the benefits of exhibiting original paper objects and the resulting damage. For objects of high intrinsic value, there is no level of loss that is acceptable. For other objects (duplicates, objects of no intrinsic value), there may be a level of loss that is acceptable, such as fading that is imperceptible to the human eye.

To ensure preservation of papers on exhibit:

- **Obtain a copy of the CD-ROM publication *Exhibition Conservation Guidelines: Incorporating Conservation into Exhibit Planning, Design and Fabrication***, available from the Department of Conservation at Harpers Ferry Center. This resource contains a wealth of guidance on developing preservation-responsible exhibitions.

- **Do not exhibit papers for more than six months** (cumulative). Six months of cumulative exposure to controlled, low light levels (50 lux or less) is the maximum exhibition time for original paper objects. Consult a conservator before exhibiting original objects for longer than six months. **Only facsimiles are appropriate for "permanent exhibits."** Be sure to distinguish between facsimiles and duplicates as follows:

  – Facsimiles are new copies of the original objects.

  – Duplicates are multiple originals, such as lithographs and blueprints.

In some collections there may be several identical copies (duplicates) of an object, such as a lithograph map. In some instances, it may be appropriate to treat one of the duplicates as a facsimile for exhibition purposes. It is not appropriate to take this approach if those objects have acquired unique characteristics. For example:

- blueprints (originally printed in multiple copies) containing annotations documenting plan changes made during construction

- the only extant copy of an object originally made in multiples

1. *How can I limit the risks of exhibiting paper objects?*

Do the following:

- Control temperature, relative humidity, pests, and air pollution.

- Eliminate all sources of ultraviolet light.

- Limit light intensity to 50 lux or less.

- Use appropriate display materials in formats that properly support the object.

- Limit the duration of exhibit and/or rotate specific objects to and from storage.

2. *Which formats are appropriate for displaying paper objects?*

Paper objects on exhibition require special protection. The exhibit mount must provide physical support to avoid mechanical damage. It also must protect the objects from direct handling. The exhibit case protects objects from vandalism.

Paper objects are exhibited in frames or display cases.

- Frames are appropriate for single sheet objects that are strong enough to be displayed upright in a mat, such as:
  - prints
  - drawings
  - manuscript materials
- Cases are required for objects that cannot be housed safely in a mat, such as:
  - multi-sheet objects
  - oversized objects that can't be framed
  - thick, or heavy objects like books

Be sure that exhibition mats and mounts are larger than the object to fully protect its edges. <u>NEVER FOLD OR TRIM AN OBJECT</u> to fit into a housing enclosure.

3. *What guidance is available for matting and framing paper objects?*

Consult *Conserve O Grams* 13/1, "Window Mats for Paper Objects" and 13/4, "Exhibit Mounting Variations for Objects on Paper," *Matting and Framing Works of Art on Paper* by Elizabeth Kaiser Schulte, Hilary A. Kaplan, and Chris Foster, available on the web at: <http://aic.stanford.edu/treasure/matt.html>, and *Caring for Works of Art on Paper*, on the web at: <http://aic.stanford.edu/treasure/paper.html>.

If you hire a commercial framer, request references of other museum customers and be sure to include a scope of work that specifies their adherence to the guidance listed in these publications.

H. Working With a Conservator When Treatment is Needed

Care of NPS museum collections is based on a preventive conservation approach to preserve objects. Sometimes, however, preventive measures are inadequate, and conservation treatment is necessary to preserve an object. Review Chapter 8: Conservation Treatment, for detailed guidance. See Section J, Glossary of Terms Used to Describe Condition, for definitions of paper condition to aid in discussing the needs of your collection with a conservator.

Conservation treatment is active ("hands-on") work to preserve and/or restore objects. Only trained conservators who have specific expertise should treat paper objects in your collection. If conservation treatment is required, park staff must ensure that:

- objects receive the most appropriate treatment for their preservation and use
- treatment is appropriate (consider the object's condition, history, significance, and use)
- treatments are performed by skilled, experienced conservators and documented properly

1. *How do I know which objects require conservation treatment?*

It is easy to determine treatment needs if objects are extremely fragile, or damaged in such a way that they cannot be displayed. However, it is important to have an overall plan for dealing with the preservation of your entire collection. Therefore, it is important to have a Collection Condition Survey completed by a paper conservator to identify the entire range of problems, and develop priorities for treatment. A survey also will identify housing issues, and minimally interventive treatments that you can undertake to better preserve the collection.

2. *What is stabilization versus treatment?*

Sometimes stabilization is as simple as removing a paperclip or using buffered paper to prevent acid migration. Stabilization of a torn document may be accomplished through encapsulation, or through mending.

The goal of stabilization is to allow the object to be researched, exhibited, and handled without damage. Work with a paper conservator to determine the amount of stabilization required to meet that goal.

Conservation treatment can actually change the chemical or physical stability of a paper object.

3. *What restoration treatments are appropriate for paper objects?*

Restoration treatments are intended to return objects to a known or assumed former state, often through the addition of non-original material. Keep the following points in mind to determine if restoration is an appropriate option:

- Restoration treatments should be undertaken only if absolutely required for exhibition or research purposes.
- There must be sufficient data about the object's earlier appearance to enable accurate restoration.
- Restoration must not modify the object's known original character.

- Restoration should be accomplished using the techniques and materials that will least modify the item.

- Restoration materials should be removable at a later time with minimal adverse effect.

- Restored areas should be distinguishable from original material upon careful examination.

- Restoration and the use of added materials must be well documented.

- All restorations will preserve significant evidence of use and other historical evidence.

4. *What cleaning techniques are appropriate for paper objects?*

You can remove dust from stable media with an air bulb syringe, a soft artist's brush, or a cosmetic brush. Refer all other treatments to a paper conservator.

Note: Some computer-generated documents may have ink/toner that didn't properly bond to the paper originally. Do not use a brush to clean such papers, as you could remove toner from the page. Consult a paper conservator.

5. *Can acidity be removed from paper to prolong preservation?*

Yes. A paper conservator often can use a water-based treatment to reduce paper acidity. There also are various treatments to neutralize acids. However, certain pigments, dyes and inks may fade or change color, and some papers darken with these treatments. A paper conservator will be equipped to determine if these treatments are appropriate.

6. *Are deacidification sprays appropriate for use on aper collections?*

Only a paper conservator should determine whether any form of interventive treatment is appropriate for your collection. These sprays may irreparably change the character of a paper object. **Use only under the guidance of a qualified conservator.**

I. Emergency Procedures For Paper Collections

Your collection is unlikely to be damaged by floods, hurricanes, or tornadoes. However, no park is immune from the threat of emergencies. A broken pipe can do untold damage to a paper collection, causing sheets to stick together and media to run and stain adjacent objects. Both a disaster plan and recovery plan are critical to ensuring the collection's preservation. Review Chapter 10: Emergency Planning for guidance. Make sure that:

- Collection needs are addressed in your park's Emergency Operations Plan

- Local authorities are aware of the special needs of your collections and are familiar with the layout of your exhibition and storage areas

- Sufficient recovery supplies are readily available (see *Conserve O Gram* 21/2, "An Emergency Cart for Salvaging Water-Damaged Objects")

Also review *Conserve O Gram 21/4*, “Salvage at a Glance, Part I: Paper Based Collections.”

J. Glossary Of Terms Used To Describe Paper Condition

Abrasion: surface loss caused by friction

Accretion: deposit of extraneous material on the surface of an object

Brittleness or Embrittlement: loss of flexibility causing paper to break or disintegrate when bent

Cockling: buckling or waving of the paper caused by expansion and contraction under changing atmospheric conditions

Crease or fold: line or mark made by bending or folding the paper

Dent: concave defect in the surface

Deterioration: breakdown of the paper caused by added ingredients or by natural aging

Discoloration: changes in color, such as darkening or fading

Dog-ear: term commonly used to describe a diagonal crease across the corner of a page

Fading: discoloration seen as a loss of color and sometimes with a change of hue

Flaking: lifting and sometimes loss of flat areas of the surface layer

Foxing: brown or reddish-brown spots caused by mold or the oxidation of iron particles in the paper support, mount, or backing

Insect damage: holes, surface loss, or organic residue from insect infestation

Gouge: defect in the surface caused by a blow where material has been scooped out

Loss: missing area or hole

Mold: group of small fungi that grow under warm, moist conditions on organic substrates causing the breakdown of the substrate

Mount: materials to which paper objects are attached for additional support

Substrate: the paper itself

Surface dirt: dirty material either loosely distributed on the surface of an object (dust) or firmly ingrained in the surface (grime)

Tear: linear break in paper resulting from tension or torsion

K. Selected Bibliograpy

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- 11/2 Storing Works on Paper
- 11/3 Glazing Materials for Framing Works on Paper
- 11/6 Removing Paper Artifacts from Their Frames

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- 13/1 "Window Mats for Paper Objects."
- 13/2 "How to Flatten Folded or Rolled Paper Documents."
- 13/3 "Polyester Encapsulation."
- 13/4 "Exhibit Mounting Variations for Objects on Paper."
- 19/2 "Care and Security of Rare Books."
- 19/3 "Use and Handling of Rare Books."
- 19/4 "Archives: Preservation Through Photocopying."
- 19/5 "Removing Original Fasteners from Archival Documents."
- 19/6 "Attachments for Multi-Page Historic Documents."
- 19/7 "Archives: Reference Photocopying."
- 19/9 "Caring for Blueprints and Cyanotypes."
- 19/15 "Storing Archival Paper-Based Materials."
- 19/16 "Housing Archival Paper-Based Materials."
- 19/17 "Handling Archival Documents and Manuscripts."
- 19/18 "How to Care for Bound Archival Materials."
- 21/2 "An Emergency Cart for Salvaging Water-Damaged Objects."
- 21/4 "Salvage at a Glance, Part I: Paper Based Collections."

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L. Selected World Wide Web Resources

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American Society of Heating, Refrigerating and Air-Conditioning Engineers: <http://www.ashrae.org>.

Canadian Conservation Institute: <http://www.cci-icc.gc.ca/>

Conservation OnLine (CoOL): <http://palimpsest.stanford.edu/>

The Getty Conservation Institute: <http://www.getty.edu/conservation/institute>.

Library of Congress: <http://www.loc.gov/preserv/>

National Archives and Records Administration: <http://www.archives.gov>

National Information Standards Organization: <http://www.niso.org>

National Park Service *Conserve O Gram* series:
<http://www.cr.nps.gov/museum/publications/conserveogram/cons_toc.html>

Society of American Archivists: <http://www.archivists.org/>

US Department of the Interior
National Park Service

Archives and Manuscript Collections Separation Sheet

Document Type (map, newspaper clipping, photograph, etc.) Catalog/Accession Numbers

Document Description (Include collection name; dates; group organizational, personal, and place names; and topics [who, what, where, why, when, and how], etc.)

Item Originally Filed (Collection identifier: specific location, box #, folder #, drawer #, sequence in unit, etc.)

Item Now Filed (Specific location: room #, shelf #, box #, folder #, drawer #, sequence in unit, etc.)

Separated By: Separation Date:

NPS Form 10-645
July 1995

Figure J.6. Archival Separation Sheet (available in ANCS+)

US Department of the Interior
National Park Service

RULES FOR HANDLING ARCHIVAL COLLECTIONS

1. Researchers (NPS and non-NPS staff) must be accompanied by museum staff at all times while in the collection research area.

2. Smoking, drinking, and eating are not allowed in any museum areas.

3. Briefcases, folders, coats, hats, umbrellas, backpacks, or other similar items are prohibited from the research area.

4. All researchers must remove necklaces, watches, bracelets, rings, and other jewelry.

5. All researchers must wear a pair of clean white cotton gloves at all times when handling collections.

6. Keep hands clean even when wearing gloves. All materials and surfaces in contact with the item must also be clean.

7. Handle papers as infrequently as possible.

8. **Only pencils** are allowed when working with collections.

9. Handle every item as though it is irreplaceable and the most valuable in the collection.

10. Researchers are limited to one folder at a time and must sign it out in the receipt book.

11. When finished working with a folder return it to the staff. Circulation to other patrons is prohibited.

12. Save all information that is associated with an item (e.g., folders, tags, labels, notes, etc.).

13. Only staff members are authorized to photocopy original materials. If you require duplication services, notify the staff.

14. If you have any questions or if any problems develop, notify the staff immediately.

Figure J.7. Example of Procedures for Handling NPS Archival Collections

Appendix K: Curatorial Care of Textile Objects

List of Figures:

APPENDIX K: CURATORIAL CARE OF TEXTILES

A. Overview

1. *What information will I find in this appendix?*

This appendix discusses the physical characteristics of textiles and outlines guidelines for their long-term care and preservation. Many different kinds of objects are called textiles. They include:

- quilts and bed covers
- clothing
- tapestries and wall hangings
- rugs
- baskets and mats
- upholstery
- embroidered samplers and other household decorations

The main topics covered in this appendix are:

- textile materials, added materials, and their manufacture
- agents of deterioration
- handling, storage, display, and transportation of textiles
- working with a conservator when treatment is needed
- specific emergency procedures for textiles

2. *Why is it important to practice preventive conservation with textiles?*

The role of preventive conservation is to avoid, block, or minimize the ***agents of deterioration***. This practice will decrease the need for costly and time-consuming conservation treatments.

Textile objects are among the most sensitive in museum collections. They are affected by light, require controlled relative humidity and temperature, and are susceptible to damage from dirt, mold, insects, pollutants and abrasion. A textile's rate of deterioration slows significantly with proper preventive care. Practicing preventive conservation also reduces the likelihood of accidents.

3. *How do I learn about preventive conservation?*

Read about the agents of deterioration that affect textiles so that you can create a preventive conservation plan. These agents are discussed in detail in Section D. Understanding how to protect your textiles from the agents of deterioration will lengthen the life of your textiles. See Chapter 3: Preservation: Getting Started, and Chapter 4: Museum Collections Environment, for a discussion on the agents of deterioration. Also refer to

Museum Handbook, Part III (*MH-III*), Chapter 7: Using Museum Collections in Exhibits.

4. *Where can I find the latest information on care of these types of materials?*

There are a variety of sources for up-to-date information about textiles:

- Read the NPS *Conserve O Gram* series.
- Review the references in the bibliography. Especially note practical information found in *CCI Notes*, Section 13, Textiles and Fibres.
- Look up the World Wide Web sources that are listed at the end of this appendix.
- Consult a textile conservator.
- Consult a curator or collections manager of a large textile collection.

B. The Nature of Textiles

The history of textiles goes back to the Stone Age. Long plant fibers were intertwined and made into baskets and mats. Basket making formed the basis of weaving technology. *Spinning*—twisting short fibers together to make a long thread—made it possible to use wool, cotton, and silk to make textiles.

Textiles are combinations of fibers, dyes, and finishes. Some textiles are decorated with thread (*embroidery)* and non-textile materials like shell, bone, and metal. It isn't possible to discuss all of these materials in this appendix. Consult the bibliography and list of resources at the end of this appendix for more detailed information

1. *What fibers are used to make textiles?*

Before the 20th century, natural fibers were used to make textiles. These fibers come from two main sources:

- animal fibers
  - hair
  - wool
  - silk
- plant fibers
  - stems
  - leaves
  - seeds

Twentieth century textiles may include synthetic fibers. These include fibers made from natural materials, mainly cellulose or proteins, and include:

- rayon

- cellulose acetate
- triacetate
- natural rubber

Other polymers are created in the laboratory. These include:

- nylon
- polyester
- polyurethanes

Some textiles include metal threads or yarns that are metal and fiber combinations. These can include any combination of metals and alloys, and backings or support materials.

2. *What are the characteristics of animal fibers?*

Animal fibers are made of chain-like molecules of proteins. The basic properties of the fibers are determined by the arrangement of these proteins. The arrangement of the proteins in wool explains why wool stretches and silk is more rigid.

Hairs are usually long and coarse and come from the outer coat of an animal. They are not always woven into fabric. Two examples of their use are:

- padding in furniture and clothing (horse hair)
- felt (made of rabbit hair rather than wool)

Examples of hair fibers that can be spun into yarn that is knitted or woven are:

- cashmere (goat hair)
- angora (rabbit hair or goat hair)
- mohair (rabbit hair)

Wool is the undercoat of sheep. Four factors determine the quality of wool yarn:

- the breed of animal
- the health of the animal
- the shearing process
- the cleaning process

Wool fibers have a “crimp” that lets the fibers cling together and makes them easy to spin. The elasticity and crimp of wool fibers varies by the breed of the sheep.

Silk is the long, continuous filament that comes from the cocoon of silkworms. The molecular structure is rigid. Therefore, silk does not stretch easily. Silk is sometimes treated with finishes and materials that add body and weight to the fabric. The effects of these materials are discussed in Section C.2 of this appendix.

3. *What are the characteristics of plant fibers?*

Plant fibers are composed mainly of cellulose molecules. The basic properties of the plant fibers are determined by the rigid structure of fairly regular chemical groups that attract water. The presence of water makes the fibers flexible and resistant to breaking.

Fibers can come from the stem, leaf, or seeds of plants. After harvesting, the fibers are separated, cleaned, and processed for spinning into thread. Each of these processes has an impact on the quality of the thread, and can influence the long-term preservation of a textile.

Flax is the most common stem (bast) fiber. Flax fibers are spun to make **linen** thread. Flax is soaked in water to loosen the fibers from the inner bark of the plant. This process, called *retting*, causes the fibers to decompose slightly. Further mechanical processing is needed to release the fibers from the bark. These fibers are hard, and not elastic. In processing, linen is:

- strong when wet
- resistant to heat
- difficult to bleach
- difficult to dye to concentrated colors

Leaf fibers are hard and strong. They are good materials for rope, cords, sandals, and baskets. Some examples that may be in collections are:

- sisal
- raffia
- abaca
- hennequin
- yucca

Cotton is the most common seed fiber. Cotton is nearly pure cellulose, and the fiber is relatively rigid. *Mercerization*, a common processing technique introduced in 1844 makes dyeing easier. It also adds softness and flexibility to cotton fabric. Other seed fibers are:

- coir (coconut fiber)

- kapok

4. *What are the characteristics of synthetic fibers?*

Synthetic fibers have been designed to have a variety of performance characteristics. For example, polyester is very strong and resists wrinkling. You should not assume that synthetic fibers are sturdier than older fibers, or even contemporary textiles made of natural fibers. Synthetic fabrics have only been available in large quantities since the 1930s. We already know that some of these fabrics do not age well. Others have not been studied long enough to know the long-term effects of aging. Monitoring the condition of 20th century textiles in collections will help conservators develop a picture of long-term changes in characteristics and preservation concerns for synthetic fibers.

5. *What are the characteristics of metal threads?*

Metallic threads can be woven into the structure of a fabric or used for embellishment. The metals are subject to oxidation (see Appendix O: Curatorial Care of Metal Objects). Metallic threads are produced in various forms including:

- gold metal layer on silver strip
- gold, silver, and other metals and alloys cut into thin strips
- small diameter metal wires of gold, silver, and copper alloys
- thin strips of metal wound around a core of thread (usually silk or linen)
- thin sheets of metal applied to leather or paper
- metallic powders and pigments applied to Mylar® or other synthetic backings

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C. The Fabrication of Textiles

There are many techniques that result in cloth or cloth-like materials. Fabrication also includes the addition of color (dyes), finishes, and other decorations. It is the structure that is important in determining the characteristics of the cloth and is directly related to its ultimate use.

1. *What techniques are used to make textiles?*

Some of the techniques used to make textiles are included here:

Felting is the process of using heat, water, and pressure to interlock loose fibers together. The best raw material is sheep wool because of its chemical structure and crimp. Lacquers and sizings can be used to stiffen the felt for particular uses. The same basic techniques for making wool felt are used today with synthetic fibers to produce synthetic felt.

Spinning is the process that converts short fibers into long threads or yarns. Loose fibers are pulled from a mass of prepared animal or plant fibers and twisted to create the yarn. This can be done by rolling the fibers down the spinner's thigh, by using a spindle, or by using a spinning wheel.

Netting is produced from a single, continuous strand using a tool called a shuttle. The thread is looped and may be knotted. Netting is the basis of some lacemaking and tatting. Knitting and crocheting are other looped structures.

Lacemaking refers to a variety of techniques that involve the intricate twisting of fine threads to form a pattern. These include needlelace and bobbin lace that use combinations of twisted, crossed, plaited, and knotted structures.

Macramé is a knotting technique that uses more than one strand of yarn. This technique is used primarily for fringes and edgings.

Weaving is the making of cloth by interlacing threads of the warp and weft on a loom.

- *Warp* is the parallel yarn stretched on a loom (lengthwise).

- *Weft* is the transverse yarn interlacing with the warp in a pattern.

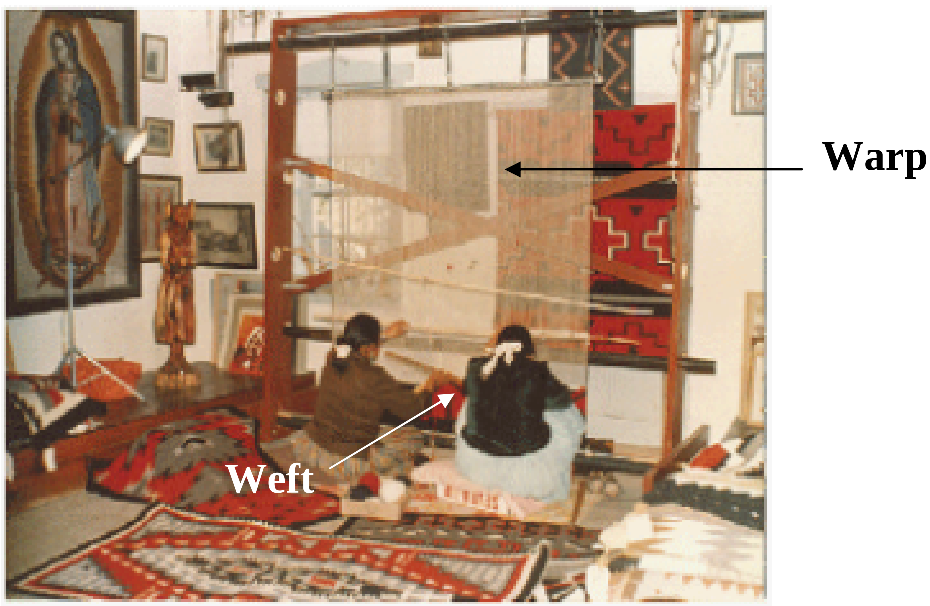


Figure K.1. Upright loom. (Weavers Mae and Sadie Curtis of Ganado at Hubbel Trading Post. Photograph by Fred Mang Jr. HUTR-23347)

Many structures and variations have been developed to produce fabric. The simplest structure of weaving (*plain weave*) is over-one, under-one interlacing of perpendicular warp and weft elements. The structure determines the characteristics of the fabric. Detailed discussions of weaving can be found in references listed in Section Q of this appendix.

2. *What kinds of finishes are used on textiles?*

Few textiles are simply processed fibers made into cloth. Dyes, lubricants, chemical compounds, mechanical treatments, sizing, water and stain repellents, mothproofing, and flameproofing are some of the treatments that prepare fabrics for use.

- *Dyes* are plant materials and various chemicals that add color to textiles. There are two general categories of dyes:

– natural (from plants, some insects, and some mollusks)

– synthetic (chemically produced colors developed in the 19th century)

Many natural dyes have good wash and light fastness. Early synthetic dyes are known for their harsh, bright colors, and poor wash and light fastness.

Some dyes have an affinity for textile fibers, but most require assistance to attach to the fibers. These chemicals, called *mordants*, are usually metallic salts applied to the cloth before dyeing begins. Mordants also can modify the dye color (different mordants used with the same dye material produce different colors).

Natural dyes mordanted with iron produce a black or brown-black color. These dyes deteriorate and destroy the fiber. Many printed cottons and tapestries used iron-mordanted yarns to outline designs. Often there are holes left in the fabric where these yarns used to be.

- *Cropping*, *napping*, and *shearing* of cloth raise the fibers to produce a soft, slightly piled fabric. *Rubbing*, *pressing*, and *glazing* give a smooth, lustrous surface. These mechanical processes are sometimes combined with oils, gums, starches, beeswax, varnishes, pitch, and gelatin. Egg white and water, or gum arabic was used on glazed woolens and linsey-woolsey blends in the 18th century. These finishes are fragile and can be damaged by handling and moisture.

- During weaving, oils, lubricants, and sizing are often used to keep yarns from tangling and to strengthen the warp against the friction of the loom. These materials are usually washed out by a laundry method called *scouring*. Scouring can range from gentle cleaning to processes using heat, pressure, and agitation.

- *Fulling* involves the use of lubricants, detergents, and other additives with water, heat, and agitation to produce felt. Felting causes the fibers to shrink and adds softness, body, and strength to the fabric. Very thorough felting produces strong, nearly waterproof fabrics that have been used for tents, coats, and shoes.

- Cotton threads and fabrics can be treated with a strongly alkaline chemical to add strength, durability, and luster to the fiber. This process of *mercerization* also reduces shrinking and makes the fiber more receptive to dying.

- During the 18th and 19th centuries, silk fabrics were sometimes treated with a variety of metallic salts to produce fuller, heavier textiles. These *weighted fabrics* were used for clothing, flags and banners, fringes, and tassels. When they were new, these fabrics had a fuller feel and drape than pure silk. However, weighted fabrics are not strong, and when aged, fracture and powder very easily. Washing and dry-cleaning easily damage weighted silks. They are very sensitive to the effects of light, moisture, and air pollution.

Finishing processes for synthetic and newer fabrics include:

- synthetic resins
- plasticizers
- mothproofing agents
- flame proofing chemicals
- emulsions used for soil, crease, and water repellency

Some of these processes are chemically active and their degradation products destructive to the textiles. Others are so recent that their long-term effects are not known.

> ***Finishes are responsible for the performance and many of the characteristics of textiles. However, some of these treatments and chemicals enhance deterioration and limit the possibilities of conservation treatments.***

3. *What other kinds of decorations are used on textiles?*

In addition to dyes, the texture of different weaving structures, and the effects of cutting and piecing fabrics together, textiles can be decorated with *embellishments* including:

- paint, pigments, and gilt
- braids and fringes
- added stitches
- metals
- beads
- fur and feathers

Embellishments may or may not be a structural component of the textile. Some embellishments, like beads, may be quite heavy. The areas where they are attached may be weak, and require extra support and care in handling.

- **Paint, pigment, and gilt** can be added to textiles to create surface designs. Printers' gums, waxes, starch, and adhesives may be present as well. These materials often are soluble in water. They also tend to stiffen the textile. Paints and gilt can crack when the textile is flexed or folded. Special care is needed for display, handling, and storage of painted textiles.

- **Fringes** may be a part of the structure of a textile or added after manufacture. In historic houses, fringes on rugs and carpets are subject to damage if they are in a public pathway.

- **Added stitches or embroidery** is a common form of decoration. All types of thread and yarn are used for embroidery. Embroidered textiles are most vulnerable to damage where the yarn or thread is stitched through the ground fabric. Cutting or tearing of the fabric is a result of the stress from tension on the yarn, or the interaction of the ground fabric and the thread together. For example, metallic thread is heavy and sometimes has sharp edges. It can cut or tear the textile.

- **Metals** in the form of metallic threads, metal strips, braids, and wires are used to decorate textiles. These decorations are often heavy and place strain on the underlying textile. A variety of metal combinations (alloys) have been used on textiles. The preservation concerns for these materials vary with the type of alloy (see Appendix O: Curatorial Care of Metal Objects).

- **Beads, buttons, and sequins** also can be used for decoration on textiles. These can be made of a wide variety of materials including glass, bone, stone, plastic, ceramic, and wood. All of these materials have different rates of deterioration and interaction with the textile. For example, early sequins were made of gelatin. In situations of high humidity these sequins become sticky and can dissolve.

- **Fur and feather** trims are particularly vulnerable to pest infestations and need to be monitored carefully.

D. Deterioration of Textiles

1. *What agents of deterioration affect textiles?*

Many factors contribute to a textile's deterioration. These ***agents of deterioration*** can occur naturally, or they can result from external forces. Avoiding agents of deterioration is the key role of ***preventive conservation***. The agents that affect textile collections most are:

- light (visible and ultraviolet)
- temperature
- humidity
- pollution
- pests

Knowing the ideal settings for temperature, relative humidity, and visible light, and knowing how to filter UV radiation and pollution is essential for preserving your collection. An Integrated Pest Management (IPM) Program is essential to protect your collection from pests. For more information about these agents of deterioration, see Chapter 3: Preservation: Getting Started.

2. *How do textiles change over time?*

As all materials age, they slowly break down and constantly deteriorate. The basic deterioration of textiles is the gradual breaking down of long-chain fiber molecules into shorter chains. The result is brittleness. Other forms of natural deterioration are:

- *gradual loss of inherent moisture*: Natural fibers come from living sources with biological functions. As they age and the structure of the fiber changes, fibers become less elastic and resilient.

- *effects of impurities*: The presence of small amounts of metals, such as copper, can accelerate deterioration in the presence of bleaching agents, ozone, ultraviolet radiation, and moisture.

- *impact of manufacturing*: Iron mordants, oils and lubricants used to facilitate the weaving process, and bleaching are some of the manufacturing processes that can contribute to the deterioration of textiles.

- *inherent vice:* Sometimes methods of manufacture and the nature of materials cause deterioration that cannot be controlled and may not be treatable. The most striking example of inherent vice is the impact of the addition of certain metallic compounds to silks to add weight and drape to silk fabrics. These compounds bond to the silk fiber and cause their eventual splitting and powdering. Another example is the interaction of some metal threads and decorations with textiles. The natural deterioration of wool accelerates deterioration of silver metallic threads causing tarnish. The tarnish can then stain the wool.

- *oxidation*: Fabrics are naturally degraded by the presence of oxygen. The result is an overall brownish discoloration on white or natural-colored textiles. When treated with water, some of these oxidation products are dissolved. However, the oxidation process begins again immediately.

3. *How does the environment affect my collection?*

Temperature, relative humidity, light, and pollution directly affect the rate at which a textile ages. Storing and displaying textiles in areas where temperature is too high and RH is too high or low will increase deterioration rates and promote pest activity. Constant or large fluctuations in temperature and RH are harmful, too. Textile fibers are ***hygroscopic***—they readily take up and lose moisture. Fluctuations of relative humidity and temperature cause textiles to take up or lose moisture. These fluctuations cause dimensional change and mechanical stress that can lead to breakage and structural damage of weak yarns. Natural and artificial lighting cause textile dyes to fade. UV radiation causes fading to happen quickly and fibers to become brittle. Pollution, including dirt, settles in the structure of a textile, causing its character to change completely. Pollutants also affect dyes, finishes, and many embellishments.

4. *What are the ideal temperature and RH ranges for textiles?*

Store textiles at temperatures between 65º and 75º F and relative humidity as close to 50% as possible. Low temperatures are not a problem for textiles and may help slow down the rate of deterioration for textiles that are damaged by weighting. High temperatures can embrittle textiles, and together with high relative humidity, promote biological activity. Low relative humidity (under 35%) can embrittle textiles. Avoid temperature and relative humidity fluctuations.

5. *How does light affect textiles?*

Light causes textile dyes to fade and undyed textiles to bleach or darken. Light can also be a catalyst for deterioration of weighted silks. Light damage is cumulative and irreversible. The amount of light damage depends on the type of light (ultraviolet and/or visible), intensity of the light, and duration of exposure. Evaluating your collection's lighting conditions and making appropriate adjustments can prolong the life of your collection. Review the natural and artificial light sources in your storage and display areas. Use monitoring equipment to identify levels of UV radiation and illuminance (levels of visible light are measured in "lux").

Reduce your collection's exposure to light by storing and displaying textiles in rooms without windows. (Clear UV-absorbing films will reduce UV levels, but will not reduce illuminance.) Cover all windows with drapes or blinds to further protect textiles. Avoid storing and displaying textiles in rooms with doors that open to the outside.

The maximum illuminance recommended for textiles is 50 lux. All UV light should be filtered. Consider ways to limit the total light exposure, such as automatic dimmer switches, or simply turning out lights when visitors are not present.

6. *What kinds of pollution affect textiles?*

Outdoor pollutants, such as dust and pollen, can easily be brought into a museum through open doors and windows. Industrial emissions as well as natural processes of erosion create pollutants. Cleaning products, asbestos fibers, building materials, paint, carpeting, and other indoor materials can generate pollution from within a museum. Cigarette, cigar, and pipe smoke are also harmful forms of pollution.

Dirt disfigures, dulls, and stains textiles. Dirt and dust also contain a high proportion of silica. The sharp surfaces of silica can cut and abrade textile fibers, especially when the fibers expand and contract in response to changes in RH.

Sulfur dioxide bleaches, discolors, and embrittles textiles. Hydrogen sulfide in the presence of moisture darkens lead pigments, tarnishes metals, and reacts with finishes and some embellishments.

Formaldehyde in paints, varnishes, wood products, and carpeting damage some dyes.

Tar and particulates from tobacco products stain textiles and are difficult to remove.

7. *How can I control pollution in my storage or display area?*

Follow these practices:

- Keep doors, windows, and outside vents closed whenever possible.
- Never allow smoking or fireplace fires in the building.
- Choose new building materials, paints, and carpeting that do not emit harmful gasses.
- Don't use custodial cleaners that emit harmful gasses (for example ammonia).
- Use appropriate particulate and gaseous pollution filters in your HVAC system.

- Store textiles in closed cabinets with appropriate gaskets.

- Keep particularly vulnerable objects in sealed display cases. Make sure these cases meet the recommendations in *MH-III*, Chapter 7: Using Museum Collections in Exhibits, and NPS *Exhibit Conservation Guidelines*.

For more information on controlling pollutants, see Chapter 4: Museum Collections Environment.

8. *What pests are attracted to textiles?*

Textile fibers are an excellent source of food for microbes and insects. Sizing, starch, gelatin, binding media for pigments, soils, and stains also are attractive to pests.

- Case bearer and webbing clothes moths are attracted to high protein material including wool, silk, hair, fur, feathers, and skins. The female moth lays eggs within the weave structure of the textile. The eggs hatch and the larvae feed on the textile material. Larvae take on the color of the materials they consume, making them difficult to see. Moths channel through the textile making holes, or "graze" on the surface thinning the yarns and weakening the textile structure.

- Silverfish, cockroaches, termites, and woodworms eat cellulose and graze on parchment, leather, paper, fabrics, glues, and painted decorations.

- Woodworms, termites, and carpet beetles can be found in furniture and associated furnishing fabrics, upholstery, and the inner structure of upholstery materials. Carpet beetles also attack silk and wool textiles.

- Mold and mildew grow in warm, damp locations. Irreversible brown stains are caused by enzyme attacks from the digestive processes of these organisms.

9. *How can I protect textile collections from pests?*

Follow these practices:

- Develop and implement a regular housekeeping plan. Pests are attracted to soils and a dirty environment.

- Develop and implement an IPM plan. Regular inspection and recording sightings of insects or insect debris is crucial to any pest management system. All park staff can be integral to systematic preventive conservation through identification of problem objects or areas.

- Prevent the initial entrance of insects into the collections. Flowers, plants, and potting soil are good sources for introducing an insect problem to the site. These materials should not be permitted in buildings that house collections.

- Isolate newly acquired collection objects from the rest of the collection. Determine if any insects are present and make sure they have been eradicated before new collections are integrated into storage or exhibition areas.

- If an infestation is suspected or located, isolate affected objects from the rest of the collection. Examine the surrounding area to locate possible sources of infestation (such as beneath floorboards, inside a cushion, or in bird and rodent nests under eaves and between walls).

- Immediately consult with a conservator and your park or regional IPM coordinator to identify appropriate treatments.

For more information about IPM and pest infestations, see Chapter 5: Biological Infestations

Controlling pests and the environment—light, temperature, relative humidity and air pollution—are keys to the long-term preservation of textiles.

E. Proper Handling of Textiles

1. *What do I need to consider before handling a textile?*

Following are a few guidelines:

- Keep hands away from textiles unless handling is absolutely necessary. The body gives off acids and oils through its pores that can damage textiles. Wash hands often and use white cotton gloves whenever possible.

- If the textile is fragile, carry it flat on a support.

- Make sure there is a clean surface of adequate size available before you move a textile from one place to another.

- Avoid carrying all but the smallest textiles by yourself. Get another person to help when you are transporting large, heavy textiles. Use a well-padded cart in good condition to transport boxed and smaller items.

- Remove jewelry, badges, belt buckles, and watches that might catch on and tear textiles, especially during installation and preparation of textiles for storage.

- Use clean, padded surfaces when working with textile collections. Keep tools, inks, and other writing materials away from the work area. Use only pencil when working around textiles.

- Avoid placing textiles one on top of another. When stacking them is absolutely necessary, interleave textiles with unbuffered, acid-free tissue paper, and be aware of the weight of one textile on another.

2. *How should I handle textile objects?*

Unlike a ceramic or wooden sculpture, textiles are not rigid, and need to be supported when they are lifted. Lack of support can result in stretching and tearing of the fabric.

- Roll a flat textile around an archival tube for transport or storage.

- Textiles with fragile surfaces, beads, heavy embroidery, or other surface attachments can be fan-folded and supported on a muslin-covered, corrugated archival board or in an archival cardboard tray (see Figure K.2).

- Place a muslin-covered, corrugated archival board or archival cardboard tray under fragile textiles and fragments for support.

- Large, heavy textiles (such as carpets and tapestries) require two handlers even if rolled on a support tube.

- Pad the interior of costumes with crumpled unbuffered, acid-free tissue and transport them in archival textile boxes.

- Fold pieces as little as possible. Textiles tend to break along fold-lines in time. Pad folds with crumpled unbuffered, acid-free tissue paper.

- Transport supported textiles on a well-padded cart.

Always use a support or container when moving textiles.

Figure K.2. Fan folding a textile into archival tray

F. Storage Specifications

1. *What do I need to know about storing textiles?*

Improper storing of textiles can be a catalyst for deterioration. Consider the elements that affect a textile in storage.

- Control the agents of deterioration.

- Choose appropriate storage space and equipment. Use only archival materials (tubes, unbuffered tissue, cardboard) in contact with textile objects (see Chapter 7: Museum Collections Storage).

- Ensure that proper security and fire detection and suppression equipment is installed and maintained (see Chapter 9: Security and Fire Protection).

2. *Where should I store my textiles?*

Your collection size is an important consideration when you determine where to store your textiles. If you have many textiles, consider creating a dedicated storage room. If you have only a few textiles in your collection, dedicate a space or cabinet in your museum storage area for your textiles. As much as possible, store textiles in properly gasketed closed cabinetry. Closed cabinets provide extra protection from pests, as well as potential water damage that might result from a flood or fire. Never store textiles:

- in attics or basements
- against exterior walls
- near furnaces or heating/air conditioning vents
- in spaces below water pipes

3. *How should I store my textiles?*

The structure of a textile, its condition, and size determine the best storage method. In general, you will choose from the following storage methods:

- archival rolling tubes
- flat-file cabinets
- archival boxes
- costume wardrobe cabinets
- shelving units
- specialized containers

G. Storing Flat Textiles

1. *Which textiles are stored flat?*

Flat storage is ideal for most textiles because it provides complete support for the object. Small textiles (for example, samplers and some household linens), fragments, and particularly fragile textiles should be stored flat. Flat storage is impractical for most large items like carpets and tapestries. However, permanently gathered or pleated curtains should be stored flat in archival costume boxes or drawers using padding techniques described for costume (see H.5 below).

Shallow drawers, like flat file cabinets, are well suited to flat textile storage. Sturdy textiles can be stored between sheets of unbuffered archival tissue. Avoid stacking textiles as much as possible. More delicate textiles may require a support to protect the fabric as it is lifted from the drawer. A simple support can be constructed by covering a piece of corrugated archival cardboard with washed muslin. Line drawers with closed cell polyethylene foam such as Volara®.

Very fragile small textiles (for example, brittle archeological textiles) may require additional protection. A modified print mat provides space economy as well as protection for handling and storage. (see *MH-1*,

Appendix I, Figure I.8 Construction of a Portfolio Mount for Archeological Textile Fragments or *Conserve O Gram* 16/3 “A Simple Storage Mat for Textile Fragments”).

Other textiles that are best stored flat include:

- velvets, and other textiles with a pile structure that could be crushed if rolled or folded
- textiles with a fragile surface, such as gilt or paint
- textiles that are particularly brittle or stiff
- textiles with a very uneven surface, such as strongly raised embroidery
- textiles with heavy beading or metallic embroidery
- costumes cut on the bias

2. *Which textiles are rolled for storage?*

Flat textiles (for example, Navajo rugs, tablecloths, and tapestries) are usually rolled for storage because they are too large to handle safely if stored flat. Archival rolling tubes are available in 2” and 3” diameters. Choose a tube with a diameter suitable for the object being stored. The 2” diameter tube is ideal for thin textiles, for example, a length of lace. The larger diameter tube is suitable for carpets or coverlets. The outside of a tube can be covered with bubble wrap to create an even larger diameter tube for oversized, fragile textiles. The tube should be at least 6” longer than the width of the textile.

3. *How do I roll a textile for storage?*

Work on a clean, well-padded surface (mattress pads make good covers for worktables). Lay the textile flat, gently smoothing wrinkles. Most textiles should be rolled face in so that the design will be face up when the textile is unrolled. Textiles with raised surfaces should be rolled face out. If the textile has a lining, roll lining side in. When a double thickness of fabric is rolled, the inner layer tends to wrinkle. It is preferable to create wrinkles on the lining rather than on the face of the textile.

- Roll unbuffered archival tissue once around the tube to provide a “leader” to guide the textile onto the tube (see Figure K.3). The tissue should extend slightly beyond the width of the textile but not beyond the edge of the tube.
- Interleave unbuffered archival tissue as you roll to protect the face of the textile.
- Two or more people should roll large pieces to maintain a uniform tension.
- To protect the roll from dust, cover it with washed muslin tied in place with cotton twill tape. Attach catalog and other identifying numbers to the dust cover to prevent unnecessary unrolling.
- Long or uneven fringes are difficult to roll. Make a “fringe folder” from a piece of unbuffered archival tissue to enclose fringes and

simplify the rolling process.

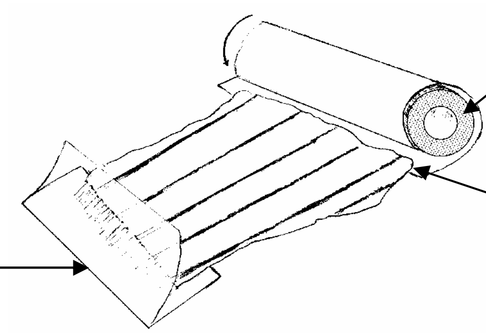


Figure K.3. Technique for rolling flat textiles for storage

4. *Is it safe to roll quilts and counterpanes for storage?*

Quilts and counterpanes are usually three layers thick (face, padding, lining). If the fabrics are in stable condition and there is no weakness in the stitching, they can be safely rolled. As with lined textiles, roll quilts and counterpanes **face out** with the lining or backing side in.

Many Victorian "crazy quilts" are made of weighted silk and velvet fabrics. These fabrics split and become powdery as they deteriorate. They should **not** be rolled for storage. Fragile over-sized textiles, like crazy quilts, can be fan-folded on a support board and stored in a drawer. Alternatively, these textiles can be stored, with minimal folding, in an archival costume box using the same general techniques described in H.5 below.

H. Storing Costume Collections

1. *How do I store dimensional textiles such as costume?*

Costume objects are stored in one of two ways depending on condition:

- hanging in a wardrobe cabinet
- folded in an archival textile or costume box

2. *How do I know which method of storage is best for costume?*

In general, fitted, constructed garments in good condition can be hung for storage (for example, dresses, bodices, coats, and jackets coming from the European clothing tradition). Museum storage hardware companies manufacture both costume wardrobe cabinets and clothing racks for this purpose. This type of storage is the most economical for costume storage because it takes less space than flat storage.

Ask the following questions to evaluate the best form of storage for costume items:

- Are shoulder seams strong and intact?
- Is the fabric in the hanging area free of splits, holes, or other weakness?
- Can the waistline support itself without causing strain at the shoulders or waist?
- If the waistline can't support itself, can it be adequately supported with the addition of waist tapes? (See Question 3 and Figure K.4)

If the answer to all of these questions is "yes," proceed to prepare the costume for hanging storage. If "no," store the costume flat following the instructions in Question 5 below.

Unconstructed clothing is better stored flat, or with minimal folding, in an archival box (for example, kimonos, and many forms of ethnic dress that use the rectangular shape of fabric yardage in clothing construction). The following are also best stored flat in boxes or drawers:

- fragile costumes and garments with weakness at the shoulders
- men's breeches or pants
- dresses with fragile waistlines
- skirts
- costumes with heavy beading
- bias cut garments (for example, some couture costume and "flapper" dresses from the early 20th century)

3. *How do I properly support and protect a garment for hanging storage?*

The goal of good hanging storage is to provide sufficient support to reduce strain across the shoulders and other vulnerable areas (for example, the waistline of a dress with a heavy skirt). See *Conserve O Gram* 4/5, Storage Techniques for Hanging Garments: Padded Hangers, and 4/15, Storage Techniques for Hanging Garments: Dust Covers.

Choose or modify a wooden hanger to provide the base for a hanging support. The ends of the hanger should reach into the sleeve, just beyond the sleeve seam.

- Reduce potential strain from heavy, bulky, or awkward garments by providing waist supports.

- Use a dust cover to protect each costume from dust, light, and abrasion from contact with other garments.

- Label dust covers with catalog and other identifying numbers to avoid unnecessary handling of the garment.

- Hang costumes in closed, properly gasketed cabinets, leaving at least 1.5 inches of space between each object. If costumes must be stored on open racks, always use **closed** dust covers.

Figure K.4. Twill tape waist supports (illustration by Jian Wu, reproduced with permission of Abrams Publishers)

4. *Why should I use dust covers for hanging costume?*

Dust covers do more than protect a garment from dust and light. For example dust covers:

- protect the textiles from oils and acids from your hands

- prevent the transfer of fugitive dyes from one object to another

- prevent metallic embroidery and other attachments (for example braid and buttons on military uniforms) from catching on and tearing other garments

- prevent abrasion of adjacent objects as costume items are moved in and out of storage cabinets

5. *How do I prepare an unconstructed garment for storage?*

Unconstructed garments (such as Pueblo and Hopi kilts and dresses) are stored flat in archival boxes or in drawers. The goal of good flat storage for these garments is to:

- use as few folds as possible
- provide adequate padding in folds to prevent creasing
- provide adequate support to safely lift the garment from the box or drawer

A muslin "sling" is useful to lift a garment from a box (see Figure K.5). A muslin-covered corrugated board, with or without a muslin wrapper, is useful to lift a garment from a drawer.

Figure K.5. Muslin "sling." Muslin can be placed under and folded over a garment to be used as a "sling" to lift and move the item. The "sling" also acts as a dust cover to protect the textile from handling.

To prepare an unconstructed garment for storage using a support board

- Lay the garment flat on a clean, padded surface.
- Cut corrugated board slightly larger than the size of the folded garment and slightly smaller than the interior dimensions of the drawer.
- Cut one piece of washed and ironed muslin the same length as the support board and three times the width, and one piece the exact length and width of the support board.
- Clean-finish the edges of both muslin pieces with pinking shears or a zigzag machine stitch.
- Attach the smaller piece of muslin to the support board with four small tabs of archival double-sided tape at the corners.

- Center the larger piece of muslin below the board and secure it to the board with strips of double-sided archival tape (1/3 of the muslin will extend beyond the edge of the support board on either side).

- Lay the garment on the support board with the neck or top edge just below the edge of the board, and the other three sides hanging over the edges.

- Place padding (for example, crumpled unbuffered archival tissue or batting “sausages”) in the garment seams.

- Using as few folds as possible, placing padding in each fold, fit the garment onto the backing board.

- Drape the muslin extensions over the folded garment and tie closed with cotton twill tape.

- Label the cover with catalog or other identifying numbers to prevent unnecessary unwrapping.

To prepare storage without a support board:

- Cut one piece of muslin the same length as the storage box and three times its width.

- Center the garment on the muslin and fold as above, making sure to keep the final size of the folded garment slightly smaller than the box interior.

- Drape the muslin extensions over the folded garment and tie closed with cotton twill tape.

- Using the muslin cover for lifting, lower the folded, wrapped costume into the costume box.

- Label the cover and the outside of the box with catalog or other identifying numbers to prevent unnecessary unwrapping.

Use two people to transport costumes on support boards and to lift costumes from drawers and storage boxes.

Figure K.6. Rolled or crumpled archival tissue pads the folds of the dress. To keep the garment from shifting as the box is transported, additional rolls of tissue fill the empty space in the box.

I. Storing Costume Accessories

1. *What are costume accessories?*

There are many objects besides clothing included in costume collections. These objects are often composed of several materials, including wood, leather, bone, ivory, metal, paper, fur, and feathers. For example, costume accessories include:

- hats and bonnets
- shoes
- gloves
- purses
- fans
- umbrellas and parasols

Costume accessories are composite objects made of several materials. The care of these objects requires attention to the specific needs of those various materials. Refer to the *Conserve O Gram* series for information on the care of individual materials. See also Appendix N: Curatorial Care of Wooden Objects, Appendix O: Curatorial Care of Metal Objects, and Appendix S: Curatorial Care of Leather and Skin Objects. You will need to provide special storage supports for most costume accessories.

2. *How do I store hats and bonnets?*

Construct padded polyethylene foam supports for hats and bonnets to maintain their shape (Figure K.7). The support should raise the brim slightly off the shelf to prevent distortion. Hats with weak brims will require a full support in the crown and under the brim. Hats with weak crowns should have a soft insert (rather than rigid polyethylene foam).

- Store hats in closed, gasketed cabinetry.
- Store hats separately from original hat boxes.
- Construct a drop-sided box to facilitate handling if a hat needs to be stored in a box for its protection (Figure K.8).
- Do not stack hats.
- Protect bows, feathers and other appendages from abrasion and crushing by padding with unbuffered archival tissue.

Figure K.7. A fabric-covered polyethylene foam support has been created to support the crown of this Civil War cap. A thin piece of Plexiglas® supports the bill.

Figure K.8. Leghorn bonnet on a support inside a drop-front archival storage box.

CAUTION: Hats made of fur, feathers, and pieces of taxidermied birds and animals may contain pesticide residues including arsenic. Test all bird and mammal skins collected and prepared prior to the mid-1980s (see *Conserve O Gram* 2/3, Arsenic Health and Safety Update). If arsenic or another pesticide is suspected, use the following handling precautions:

- Do not touch specimens with bare skin. Wear plastic gloves and a protective smock or lab coat. Wear a dust mask rated for toxic dust. If possible, handle the object or specimen by a container or a mount.

- Always wash hands after working with specimens. Discard gloves. Keep the protective smock or lab coat clean. Do not take protective clothing home to wash—especially if you live with small children or elderly people.

- Obtain a Material Safety Data Sheet (MSDS) on arsenic and other pesticides and keep in the park's curatorial workspace/office. Consult the MSDS for specific information.

- Label museum cabinets or storage spaces that house specimens contaminated with pesticides with warning signs. Also label individual specimens that have been tested. Prepare and post a written set of instructions for handling specimens contaminated with arsenic and other poisons.

Consult Chapter 11: Curatorial Health and Safety, for more information.

3. *How do I store shoes?*

Shoes should be padded for support on display and in storage. Supports should fill the entire shoe all the way to the back of the heel. Make a "sock" of cotton stockinet to fit the interior of the shoe. Stuff the sock with polyester batting from the toe to the arch. Insert a shaped piece of rigid polyethylene foam from the arch to the heel, and stitch the sock closed. The sock should provide uniform, solid support without stuffing the shoe tightly.

- Support the entire shoe. Do not handle shoes by the heel alone.

- Provide adequate support to the ankle and leg sections of boots by constructing a second "sock" filled with polyester batting to fill that area. If the ankle is weak, the support can be constructed of shaped polyethylene foam.

- For the protection of staff as well as the shoes, do not store shoes and boots on upper shelves or movable shelves. It is best to contain shoes and boots within shallow boxes for storage.

- Store shoes and boots in closed, gasketed cabinetry. If this is not possible, provide dust covers of washed muslin for each pair. Label the dust cover with catalog and other identifying numbers to prevent unnecessary handling.

4. *How do I store gloves and mittens?*

Gloves and mittens may require internal supports to prevent crushing or creasing. Do not force a support into the fingers of the glove. A simple support can be cut from 2-ply archival matboard. Be sure to sand or burnish the cut edges of the board so that there are no rough spots. If more padding is required, pad the matboard with polyester fleece Pellon and finish with a layer of cotton stockinet (Figure K.9).

Figure K.9. Internal support for gloves and mittens. Internal supports should be smooth and slightly smaller than the object. Do not over pad the interior of a dimensional textile.

5. *How do I store bags and purses?*

Bags and purses may need to be gently stuffed with unbuffered archival tissue to maintain their shape. The best way to prevent damage to handles, chains, and clasps, is to wrap them with tissue, or create cavity packs in storage drawers. Cavity packing offers the additional benefit of isolating the metals and other materials of the handles and chains from the textile.

6. *How do I store fans?*

Fans should be stored closed if they are in good condition. Storing fans open may cause distortions that will prevent their being closed in the future. However, if the paper or fabric body of the fan is cracked or split, repeated opening and closing will cause damage. In this case, the fan should be stored open on a graded support (see Figure K.10).

- Provide support for tassels attached to the heel of the fan.

- Store fans separately from original cases or boxes.

Step 1: Cut a fan-shaped support board from 4-ply archival mat board or archival corrugated board at least 1” larger in dimension than the fan.

Step 2: Cut wedge-shaped pieces of polyester batting, layering them on the support board to match the profile of the opened fan.

Step 3: A small roll of batting will be necessary to support the uppermost fan sticks.

Step 4: Cover the padded support with washed cotton fabric, stitching the cover together in the back. Make two parallel cuts through the mount on both sides and thread twill tape ties through to the front. Secure the fan sticks with the twill tape ties.

Figure K.10. Padded support for a fragile fan.

7. *How do I store parasols and umbrellas?*

Parasols and umbrellas are composite objects made of combinations of fabric, paper, bone, wood, and ivory. The condition of individual objects will determine the best storage method.

- Check for metal corrosion and sharp edges. These will need to be wrapped or padded to prevent damage to the rest of the object.

- Store parasols and umbrellas slightly furled, padding the folds with unbuffered archival tissue that is rolled into narrow cones (Figure K.11).

- Do not open a parasol or umbrella completely unless it is absolutely necessary.

- If the parasol or umbrella fabric is relatively sturdy, wrap the padded object in muslin secured with twill-tape ties before laying it in a drawer.

- If the parasol or umbrella fabric is weighted silk or another fragile material, wrap the padded object in unbuffered archival tissue before securing it in a muslin wrapper.

- Label the muslin wrapper with catalog and other identifying numbers to prevent unnecessary handling.

Figure K.11. Pad the folds of an umbrella with cone-shaped rolls of archival tissue.

J. General Considerations for Exhibition

Textiles are fragile. They are subject to deterioration by improper levels of temperature and RH, UV and visible light, pests, pollutants, and improper handling. Like other sensitive materials, you should periodically change textiles in exhibitions.

1. *How often should I rotate textiles in exhibitions?*

Rare or fragile textiles should remain on display for periods of three to six months. Sturdy textiles, properly mounted and displayed in optimum exhibition conditions may remain on display for six to nine months.

Long-term and permanent exhibitions should be designed to allow for rotation of textile objects at three, six, or nine month intervals, depending on the condition of the item.

2. *What are special considerations for exhibiting textiles in open displays in historic houses?*

Location of objects within the display is important. Check the location of lighting fixtures, air vents and intakes, and entry and exit locations for visitors. Avoid placing textiles in these locations in the display. Use these guidelines:

- Place furniture cups or small discs of archival corrugated cardboard under furniture legs and casters when furniture is placed on historic carpets or floor coverings.

- Separate textiles from polished wood and other surfaces with a sheet of thin Mylar® or unbuffered archival tissue.

- Use barriers to prevent visitors from sitting on furniture or entering rooms.

Ropes and chair cords are not always completely effective in preventing visitors from touching fragile objects or sitting on furniture. Place delicate objects beyond reach. Construct chair cords so that they will give way if a visitor sits on the chair. If the cord is tight, it may stress the furniture joints and cause them to break.

3. *What are special considerations for using rugs and carpets in historic house displays?*

Avoid using valuable historic carpets and rugs on the floor unless they are where the public will not walk on them. For all rugs and carpets used on the floor, use the following guidance:

- Appropriate rug pads should be used. Some synthetic padding (Dacron polyester) has a non-skid surface that is placed against the floor to prevent the rug from slipping. Avoid rubber non-skid pads, jute, and horsehair.

- Remove shoes, or cover shoes with operating room “booties” when performing maintenance activities on and around historic carpets.

- Do not use vacuums with beater attachments on historic rugs. All parks should have a vacuum that is reserved for collection objects rather than routine maintenance of the building. Use that vacuum and control the suction. The plastic wood-floor attachment is usually adequate for vacuuming rugs that are not walked on regularly. Vacuum in the direction of the pile.

- Vacuum the back of the rug, padding, and floor underneath at least once a year.

- Monitor pest traps for carpet beetle and moth evidence regularly, and act quickly if an infestation is suspected.

- If visitor traffic must be directed across a carpet, use a runner to designate the walkway. A runner made from synthetic carpet is the best choice. If clear plastic runners must be used, choose one that does not have pointed tabs on the back that are meant to pierce the carpet underneath to hold the runner in place.

- Avoid traffic across the fragile fringe of any carpet.

- Consider using a reproduction carpet.

4. *How should I treat original draperies, fabric wall coverings, and upholstery if they must be replaced by reproductions?*

It is important to keep representative samples of all components of furnishing fabrics as part of the collection. This will include fringe, gimp, decorative tacks, and linings. If samples of materials like horsehair padding are kept, be sure to enclose them in polyethylene zip closure bags to prevent insect infestation. The original material, its location, method of attachment, and any other data should be thoroughly documented in writing and with photographs before it is replaced. Consult with historic furnishing experts before any disassembling or decisions on replacement are taken.

K. Exhibition of Flat Textiles

1. *How should flat textiles be displayed?*

Carefully assess the condition of an object before deciding upon a display technique. If there is any question, consult with a textile conservator for guidance. Use the least interventive method of installing textiles in exhibition wherever possible. Use minimal stitching, or avoid stitching if possible. Pinning is sometimes an option. Use only rustproof entomological pins to secure textiles to supports.

Preparing a stitched textile mount requires skill and care. In most cases, a textile conservator should prepare a stitched

Small and fragile textiles can be placed flat or on a slanted support in an exhibition case.

- Display cases must be constructed of appropriate materials (see the *NPS Exhibit Conservation Guidelines* CD available from the Division of Conservation at Harpers Ferry).

- Avoid folding textiles wherever possible.

- Minimize handling during installation and de-installation by using rigid, padded supports (see Question 2. below).

2. *What is the best way to construct padded supports for flat textiles?*

Choose a lightweight but sturdy material like archival corrugated cardboard, archival honeycomb panels, or corrugated polyethylene sheets (Core-X®) for the support. The board should be equal to or slightly larger than the size of the textile.

- Pad the board with a thin layer of polyester quilt batting or Pellon fleece.

- Wrap washed cotton fabric around the padding and board and secure the fabric to the back of the mount with double-sided archival tape or polyethylene hot-melt adhesive.

- Lay the textile on the fabric surface. Use a few rustproof entomological pins to secure the textile to a slanted support. Try to slide the pins between, rather than through, yarns.

- Avoid using pins if a textile is brittle or fragile. Instead, place the textile on its support flat in the exhibition case.

3. *What are appropriate supports for large textiles?*

Consult with a conservator before attempting to mount large textiles for hanging. A fine silk hanging will have different requirements than a heavy wool tapestry.

- A textile should be hung in the warp direction whenever possible. Do not hang along the bias.

- The mount should distribute the weight of the textile without causing stress to any particular point.

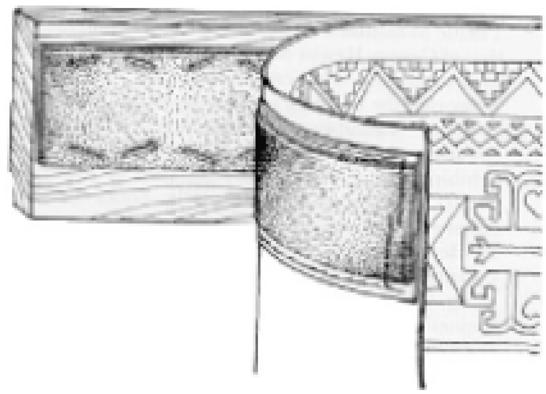
- Roll, rather than fold, excess length for oversized textiles.

- There are several display options for large textiles, including hook and loop tape, draping, rolling, and large slant supports.

4. *What is a hook and loop tape mount?*

Hook and loop tape (also known as VELCRO®) is an appropriate hanging material for large textiles in sturdy condition. Do not use the adhesive-backed tapes. The soft (loop) tape should be machine-sewn to a strip of upholstery webbing, and the webbing hand-sewn to the back of the textile. The stiff, hook tape is attached with rustproof staples to a sealed wooden batten. The wooden batten is installed on the wall, and the two tapes pressed together (see Figure K.12). Hook and loop tapes are sometimes used on the sides of textiles to stabilize areas that are uneven. The bottom of large textiles should not be fastened down to allow the textile to expand and contract in response to small environmental changes.

Figure K.12. Installation of a hook and loop tape mount (drawing by Jian Wu courtesy of Abrams Publishers).



5. *What if the textile is too long for the exhibition space?*

Hang large textiles at least twelve inches above the floor to prevent damage by visitors and cleaning equipment. If a textile is too long for the space, consider the following options:

- Hang the upper edge of the textile with hook and loop tape. Allow the extra length to drape onto a platform in front of the textile. Separate the textile from the platform with a sheet of Mylar®.

- Cover an archival rolling tube with washed cotton fabric and roll the top edge of the textile object onto the tube. Mount the tube on the wall with brackets.

- Drape the textile over a fabric-covered archival rolling tube and install the tube on the wall with brackets. This method is safe for many textiles, but is not very secure against theft. If you use this mounting technique, provide a barrier or enclose the textile in an exhibition case.

6. *What is a slant support?*

Large textiles that are too fragile to be hung by the top edge alone can be displayed flat on a platform, or on a slanted, fabric-covered support. Use the following materials to construct large slanted supports:

- Rigid paper honeycomb panels are among the best materials to use in constructing large supports. Use aluminum channel frames to construct a support with several panels.

- Some woods and plywood can be used to construct a support if properly finished (see Technical Notes 5: Exhibit Case Construction Materials from *NPS Exhibit Conservation Guidelines* available from the Division of Conservation, Harpers Ferry).

  – Choose well-seasoned, air-dried poplar, exterior grade plywood or high or medium-density boards using formaldehyde-free adhesive.

– Finish these boards with several coats of moisture-borne polyurethane varnish and allow to dry completely.

NOTE: Not all moisture-borne polyurethanes are safe for use. Also, formulations can change without notice. Test the varnish prior to use to guarantee its acceptability.

- Place a layer of polyester quilt batting or Pellon® on the finished wood.
- Cover the board with washed cotton fabric. Fabric can be secured at the back of wooden boards with rustproof staples.
- Attach the textile to the display board with hook and loop tape mounts. If the textile is fragmentary or uneven, several short lengths of the hook and loop can be attached strategically behind the textile.

Install slant boards at a maximum angle of 15° to reduce the stress of gravity on weakened textiles.

7. *What are the considerations for framing textiles?*

Small and medium-sized textiles can be framed with stitching techniques, or by using a specialized mount called a "pressure mount." A stitched mount is an interventive technique that must be carried out by a textile conservator. A conservator or technician with specialized training constructs pressure mounts.

Specify the following in working with a conservator to frame a textile:

- Whenever possible, choose cotton fabric as the exhibition fabric. Linen is a second choice. Silk is a poor choice because of dye stability and poor light fastness. Wool is susceptible to insect infestation and should not be used.
- Exhibition fabric should be pre-washed to remove sizings and finishes.
- Wooden elements of stretcher frames should be made of low-resin wood (such as poplar). All wooden framing elements should be coated with an appropriate moisture-borne polyurethane varnish and thoroughly dried before use.
- Stretcher frames should be faced with archival matboard to provide a solid support for the mount.
- One or more layers of padding (thin polyester quilt batting or Pellon® fleece) should be placed behind the exhibition fabric for cushioning. Pressure mounts require several layers that are graded in size, to provide even support (see Question 13 below).
- Use Acrylic® as the glazing material. Avoid glass when working with textiles because it can break and damage the object. Specify ultraviolet-filtering Acrylic® in framing textiles if exhibition lighting conditions are imperfect.

- In a stitch-mount, make sure that the glazing does not come in contact with the textile. Archival mat board or thin acrylic strips at the edges of the frame can act as a spacer between the frame and the textile.

- Never turn under ragged edges or turn part of the textile over the edge of the stretcher. If the edges of the textile are unsightly, consider using a window mat of archival mat board to cover that part of the object.

8. *What is a pressure mount?*

A pressure mount uses the friction of the backing fabric and the glazing material (acrylic) to hold a textile in place without stitching. Padding behind the exhibition fabric provides cushioning to the textile object. This kind of mount is ideal for short-term exhibition of moderate to small-sized textiles and textile fragments. It is often the most suitable mount for somewhat brittle or fragile textiles that might be damaged by sewing techniques. A diagram of a typical pressure mount can be found in Figure K.13.

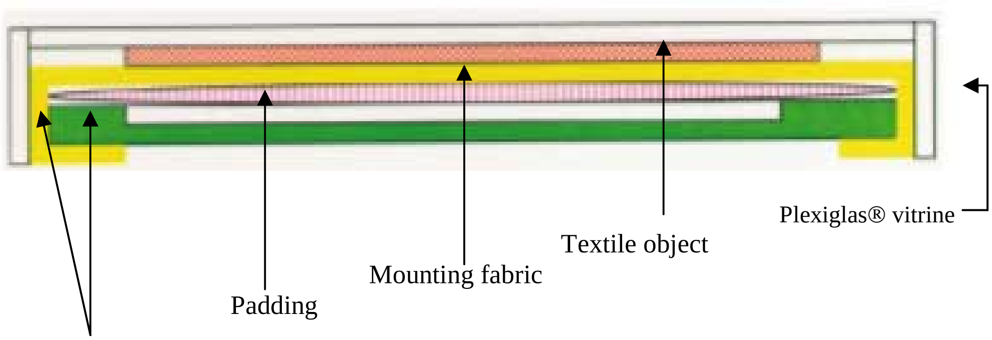


Figure K.13. Diagram of a pressure mount

9. *When do I know if a pressure mount is the most appropriate display method?*

A textile conservator should determine whether a pressure mount is appropriate for a specific textile. There are some risks in using this kind of mount even though no stitching is involved. The Plexiglas® face of the mount often carries a static charge. That charge can lift fibers from a brittle textile. In those cases, a slanted or flat mount in an exhibition case would be a better choice.

The other limit on pressure mounts is size. The maximum size of a pressure mount is limited by the size of acrylic sheet used for the face of the mount. It also is very difficult to maintain complete contact between the textile and the acrylic over a large span. Large sheets of acrylic bow at the center. It requires substantial padding, and sometimes trial and error, to create a pressure mount for a large textile.

L. Display of Historic Costumes

Wearing original historic costumes is unacceptable in a museum context. Accidents, perspiration, make-up, stress of dressing and wear, and sudden gestures or movements create excessive, immediate hazards that cannot be justified. Reproductions can be made and used for educational purposes in conjunction with appropriate display of the collection.

Each costume item should be carefully evaluated before deciding on a display method. If the seams and fabric are sufficiently strong, a mannequin may be the most appropriate choice. If the garment is fragile, it may be necessary to use a flat or slanted display. However, costumes are three-dimensional, and it is important to pad the interior of a garment to prevent folding and creasing.

Costumes need the support of a mannequin of correct size and proportion. The mannequin must represent the fashionable profile of the period to provide appropriate internal support. Certain period costumes may also require the construction of period undergarments such as bustles, hoops and corsets for correct presentation.

Bias cut garments prevalent in costume of the 1920s and 1930s should not be on extended display because of the tendency of the fabrics to stretch. Dresses of this period often have few closures and can be difficult to install on a mannequin.

No seams should be undone in order to put a piece on display.

1. *Where do I find appropriate mannequins to display costumes?*

There are several companies that provide both generic and custom-made mannequins for museum use (see Section R. Additional Resources below). Castoff store mannequins can sometimes be adapted for use. In particular, child and youth mannequins may be adapted to historic costumes that often are smaller in size than current adult clothing.

Simple supports can be constructed by carving polyethylene foam blocks to shape. These forms are covered with layers of batting to pad the form to the correct shape, and then can be finished with cotton knit “skin” (see Figure K.14).

Figure K.14. Polyethylene foam cut to the shape of a torso, then padded with quilt batting and covered with cotton knit.

2. *How do I display unconstructed garments?*

Traditional mannequins may not provide sufficient support for fragile, unconstructed garments like ponchos. An archival tube padded with quilt batting and covered with cotton fabric is a simple mount for display of these kinds of garments.

M. Conservation Treatment

The following section discusses particular considerations before any treatment is carried out either by park staff or a conservator. NPS policy emphasizes stabilization as the goal of conservation treatment. Maintenance of proper environmental control, use of appropriate storage and display techniques, and careful handling can reduce the need for costly, interventive conservation treatments.

1. *What NPS guidance is available to help me make decisions about conservation treatment?*

Review Chapter 3: Preservation: Getting Started, for information on the roles of the curator/collections manager and the conservator and information on the Collection Condition Survey (CCS). Refer to Chapter 8: Conservation Treatment, for information on conservation treatment issues and working with a conservator. In addition, NPS *Management Policies,* (Dec 2000) Chapter 5: Cultural Resource Management, discusses NPS policy for conservation treatment of museum objects.

2. *What kinds of treatment and maintenance can be undertaken by park staff?*

Park staff with appropriate training can undertake many maintenance activities associated with textile collections, such as:

- preparing appropriate storage housings
- constructing mannequins and other support mounts for exhibition
- vacuuming textiles, costume, upholstery and historic carpets on display to remove dust and protect from insect infestation

3. *What kinds of treatment and maintenance should be undertaken only by a conservator?*

All **interventive** treatments must be undertaken by a textile conservator including:

- wet and dry cleaning

- repair using needle and thread techniques
- consolidation with adhesives
- application of linings
- restorations and reconstructions
- specialized mounts (including stitched and pressure mounts)

There are many considerations in developing a conservation treatment. Some of the factors that a textile conservator will take into account before recommending a treatment are:

- no treatment is undertaken that is not absolutely necessary for the preservation, safe storage, or safe display of the object
- no treatment is completely reversible, so conservation should involve materials and methods that are the least harmful to the object
- treatment should not interfere with future research about the properties of the textile and the techniques used in its fabrication

4. *What cleaning methods are used on textiles?*

Cleaning of textile objects requires a different approach from that normally used for your own clothing. Even gentle cleaning is a drastic treatment, but it can be essential to the long-term preservation of a textile object (see Sections D.7 and D.9 above).

There are four categories of cleaning:

- surface (suction cleaning by vacuum)
- wet (cleaning with water or water plus detergent)
- dry (cleaning with organic solvents)
- spotting (treating of localized stains with wet or dry-cleaning solvents)

Wet, dry, and spotting treatments must be carried out by professionals. Vacuum cleaning is a regular form of maintenance of materials on open display, textiles being returned to storage, and newly acquired textiles before they are placed in storage or on display.

5. *What should I know about vacuuming textiles?*

Every park should have at least one vacuum cleaner that is reserved for use on museum objects. A vacuum with a HEPA filter (High Efficiency Particulate Air) that removes 99.97% of particulates 0.3 microns or larger in size is the most appropriate for removing dust and particulates from textiles (see *Conserve O Gram* 1/6: Choosing a Vacuum Cleaner for Use in Museum Collections, and *Tools of the Trade*). Your vacuum also should have a rheostat to allow for suction control. Most textiles should be vacuumed with very low suction. The upholstery or crevice wand is the best tool for vacuuming most textiles and upholstery; an upholstery brush works well on pile carpets.

It is easy to pick up loose threads and surface embellishments like embroidery when vacuuming. To prevent damage when vacuuming, protect the textile surface with polyester or nylon window screening. Sew cotton tape over the cut edges of the screen.

Figure K.15. Proper vacuuming technique. Loop the vacuum hose over your arm to keep from dragging it across the textile. Place the brush down on the surface of the screen. Lift the brush to move it to the next location (do not rub the brush back and forth across the screen).

6. *What techniques are used to repair textiles?*

Many repair techniques involve the use of needle and thread to close broken seams, compensate for fabric loss, or provide support to weakened areas. Work with a conservator to determine which repair technique is appropriate for your textile. Some questions you might want to discuss are:

- What is the goal of the treatment?
- Are repairs necessary to strengthen the textile structurally?
- Are repairs necessary to aesthetically improve the textile?
- What new materials will be introduced into the textile?
- Is it more appropriate to use synthetic or natural fabrics and thread for repairs?
- What is the wash and light-fastness of new materials?
- How will new materials be distinguished from the original?
- Will repairs of seams attempt to use original sewing holes?
- Will repair fabrics be dyed to a shade slightly different than the original?
- What kind of documentation will be used to record the use of new materials?

Some fabrics like weighted silks may be too brittle for needle and thread repairs. Adhesive techniques may be the only way to safely consolidate and repair those textiles. Adhesive techniques cannot be reversed easily. They also change the drape and "hand" of the fabric. Consider all of the options carefully before deciding on an adhesive treatment. You may want to discuss the following questions with the conservator:

- Are any other consolidation and treatment techniques available?
- Is it possible to use an overlay of translucent fabric or netting to hold the damaged areas in place?
- Are there less stressful display and storage techniques that could preserve the textile without further treatment?
- Will the textile continue to deteriorate or be in danger of further damage from handling if it is not treated?

Successful conservation treatment is the result of collaboration between the curator and conservator. Conservation treatments can be expensive and time consuming. Not all treatments result in striking visual changes. A well-structured plan and continuing communication with the conservator can avoid surprises and result in the best possible outcome.

7. *What textile conservation terminology should I be familiar with when talking to a conservator?*

Following are some of the common terms and practices used in textile conservation:

- **Wet cleaning**. Using water or water plus detergents to remove soils from a textile. Water is a powerful solvent. It can solubilize and react with dyes, degraded fibers, chemical pollutants, and other materials and additives found in and on a textile. Wet cleaning requires an understanding of the:
  - physical and chemical nature of the textile
  - source and chemical character of the water to be used
  - properties of the detergent system
  - type and nature of the soils to be removed

A textile conservator will always test the dyes and finishes of a textile before attempting wet cleaning to make sure that the textile can be safely treated.

- **Dry cleaning**. Cleaning using organic solvents with or without detergents or additives. Dry cleaning may be recommended when dyes or finishes are affected by water and there is no other safe cleaning treatment.

Dry cleaning solvents are extremely volatile and should only be handled by experienced professionals. Few historic textiles can withstand conventional dry cleaning. There are few dry cleaners offering hand cleaning. If dry cleaning is recommended, the conservator should provide supervision and oversight to the cleaner undertaking the work.

- **Spotting**. Spotting or spot cleaning is the treatment of localized stains with water or an organic solvent. Spot cleaning requires specialized equipment to prevent the stains from migrating into surrounding areas. This technique is often used to remove oily stains from a textile prior to wet cleaning.

- **Support**. The term “support” can refer to materials that provide shape and structure (such as a mannequin) or materials used to stabilize weakened areas of a textile. A support also can be a box or tray used to safely transport a textile.

  A support often is a piece of new fabric used as a *patch* or *backing*. Support patches and backings are attached by stitching or adhesive techniques. The fabrics are chosen for their visual and chemical compatibility with the original, as well as light and wash-fastness.

- **Mount**. A mount is a kind of support used to prepare a textile for exhibition or storage. Unlike other kinds of supports, mounts are not permanently attached to the textile. A few examples of mounts are:

  – mannequins

  – frames

  – slant boards

  – structures that provide shape to hats

  – cavity packs

  – padded hangers

- **Lining**. Linings are protective dust covers for the back of a textile. In a garment, linings are integral to the garment structure. A conservator may add additional linings to a garment to protect the original fabric from abrasion from handling or display on a mannequin. Linings for large wall-hung textiles, like tapestries, are usually a tightly woven fabric. Linings are separate from supports, and like mounts, are not permanently attached to the textile.

N. Packing and Shipping Textile Objects

For general information on packing and shipping museum collections see Chapter 6: Handling, Packing, and Shipping. Flat textiles, costumes, and costume accessories should be packed in boxes, and the boxes packed in crates. Rolled textiles should be immobilized in crates by polyethylene foam blocks that suspend the roll in the crate (see Figure K.16).

Figure K.16. Shipping crate with suspended textile rolls. (Photograph courtesy of Harold F. Mailand)

1. *Are there special considerations for packing and shipping textile objects?*

The condition of a textile will determine appropriate packing and shipping techniques. The most difficult situations will occur when it is necessary to ship a fragile textile to a conservator for treatment. Work with the conservator to determine the best method. In general:

- Roll medium to large-size flat textiles if possible. Roll the textile as you would for storage. Wrap clear polyethylene sheeting around the rolled textile and seal completely with packing tape to protect against water damage.

- Fragments and small textiles can be shipped in storage mats (see Appendix I, Figure I.8 Construction of a Portfolio Mount for Archeological Textile Fragments) or padded in archival boxes of various sizes. If you are using a box, be sure to use sufficient padding to fill the box completely. Polyethylene foam blocks covered with polyester batting and muslin are good for this purpose.

- Do not use crumpled tissue in packing textiles and costume. The tissue tends to shift and compress. Use tissue folded into pillows, or batting-stuffed cotton-knit "sausages" in place of crumpled tissue to pad folds and provide interior supports.

2. *Are there special considerations for packing and shipping framed textiles?*

Never ship textiles framed behind glass. Replace glass with acrylic (Plexiglas®). Always wrap framed textiles in clear polyethylene sheeting and seal with packing tape to protect against water damage. Use the "box-within-a-box" method to pack and ship framed textiles.

3. *Are there special considerations for packing and shipping costume accessories such as hats?*

Three-dimensional textiles require the same kinds of interior supports for packing and shipping as for storage. The ideal packing method for three-dimensional textiles are cavity packs within archival boxes (see Chapter 6, F.4).

O. Emergency Procedures for Textile Objects

Appropriate response to emergencies from a natural disaster or vandalism should be incorporated within the park's Emergency Operations Plan (EOP). Consider the following:

- Close off the affected area and assemble sufficient personnel to deal with the problem. Unnecessary or inappropriate handling can create greater loss than the initial situation.

- Prepare a clean, dry workspace. If the emergency includes water or other liquids, have fans and dehumidifiers ready.

- Be aware of the size of doorways, stairways, corridors, and objects that cause difficulty in maneuvering to get to the workspace.

- Deal first with objects that are in danger of additional damage, such as those hanging precariously or with elongated tears.

- Water-soaked textiles are heavy and weaker than when they are dry. Carry one object at a time. Use auxiliary supports such as rolling carts or trays to move wet textiles.

- Be careful to support the whole textile. Avoid handling by edges and corners to avoid stretching and tearing.

- Collect and preserve all fragments.

- No piece should be in contact with another object.

- The immediate danger to wet textiles is dye bleed and mold. Do not attempt to dry textiles with heat. Instead, set up fans and dehumidifiers, and try to absorb excess water. Your emergency supplies should include clean toweling and boxes of disposable baby diapers for this purpose.

- If the liquid is unknown, assume the worst. It might be a corrosive or caustic chemical that could cause damage to personnel. Do not flush the textile with water as this could spread the chemicals and cause further damage and additional chemical reactions. Locate protective equipment, warn other staff of the potential hazard, and contact the park or regional HAZMAT coordinator according to the park's EOP.

P. Glossary

Constructed Garment: clothing that has been made by cutting and piecing fabric(s) together. Most Western dress is made this way (see also: *unconstructed garment*).

Costume Accessory: objects associated with costume collections including hats, bonnets, shoes, gloves, purses, fans, umbrellas, and parasols

Dry Cleaning: textile conservation treatment using organic solvents and detergents

Dye: plant materials and various chemicals that add color to textiles

Felting: the process of using heat, water, and pressure to interlock loose fibers together

Fibers: the raw materials used to make textiles. Fibers come from natural (animal and plant) and synthetic sources and may also include metals and alloys.

Finish: manufacturing process to prepare textiles for use. Finishes include dyes, lubricants, chemical compounds, mechanical treatments, sizing, water and stain repellents, mothproofing, and flameproofing.

Lacemaking: a variety of techniques that involve the intricate twisting of fine threads to form a pattern

Lining: protective dust cover for the back of a textile. Linings for garments are integral to the garment structure.

Macramé: a knotting technique using more than one strand of yarn to create fringes and edgings

Mercerization: cotton processing technique using a strongly alkaline chemical to improve dyeing, add softness, and add flexibility

Mordant: chemicals (usually metallic salts) applied to yarn or cloth to fix dyes

Mount: a type of support used to prepare a textile for exhibition or storage

Netting: textile produced from a single, continuous strand by looping and knotting

Pressure Mount: a temporary framing technique for flat textiles

Retting: soaking flax to loosen fibers from the plant stem

Spinning: twisting short fibers together to make a long thread

Spotting: treatment of localized stains with wet or dry-cleaning solvents

Support: materials that provide shape and structure, or are used to stabilize weakened areas of a textile

Unconstructed Garment: clothing that uses the rectangular shape of fabric yardage for construction. This type of garment is common in many forms of ethnic dress such as Hopi and Pueblo clothing and Japanese kimonos.

Warp: the parallel yarns stretched on a loom (lengthwise)

Weaving: making cloth by interlacing threads of the warp and weft on a loom

Weft: the transverse yarns interlacing with the warp in a pattern

Weighting: an 18th and 19th-century silk processing treatment using metallic salts to produce fuller, heavier fabrics

Wet Cleaning: conservation treatment using water or water plus detergents

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R. Additional Resources

Handling, Storage, and Care

Canadian Conservation Institute. *CCI Notes*. Ottawa: Canadian Conservation Institute
1030 Innes Road
Ottawa, Ontario
K1A 0C8
Canada
<http://www.cci-iic.gc.ca/>

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Society for the Preservation of Natural History Collections (SPNHC)
<http://www.spnhc.org/>

National Park Service. *Conserve O Gram*. Washington, DC: National Park Service.
<http://www.cr.nps.gov/museum/publications/conserveogram/cons_toc.html>

The Textile Museum <http://www.textilemuseum.org/care.htm>
"A Hanging System for Textiles in Sturdy Condition"
"Storing Oriental Rugs"
"Guidelines for the Care of Textiles"
"Pestbusters"

Conservation Resources

Conservation On-Line: <http://palimpsest.stanford.edu/>

American Institute for Conservation of Historic and Artistic Works (AIC): <http://palimpsest.stanford.edu/aic/>

Mannequins

Dorfman Museum Figures, Inc.: <http://www.museumfigures.com/>

Anatomic Studio: <http://www/anatomic.net/>

Professional Societies and Research Organizations

Costume Society of America
<http://www.costumesocietyamerica.com/

Pasold Research Institute (publishers of the periodical *Textile History*)
<http://www.maney.co.uk/textilehistory.html>

Textile Society of America
<http://textilesociety.org/>

Appendix L: Curatorial Care of Easel Paintings

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APPENDIX L: CURATORIAL CARE OF EASEL PAINTINGS

A. Overview

1. *What information will I find in this appendix?*

This appendix discusses the physical structure of easel paintings and outlines their long-term care and preservation. Easel painting is historically a European technique using canvas or wooden panels for the image support. The main topics covered in this appendix are:

- canvas and panel painting materials, structure, and construction
- agents of deterioration
- handling, storage, display, and transportation of paintings
- working with a conservator when treatment is needed
- specific emergency procedures for paintings

This appendix does not cover works of art on paper, such as watercolors, scroll paintings, or screens. These materials are covered in Appendix J: Curatorial Care of Paper Objects. This appendix also does not include painting techniques typically associated with architecture, such as fresco and mural painting.

2. *Why is it important to practice preventive conservation with paintings?*

Preventive conservation aims to prevent harm to an object before it occurs. This practice will decrease the need for costly and time-consuming conservation treatments. Paintings are very delicate because they are composite objects made up of a variety of materials. Many factors contribute to their deterioration. A painting's rate of deterioration slows significantly with proper preventive care. Practicing preventive conservation also reduces the likelihood of accidents.

3. *How do I learn about preventive conservation?*

Learn about the ***agents of deterioration*** that affect paintings so that you can create a preventive conservation plan. These agents are discussed in detail in section C. Understanding how to protect your paintings from the agents of deterioration will increase the longevity of your paintings. See Chapter 3: Preservation: Getting Started, and Chapter 4: Museum Collections Environment, for a discussion on the agents of deterioration. Also refer to *Museum Handbook*, Part III (*MH-III*), Chapter 7: Using Museum Collections in Exhibits.

4. *Where can I find the latest information on care of these types of materials?*

There are a variety of sources for up-to-date information about paintings:

- Read the NPS *Conserve O Gram* series.
- Review the references in the bibliography. Especially note practical information found in *CCI Notes*, Section 10, Paintings.

- Look up the World Wide Web sources that are listed at the end of this appendix.
- Consult a painting conservator.
- Consult a curator or collection manager of a large painting collection.

B. The Nature of Canvas and Panel Paintings

Paintings are ***composite*** objects made up of several distinct parts. Artists create paintings by preparing a support and then painting an image on that support. These two main components of a painting are called the ***support*** and ***image layers***. Both the support and image layers are usually composed of two or more parts. These parts often react differently to external conditions, like temperature and relative humidity (RH), placing stress on the object. Because of this complexity, paintings are delicate objects that must receive specialized care in order to remain in optimum condition.

1. *What are the structural layers of a painting?*

The two principal layers are composed of these parts:

Support layer:

- auxiliary support
  - stretcher or strainer (canvas paintings)
  - mount or cradle (panel paintings)
- support
  - canvas (canvas paintings)
  - wood (panel paintings)

Image layer:

- sizing
- ground
- paint film
- varnish

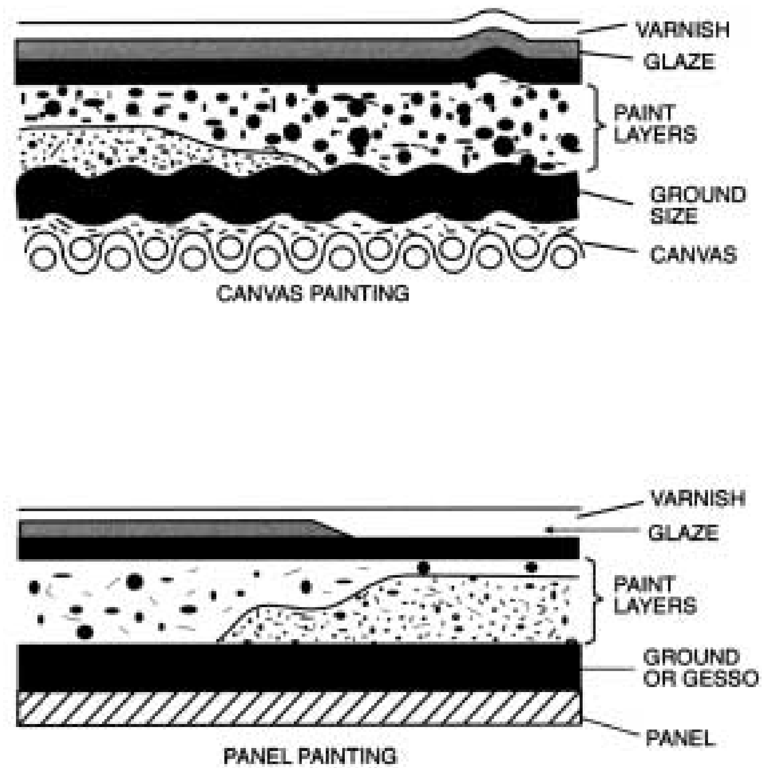

Figure L.1. A cross-section of a painting

Not all canvas and panel paintings have all of these elements. For example, many acrylic paintings are not varnished. Folk artists often paint directly onto wood without first applying sizing or ground. Modern artists often incorporate other materials into the image layer, such as pieces of glass, textiles, paper and plants. Some specialized painting techniques will have different image layer elements from those discussed in this appendix. For example, the encaustic method uses paints that contain a beeswax and resin medium. The painted image is fixed with heat after it is applied to the support. Use the information in this chapter as a guideline for identifying your painting's layers, but realize that it doesn't cover every painting technique.

2. *What are the differences between canvas and panel paintings?*

Canvas paintings consist of a piece of fabric—usually linen, cotton, hemp, polyester, or silk—that is stretched over and attached to a wooden strainer or a stretcher. The fabric (canvas) is the support for the image layer, and the stretcher or strainer is the auxiliary support.

A ***strainer*** is a wooden frame with secured corners that are joined with glue, nails, or screws. Strainers cannot be enlarged mechanically.

A ***stretcher*** is a wooden frame constructed to open out at the joints and tighten the canvas. Small, triangular wooden wedges called ***keys*** are fit into slots on the inner joints of the stretcher to tighten it. This action is called "keying out."

If the stretcher or strainer is damaged or warped so that it does not properly support the canvas, the image layer will also be damaged. The structural stability of a painting is dependent on a sound foundation.

Panel paintings are paintings on wooden supports. The cut of the wood, the type of wood, and the age of the wood are just a few of the factors that influence how prone a panel is to warping. Some panel paintings have an auxiliary support called a ***cradle.*** A cradle is a system of wooden bars that run in a grid pattern along the back of a panel. It has two purposes: to add support to the panel and to prevent the panel from warping. However, sometimes cradles actually cause the panel to warp or crack because they restrain natural movement of the panel due to changes in RH.

3. *What are the parts of a painting's image layer?*

The image layer is the paint film with one or more of the following layers:

- ***Sizing*** is a solution applied to raw canvas or a wooden support to fill in porous surfaces. Sizing reduces the support's absorbency so that the other layers do not soak into the support. If the ground or paint layers sink into the support, the support will become brittle. Traditionally, sizing is made of glue, varnish, starch, or gelatin. Today, acrylics and other synthetics are often used.

- ***Ground*** is an opaque coating that is applied to the support. It provides texture and evens out the painting surface. Painters often add pigment to the ground, which adds an overall tone to the painting. Common colors include red, brown, and gray. A material that has been used for centuries is "gesso," which is often made from chalk mixed in rabbit skin glue. Many synthetic alternatives are currently used.

- ***Paint film*** is the image layer composed of finely-ground ***pigments*** mixed with a ***medium,*** which binds them together. The pigments are what give the paint color. They are either inorganic (minerals, metals, and earths) or organic (vegetal, animal and synthetic dyes). The most common ingredients in paint mediums are drying oils (like linseed and walnut oil), egg yolk (in tempera paint), synthetic resins (like acrylics), and beeswax (in encaustic paintings).

- ***Varnish*** is a transparent, protective film that is brushed onto a dried painting. It protects the paint and saturates the colors. It was traditionally made from natural resins that are dissolved in oil or solvent. Synthetic varnishes and acrylic resins are the most modern varnishes. Varnish should never be applied to a painting that has not dried properly. Because some oil paints can take a long time to dry, artists often sold paintings with the instruction to varnish in a year's time.

The image you see when looking at a painting is created by the interaction of these layers. The image will change as colors darken, become lighter, yellow, or even fade completely. Physical changes such as cracks, crazing, or bulges may distort the surface. Some of these changes are appreciated as patina of age; others are less desirable, especially if there is a chance that part of the image will be lost if left untreated.

C. Factors that Contribute to a Painting's Deterioration

1. *What agents of deterioration affect paintings?*

Many factors contribute to a painting's deterioration. *These **agents of deterioration*** can occur naturally, or they can result from external forces. Avoiding agents of deterioration is the key role of ***preventive conservation***. The agents are:

- direct physical forces, such as shock, vibration, and abrasion
- thieves or vandals
- fire
- water
- pests, such as insects, vermin, or mold
- contaminants, such as air pollution or dust
- ultraviolet and visible light
- high, low, or fluctuating temperatures
- high, low, or fluctuating relative humidity

For more information about these agents of deterioration, see Chapter 3: Preservation: Getting Started.

2. *How do paint films change over time?*

All layers in a painting deteriorate and take on different physical characteristics over time. Paint may become brittle and inflexible, varnish may discolor, and supports may become warped. Changes in temperature and relative humidity affect older paintings more than younger paintings because their materials become less resilient as they age.

Varnish oxidizes with light and air, eventually turning yellow or brown. It can lose transparency, turning milky in appearance. This opacity is called "bloom" and is caused by fingerprints and high relative humidity. Dirt and grime slowly accumulate on the surface, further obscuring the paint layer. Old varnish can also crack, sometimes resulting in damage to the paint layer.

When paintings are in good condition, their ***paint films*** are flexible, and they usually adjust to the expansion and contraction of their supports. However, most paint becomes brittle over time. When an older painting's support changes dimensions, deteriorating paint film may crack. Cracking paint will eventually begin to flake and fall off the support. This loss is irreversible.

3. *Which agents of deterioration will affect my collection the most?*

The following four agents of deterioration are the most likely to cause damage to your paintings:

- temperature

- relative humidity (RH)
- light
  - visible light
  - ultraviolet (UV) radiation
- pollution

Knowing the ideal settings for temperature, RH, and visible light, and knowing how to filter UV radiation and pollution is essential for preserving your collection.

4. *How does the environment affect my collection?*

Temperature, relative humidity, light, and pollution directly affect the rate at which a painting ages. Storing and displaying paintings in areas where temperature and RH are too high or low will increase deterioration rates. Constant fluctuation in temperature and RH is harmful, too, because it causes the materials in the paintings to continuously expand and contract. This often leads to flaking paint. Natural and artificial lighting can cause pigments to fade. Ultraviolet radiation is harmful to all parts of a painting. Atmospheric pollutants can settle onto a painting's surface, masking the artist's image. Pollutants can also break down the chemicals in paint and varnish, acting as a catalyst of deterioration.

Creating an ideal environment for your collection will extend the longevity of your paintings.

Temperature and RH have tremendous effects on paintings. Many structural layers in a painting are ***hygroscopic***--they readily take up and retain moisture. Wood and sizing are particularly hygroscopic. Changes in RH greatly affect these materials. Wood will expand and contract, and subsequently, can twist and warp. Sizing causes a canvas to shrink with dryness and expand with moisture. These changes can be devastating to the entire painting, especially when the paint layer becomes brittle and cannot conform to these changes.

The key to preserving paintings is maintaining stable temperature and RH levels. You must avoid extreme fluctuations in RH and temperature. If you change a painting's environment, do it gradually.

5. *What are the ideal temperature and RH ranges for paintings?*

Store paintings at temperatures between 64º and 75º F (18º to 24º C). Temperature is less important for paintings than RH, but sudden temperature changes can harm paintings. For example, moving a painting from a cool to a warm area can cause moisture to condense on the surface. Maintain a RH of 40% to 55%. Low RH levels (under 35%) can embrittle all parts of a painting and encourage cracks and losses. High RH levels (over 65%) encourage mold growth. Decide on a "set point," and keep temperature and RH as close to this point as possible. See Chapter 4: Museum Collections Environment, for a discussion of proper environment and methods to control that environment.

6. *How does light affect paintings?*

Many pigments are sensitive to light and will eventually fade upon repeated exposure to light. Light can also be a catalyst for the deterioration of the paint medium. Light damage is cumulative and irreversible. Light damage depends on the type of light (ultraviolet and/or visible), intensity of the light, and duration of exposure. Evaluating your collection's lighting conditions and making appropriate adjustments can prolong the life of your collection. Review the natural and artificial light sources in your storage and display areas. Use monitoring equipment to identify levels of UV radiation and illuminance (levels of visible light measured in "lux").

Reduce your collection's exposure to light by storing and displaying paintings in rooms without windows. If this is not possible, use tinted UV-absorbing films on the windows. (Clear UV-absorbing films will reduce UV levels, but will not reduce illuminance.) Cover all windows with drapes or blinds to further protect paintings. Also, avoid storing and displaying paintings in rooms with doors that open to the outside.

For many situations 50 lux is enough light to view a painting. In cases where higher illuminance is needed, don't allow visible light levels to go above 200 lux. All UV light should be filtered. Consider ways to limit the total light exposure, such as automatic dimmer switches or simply turning out lights when visitors are not present.

Don't use traditional picture lights that are hung just over a painting or on the frame. They concentrate light onto a small portion of the painting, creating light and heat damage. When they are mounted on the frame, their weight strains the entire structure.

7. *What kind of pollution affects paintings?*

Outdoor pollutants, such as dust and pollen, can easily be brought into a museum through open doors and windows. Industrial emissions as well as natural processes of erosion create these pollutants. Cleaning products, asbestos fibers, building materials, paint, carpeting, and other indoor materials can generate pollution within a museum. Cigarette, cigar, and pipe smoke are also harmful forms of pollution.

8. *How can I control pollution in my museum or display area?*

Follow these practices:

- Keep doors, windows, and outside vents closed whenever possible.
- Never allow smoking or fireplace fires in the building.
- Choose new building materials, paints, and carpeting that do not emit harmful gasses.
- Don't use custodial cleaners that emit harmful gasses (for example, ammonia).
- Use appropriate pollution filters in your HVAC system.
- Cover paintings in storage.
- Keep particularly vulnerable objects in sealed display cases. Make sure these cases meet the recommendations in *MH-III*, Chapter 7: Using Museum Collections in Exhibits, and NPS *Exhibit Conservation Guidelines*.

For more information on controlling pollutants, see Chapter 4: Museum Collections Environment.

9. *Are museum pests attracted to paintings?*

Some paintings are extremely attractive to pests, depending on their materials. Termites and other wood-boring pests can damage the wood in panel paintings, in stretchers, and in frames. Rodents have been known to nibble at paintings. Insects, such as moths, silverfish, and beetles, like to eat fabric. The gelatin in size and the egg yolk in tempera paint are also attractive to pests. Mold can destroy canvas. Develop an integrated pest management plan (IPM) to protect your paintings and other objects in your collection to prevent these problems. For more information about IPM and pest infestation, see Chapter 5: Biological Infestations.

10. *How can faulty handling affect a painting?*

Improper handling can affect a painting in various ways:

- Moving a painting suddenly can cause cracks in any of the layers.
- Touching a painting's surface often results in scratches and discoloration of varnish, and can dislodge flaking paint.
- Touching the back of the canvas can undermine the surface layers.
- Picking up a painting by the top of the frame can cause strain to the joints in the frame and stretcher/strainer, damaging the entire painting.
- Picking up a painting that is too large for one person to handle can result in a jolting fall.
- Keying-out a stretcher improperly can over-stretch the canvas, creating cracking and flaking.

Many things happen to a painting during its lifetime that do not show immediate damage, but will surface as the painting ages.

Any pressure applied to a painting can cause hairline cracks that will eventually create problems. This pressure may occur when someone marks the back of a painting or glues a label to it. An improperly framed painting will create strain on the canvas that may not be evident for years. These small problems will escalate over time and eventually require treatment. You must take care now so that the objects in your collection will not deteriorate to the point where treatment is needed.

11. *How can past treatments adversely affect a painting?*

The notion of “treatment” has changed significantly through the years. In the past, paintings were taken to “restorers” rather than “conservators.” The emphasis was often on restoring the appearance of the painting, and quite often no consideration was given to the historical importance of the piece. Some restorers slapped patches on the back of a canvas, or sloppily glued on a lining. This has often caused the image layer to flake on the front side of the painting. Restorers sometimes repainted part or all of the surface of a painting. This “overpainting” altered the original image. Some restorers covered their overpainting with brown varnish to give the new paint an old look. Many restorers were careless when they cleaned a painting, removing the original paint along with the varnish. Some restorers just added another layer of varnish on top of everything, including the old varnish and dirt.

12. *How do I know if a painting is actively deteriorating?*

The main purpose of examining paintings is to detect problems as early as possible, and to act accordingly. Carefully examine a painting to identify damage and active deterioration. See Section K for a glossary of terms to use when describing the condition of paintings. In particular, when examining paintings look for these indications of active deterioration:

- cracks in the varnish and/or paint layer
- mold on the canvas or frame
- evidence of pest infestation, such as shed skins and droppings collected in the frame
- rusty or loose hooks and hanging wire
- warping in the frame or stretcher
- slackness in the canvas

These are all indications that your painting may have problems. Some of these problems, if left untreated, may lead to irreversible damage.

D. Proper Handling and Storage of Paintings

1. *What do I need to consider before handling a painting?*

Following are a few guidelines:

- Never touch the paint surface or push on the canvas from the reverse.
- If loose paint is present, carry the painting flat.
- Wash your hands before handling a painting.
- Always wear clean white cotton gloves.
- Clean all surfaces that the painting will touch.
- Check the stretcher keys to ensure that they are secure.
- Carry paintings with both hands on either side. Don't lift the top of the frame or stretcher.
- Carry only one painting at a time.
- Never carry a large painting by yourself. Get another person to help. If it is still too large to handle, place it on a trolley or cart that is well padded and in good condition. An old, rickety cart may produce enough shock to damage a painting.
- Know the painting’s destination before you handle it. If you are moving it to hang it, have the mount prepared. If you are moving it to pack it for transport, have the packaging prepared for it. If you are moving it for

examination purposes, make sure you have set padded blocks on your table for its arrival.

- Never stack paintings on top of each other.

Proper handling of paintings is very important. As a general rule, do not handle a painting (or any other museum object) unless it is absolutely necessary.

For more information on handling, see Chapter 6: Handling, Packing, and Shipping.

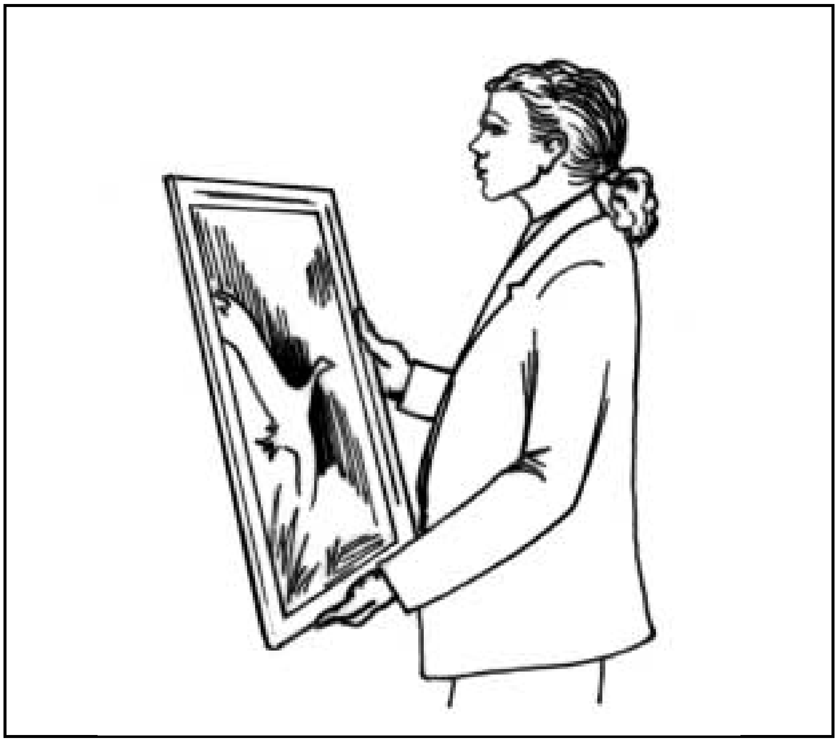

Figure L.2. Proper way to carry a small painting

2. *What do I need to know about the storage of paintings?*

Improper storage of paintings can be a catalyst for deterioration. Consider the elements that affect a painting in storage.

- Control the agents of deterioration.

- Choose appropriate storage space and equipment. See Chapter 7: Museum Collections Storage.

- Ensure that proper security and fire detection and suppression equipment is installed and maintained. See Chapter 9: Security and Fire Protection.

3. *Where should I store my paintings?*

Your collection size is an important consideration when you determine where to store your paintings. If you have many paintings, consider creating a dedicated storage room. If you have only a few paintings in your collection, dedicate a space in your museum storage area for your paintings:

Never store paintings:

- in attics and basements
- against exterior walls
- near furnaces or heating/air conditioning vents
- in spaces below water pipes
- near sources of asbestos, such as old insulation or wiring
- in areas of extreme vibration, such as well-traveled walkways

Always store paintings at least four inches from the floor to minimize dirt and dust collection on surfaces and to protect them from flooding.

Always remove hanging wires, hooks, and all other hanging devices from a painting before storage. These can easily pierce canvas, and can scratch varnished surfaces and frames.

4. *How should I store my paintings?*

There are three main ways to store paintings:

- Hang them from storage screens.
- Place them on storage shelves.
- Stack them vertically against an interior wall or side of a cabinet.

Do not stack paintings against a wall or cabinet unless you have no other option. ***Never lean paintings against exterior walls.***

However you store paintings, it is helpful to fit canvas paintings with protective backing boards (see *CCI Notes* 10/10, Backing Boards for Paintings on Canvas). Backing boards prevent damage by blocking the reverse of the canvas with a rigid material so it cannot be knocked or pierced. It also buffers RH and temperature next to the canvas. The board is attached to the back of the frame using stable metal screws and plates. Don't use this technique on important historic frames. Contact a conservator if you have questions about attaching backing boards.

Storage screens are constructed of a vertically standing wooden frame onto which fencing material or rigid wire mesh screening is attached. Paintings in good condition are then hung from the screens by rigid hooks. This is a particularly useful painting storage method if your storage area is in an earthquake zone. Paintings without frames, of course, cannot be stored on storage screens because these paintings aren't equipped for hanging.

Conserve O Gram 12/1, Storage Screens for Paintings, provides instructions for constructing storage screens.

Note: Paintings that are not in good condition, especially paintings with flaking paint, should not be stored in a vertical position. Lay damaged paintings flat on shelves.

Storage shelves can be constructed of coated wood or metal and can be either horizontal or vertical (sometimes called storage bins). Storage shelves are recommended for smaller painting collections because empty shelves can be used to store other museum objects. (See *CCI Note* 10/3.) It is inadvisable to store more than one painting in each vertical compartment, but if you must, protect the paintings by placing heavy-duty, acid-free cardboard between them. The cardboard must be larger than the largest painting in each compartment. Never stack paintings horizontally.

Stack paintings vertically against a wall. This method is for temporary storage only and only for paintings in good condition. Lean them against a wall, resting on skid-proof, padded blocks. Make sure the blocks are at least four inches from the ground to avoid potential flood damage. Separate paintings from each other with heavy-duty, acid-free cardboard. The cardboard must be larger than the largest painting that will rest against it. Keep paintings of relatively the same size together, and never stack more than a few paintings on each set of blocks. The stacking angle is very important. Keep the stack's angle as close to vertical as possible, but make sure that the paintings can't topple forward. If the angle is too great, the paintings may collapse backwards onto each other. If an unframed painting has to be stacked in this manner, construct a temporary frame. You can place dust covers of washed cotton muslin over the paintings as additional protection. Do not allow the fabric to touch painted surfaces.

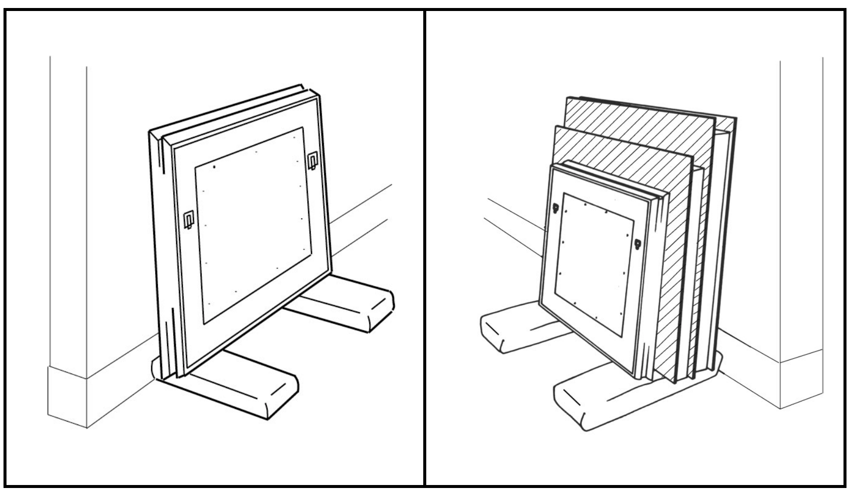

Figure L.3. Paintings stacked against a wall. Redrawn from *CCI Notes* 10/2, Figure 1, and 10/3, Figure 1.

Never stack a damaged painting against a wall.

E. Exhibiting Paintings

1. *What do I need to consider when I am planning an exhibit?*

When you prepare for an exhibit, you need to consider many factors. Refer to *MH-III*, Chapter 7: Using Museum Collections in Exhibits. In addition to factors such as environmental conditions and painting stability, think about:

- placement of paintings
- flow of traffic
- protection from touching and vandalism
- housekeeping requirements

2. *What do I need to consider when installing the exhibit?*

It is very important to make sure that the placement of paintings will not put them in jeopardy. Follow this advice when installing the exhibit:

- Hang paintings away from doors, furniture, or other objects that could bump into the painting.
- Set up the display in a way that is conducive to the optimal movement of visitors.
- Hang paintings in open areas to lessen the chance of visitors brushing up against them.
- Hang paintings away from heat sources, like vents, radiators, and light sources.
- Ensure the security of the paintings.
- Ensure that light sources will not emit UV and that visible light levels on paintings are below 200 lux.

3. *How do I properly hang a painting?*

Use extreme caution when hanging paintings. Improper hanging procedures can allow a painting to fall or allow a theft. Periodically check your paintings to make sure that hangers, hooks, nails, screws, "D"-rings, and all other hanging hardware are securely fastened and not rusty. Make sure that the wall where you hang paintings is strong enough to support the weight. Hang paintings with picture hooks (not nails) and use two hooks for heavy paintings. Drill holes in concrete walls or in studs, not in plaster or sheetrock.

Many paintings are hung by "hanging wire" that is secured to the back of the painting. Hanging wire can become loose if not properly attached and can rust easily, so check it often. To improve security of hanging paintings see *Conserve O Gram* 2/7, Fabricating Secure Hangers for Framed Works of Art.

4. *How do I prevent touching and vandalism?*

Paintings on exhibit are tempting targets for touching and vandalism. Follow these guidelines to prevent the possibility of these hazards:

- Station an employee or security guard in the display room.
- Use guard rails, ropes, platforms, or other deterrents.
- Place "Don't Touch" warning signs near paintings.
- Install security alarms wherever appropriate.

5. *How do I do safe housekeeping?*

If paintings and frames become dusty, you may dust them, but first, carefully examine each painting for loose or flaking paint. If the surface is stable, dust with soft, white-bristle Japanese brushes, or sable or badger-hair brushes. Don't use feather dusters that can scratch paintings. Never try to wet clean a painting yourself or use any liquid or commercial cleaners on a painted surface. Commercial preparations can cause irreparable damage to the fragile layers of a painting. Explain the potential dangers of dusting and cleaning paintings to all staff.

Avoid using pesticides, foggers, air fresheners, or furniture sprays near artworks. Remove paintings from a room before painting, plastering, or steam cleaning carpets or wallpaper. Make sure that cleaning staff are careful with mop and broom handles, which can scratch or puncture a painting. Never use spray cleaners, aerosols, or plant misters in the display rooms because the cleaner or water can settle on the paintings’ surfaces. Avoid using very wet mops that can raise the RH.

Refer to Chapter 13: Museum Housekeeping, for additional information.

F. Proper Shipping of Paintings

Unlike people, paintings will live longer if they lead a sedentary life. Shipping a painting increases the likelihood of damage, which could decrease its lifetime. Improper handling, vibration, shock, and uncontrolled temperature and RH are all potential threats to paintings during shipping. In most cases, the reason to ship paintings will be to loan them to another museum or gallery for an exhibition or to a conservator for treatment.

1. *What do I need to consider before loaning my paintings?*

Before agreeing to loan your paintings, you must first assess their condition, and then decide if they can handle the move. If a painting is in good condition, it will probably survive travel with little harm, provided that it is packed and transported properly. Fit the painting with a protective backing board (see *CCI Notes* 10/10, Backing Boards for Paintings on Canvas). Backing boards will protect the canvas. Keep the following in mind:

- In general, travel will impact small, light paintings less than large, heavy paintings.

- Don’t loan paintings that are fragile, have flaking paint, or are otherwise in poor condition.

- Canvas paintings that are too slack or that have uneven tension can be easily damaged during transportation because the canvas moves easily. Correct any problems with tension before shipping the painting.

- Paintings with holes, tears, or other damage should not travel because of their vulnerable state.

- Large panel paintings, especially those with separate pieces of wood bonded together, are more likely to bend and flex with the vibrations of transport.

See *MH-III*, Chapter 1: Evaluating and Documenting Collection Use, for information on loans. For in-depth information on proper packing procedures, materials, and supplies, see Chapter 6: Handling, Packing, and Shipping (this volume).

G. Conservation Treatment

1. *Why should I contact a conservator?*

There are many reasons to contact a painting conservator, who is trained to examine, analyze, stabilize, and treat paintings. See Chapter 3: Preservation: Getting Started, for information on choosing and contracting with a conservator. Be sure you check references and question the experience and background of any conservator you choose. Talk over any recommended treatments and be sure you understand what is planned and why it is necessary.

Only experienced conservators who agree to follow the AIC Code of Ethics and Guidelines for Practice should be allowed to treat paintings.

Only an expert should clean a painting that has discolored. Flaking paint and tears in the canvas will only become worse without conservation treatment. Water-damaged paintings require immediate conservation treatment. Fire-damaged paintings will usually have blistered paint, as well as a soot covering, and need expert care.

Never attempt to clean paintings or to treat damaged paintings yourself.

2. *What might a conservator be able to tell me about my painting upon examination?*

When conservators thoroughly examine paintings, they will make a number of observations. Conservators will identify the paint medium, the type of varnish, and the type of sizing. The examination may reveal underpainting below the visible image. Conservators are also able to judge the state and extent of deterioration in your paintings and to recognize past conservation/restoration treatments. This knowledge combined with their art historical understanding, enables conservators to make treatment proposals for your paintings.

3. *What might a conservator do to stabilize my painting?*

There are hundreds of treatment procedures involved in painting conservation. The treatment(s) your conservator uses will decrease your painting's rate of deterioration. Conservation treatments for paintings involve methods that will stabilize and/or restore paintings.

There are many variations in the treatments that conservators do, but typical stabilization might include one or more of the following:

- ***Framing or reframing*** to give structural protection to the painting
- ***Minor repairs to the canvas*** to remove dents or bulges or patch small holes
- ***Minor repairs to panels*** to mend splits or loose joins in the wooden support
- ***Consolidation*** to reattach loose paint to its support with appropriate adhesive
- ***Facing,*** or attaching tissue to the paint with a suitable adhesive. Facing is a protective measure that holds flaking paint in place until the painting can be treated.
- ***Lining,*** or attaching a new piece of fabric or other support material to the back of the original canvas to reinforce it, thus preventing loss that can occur due to a painting's structural weaknesses.
- ***Removing old repairs,*** such as removing patches and tape from the back of a canvas or old cradles on panel paintings that are contributing to a painting's deterioration.

4. *What might conservators do to restore my painting?*

Conservators will choose from among hundreds of restoration techniques, depending on your painting's condition. Restoration includes:

- ***Cleaning:*** This involves removing surface dirt and usually involves removing the varnish. Cleaning methods are chosen based on the type of paint and varnish used on a painting.
- ***Filling:*** This includes filling any losses to the ground layer.
- ***Inpainting:*** This involves painting in areas of paint loss or new fills so they are not obvious. Inpainting is done for aesthetic reasons, so that losses don't detract from the painting's overall appearance. Conservators will usually choose paints that can be easily removed so that future conservation treatments won't have to include difficult paint removal.
- ***Removing old paint:*** This involves removing paint from past "restoration" treatments. Restorers often painted on top of the original paint, known as "overpainting."
- ***Transfer:*** This is an extreme treatment that involves moving the image layers to a new support. This is done only if the existing support is contributing to the image layer's decay. This is a complicated procedure that involves removing the support from the back of a painting.

H. Procedures for Handling Paintings During Emergencies

Chapter 10: Emergency Planning, gives information about planning for emergencies and minimizing damage. This section gives specific information on caring for paintings damaged in an emergency.

1. *In what ways can a disaster affect my paintings?*

Unfortunately, accidents and natural disasters occur and cause damage to museum collections. For paintings, water damage is very serious and requires immediate treatment. Water causes wood to swell, creating instant pressure on panels and stretchers. Water can also dissolve sizing, causing the image layer to separate from the support.

Other accidents and disasters can leave torn, burned, sooty, or muddied paintings. In these cases, the damage to the paintings has already occurred. Contact a conservator immediately. Don't attempt to clean mud, dirt, or soot or to mend a ripped painting. You can increase the damage to the painting.

Fire can blister the paint layers. Never try to press the paint back down into place. A trained conservator will usually apply heat to flatten the blisters before attempting to clean the painting, which is a very delicate procedure.

2. *What do I do if my paintings are water damaged?*

Act quickly. Water can seriously damage paintings in a matter of minutes. Immediately contact a conservator if one is available. If not, salvage your collection in order of priority identified in your park's disaster plan. Salvage paintings that have the highest value in your collection first.

- ***Remove frames***. **Don't** remove canvas from stretchers.
- ***Remove excess water*** by gently tilting each painting to let the water run off the surface.
- ***Set up a work area where there is no danger of further damage***. Paintings with flaking layers should be dried face-up on a table, and should not be touched.
- ***Keep wet paintings horizontal*** and paint side up.
- ***Place fans around the work area*** to increase circulation and decrease drying time.
- ***Use dehumidifiers*** to assist in the drying process. Maintain a RH of 60% to 70% to avoid over drying.

3. *What should I do in the case of an emergency that is NOT water-related?*

In most cases the damage will already be done, so there is no need to rush as you would in the case of water damage. However, be aware that some damage, like rips and tears, usually become worse over time.

- ***Don't touch anything***, if possible.
- ***Contact a conservator*** as soon as you can.
- ***Contact your regional/SO curator*** for additional technical assistance.

- ***Move the paintings only enough to be sure they are not in a vulnerable position that could cause further damage***, such as perched at the edge of a table or hanging crookedly on the wall.

- ***Remove anything that may have fallen onto your paintings***.

I. Glossary of Terms Used for Condition Reporting When Examining Paintings*

Blanching: irregular, obtrusive, pale or milky areas in paint or varnish; not a superficial defect like **bloom** but a general scattering of light from increased porosity or granulation in aged films

Blister: a separation between layers appears as an enclosed, bubbled area

Bloom: a whitish, cloudy appearance in the varnish layer caused by exposure to moisture or resulting from deterioration of wax-based media; sometimes called efflorescence

Buckling: waves or large bulges in a canvas from non-uniform tension around the stretcher or strainer

Chalking: loss of a paint or emulsion layer by powdering off

Check: splitting of wood along the grain, from the edge of a board or panel for a part of its length; usually in response to repeated dimensional change brought on by fluctuations of temperature and humidity

Cleavage: a separation between the paint layers and the support producing tenting (gable-like ridges) or cupping (concave flakes); caused by the contraction of the support, forcing the paint layer up off the surface

Crackle: a network of fine cracks; also found in other materials such as lacquer, and glazed ceramics

Crazing: a fine system of crackling in a varnish layer, usually found in aged films in the final stages of drying and embrittlement

Cupping: see ***cleavage***

Dishing: a defect in the stretcher caused by the torque of a drawn fabric; if the stretcher members are twisted out of a common plane, a shallow angle is formed at the corners

Draw: a local distortion at the corner of a painting, marked by diagonal cockling from the corner toward the center of the mount

Fill: the material used to replace areas of loss; fill is then inpainted

Flaking: lifting and sometimes loss of flat areas of the surface layer

Inpainting: new areas of paint to restore design or color continuity; restricted to areas of loss

Overpainting: areas of repainting over existing original paint

Split: a rupture running along the grain of a piece of wood from end to end, usually caused by exterior mechanical stress

Stretcher crease: a crease or line of cracks in the ground and paint layers of a painting on fabric, following the inside edges of stretcher members or the edges of cross-members; caused by the flexing of the fabric against the edges of these members

Tenting: see cleavage

Warp: in a panel, the planar deformation of the support caused by changes in relative humidity

Wrinkling: small ridges and furrows of crawling paint or varnish caused by improper methods or materials

*Terms taken from Demeroukas, 1998

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Appendix M: Management of Cellulose Nitrate and Cellulose Ester Film

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Appendix M: Management of Cellulose Nitrate and Ester Film

A. Overview

1. *What is cellulose nitrate (nitrate)?*

Nitrate refers to a group of early transparent plastic film supports that were most common between 1910 and 1950. Created as an easy-to-handle replacement for heavy and awkward glass plates, gelatin film, and paper negatives, nitrate film was used for still photographic negatives and transparencies, as well as motion picture film. Most nitrate film consists of a flexible sheet or roll of cellulose nitrate (nitrate) film base with a silver gelatin photographic emulsion (image bearing layer) on top. During the 20th century, amateur and professional photographers and filmmakers used nitrate more frequently than any other film support to hold the emulsions of their negative and film images.

Cellulose nitrate polymers, initially called gun cotton, were first synthesized over 150 years ago for use in the manufacture of military explosives. Later, cellulose nitrate polymers were treated with camphor to produce some of the earliest plastics. Celluloid, an early plastic replacement for ivory, was made into hairbrushes, billiard balls, toys, and a variety of home products. In the late 1940s, cellulose nitrate lacquers, adhesives, and metal coatings became popular, many of which are still in common use today. More recently, printing inks; plastics; coatings for stone, metal, and ceramics; and common adhesives, such as DUCO Cement and UHU All Purpose Clear Adhesive, have used cellulose nitrate polymers. Cellulose nitrate polymers vary in the amount of actual cellulose nitrate in their composition, from collodion photographic emulsions with a 10.5% concentration, to photographic flexible film bases with a 12% concentration, to explosive weapons-grade gun cotton with a 12.5% concentration.

If deteriorated, nitrate may be yellowed, tannish, stained, bleached, sticky, brittle, blistered, pungent-smelling, or powdery, depending upon the stage of deterioration. Nitrate photographic film has sometimes been called:

- celluloid
- nitrocellulose
- flammable film
- pyroxolin
- flam film
- cellulose nitrate

Nitrate is often confused with the cellulose ester films, including acetate, diacetate, and triacetate negatives, which deteriorate in a similar fashion. Cellulose ester films are described in Section B.1. Paper-based photographs are **never** nitrate. Specific tests have been developed to identify nitrate.

See Section B.6 below for more information on these tests. The modern replacement for nitrate and acetate films is polyester, a stable plastic.

2. *What are nitrate photographic negatives and transparencies?*

In the United States, nitrate-based still photographic negatives and, less commonly, positive transparencies were produced between 1889-1950. Both amateur and professionals photographers used nitrate film for fine art photography, photojournalism, portraits, travel photography, and technical photography such as aerial, dental, legal, and medical photographs (both X-ray and standard negative and transparency images). Manufacturers such as Agfa, Ansco, Defender, DuPont, Hammer, and Kodak produced nitrate films. See Table 1 (Section A.4) to learn when different formats and types of nitrate still negatives were first introduced or last available in the U.S.

The earliest nitrate film (1889-1903) has a thin (<8/1000 of an inch or <8 mil) nitrate film base and gelatin coating on only one side; therefore it tends to curl. This earlier film is more stable than later professional film, which has a thicker nitrate base (8 mil) to keep the film flat during processing. Professional negatives are the least stable of the still negatives. On occasion, rolls of 35mm-nitrate still negative film are confused with motion picture film when the roll film remains in its original roll format. Roll films may be identified by their frame numbers, which motion picture films lack. Nitrate sheet and cut film have a border pattern (frame-like edge) that doesn't occur consistently around the image. On the long edge of the film, the border ends about an inch from the end of the image, while the image reaches to the film edge in this area.

Most nitrate still images are flat sheets of transparent flexible film containing negative or positive photographic images in a wide variety of sizes (formats) from 35mm to greater than 16" x 20". Included in this category are:

- ***aerial film*** (ranging in size from 4" x 5" to 8" x 10"), which is easily identifiable by subject content

- ***X-ray film*** (emulsion coated on both sides of the base), which is also easily identifiable by subject content

- ***film packs*** (up to 5" x 7"), which are recognizable by the lightweight film base, a wide short-edge border (frame-like edge of the image) and thinner long-edge border, and the adhesive or paper residue from a pull tab that may be present on the short border.

3. *What is nitrate motion picture film?*

Nitrate motion picture film consists of varying length strips of flexible film with perforations along both side edges, which allow the film to be fed through a camera, projector, or film editor. Unlike slides and negative roll film, however, the motion picture film frames have no sequential frame numbers. Nitrate motion picture film was used to create educational film strips, amateur films, training films, travel films, and amateur and commercial motion picture releases, both silent and with sound.

Nitrate motion picture film can contain positive or negative motion picture images. These images may be either color or black and white, generally showing motion in sequence from left to right like a comic strip. Most nitrate motion picture film is thinner than negative film but relatively less stable as it is stored tightly rolled and in large quantities, which hastens deterioration.

Nitrate motion picture film was originally available between 1895 and 1951. These nitrate motion picture film availability dates are not absolute, however, as some filmmakers had stockpiles of this film and continued to use it for some years. See Table 1 below for precise dates when specific types of nitrate stopped being manufactured in the U.S.

4. *When was nitrate used in the United States?*

American amateur and commercial still photographers used nitrate-based film most frequently between about 1908-1939, although nitrate film was available between 1889 and 1951. Specific dates vary for some gauges and formats (X-ray, aerial film, and roll film). The history of nitrate and other film types produced in the U.S. is chronicled below.

Table 1: A History of Nitrate Film
1889 – Nitrate film is developed for roll film (not 35mm), sheet film, film pack film, X-ray film, and professional 35mm motion picture film.
1895 – Nitrate commercial motion picture film is available.
1900 – Nitrate motion picture film becomes commonly available.
1903 – Nitrate film is given a thicker nitrate film base and a gelatin backing on both sides.
1908 – Kodak introduces cellulose acetate “safety” roll film negatives for still cameras.
1909 – The National Board of Fire Underwriters develops rules for nitrate handling and storage.
1920 – Nitrate 35mm roll film and aerial film are available.
1920 – Acetate amateur motion picture film is available in 8mm and 16mm formats.
1920 – Nitrate negative film commonly replaces glass plate negatives.
1923 – Kodak introduces cellulose acetate amateur motion picture film.
1925 – 35mm nitrate still negative film begins to be available and cellulose acetate film becomes much more common.
1930 – Acetate sheet film, X-ray film, and 35mm roll film become available.
1933 – Last year Kodak manufactures nitrate X-ray film in the U.S.
1935 – Nitrate still negative film begins to be replaced by cellulose acetate “safety” film.
1937 – Cellulose acetate film begins to be replaced by cellulose diacetate.
1938 – Last year Kodak manufactures 35mm nitrate still negative roll film in the U.S.
1939 – Nitrate still negative film is largely replaced by “safety” films.
1939 – Last year Kodak manufactures portrait and commercial sheet nitrate film.
1940 – Acetate aerial film and roll film (other than 35mm) is developed.
1942 – Last year Kodak manufactures aerial nitrate film in the U.S.
1947 – Cellulose diacetate still negative film begins to be replaced by cellulose triacetate.
1948 – Kodak introduces triacetate motion picture films. *Note***:** If your print is edge marked “safety,” it dates after 1948.
1949 – Triacetate motion picture films are now in common use.

1949 – Last year Kodak manufactures nitrate film packs in the U.S.

1950 – Last year Kodak manufactures roll film in sizes 616, 620, and 828 in the U.S.

1950 – Acetate film pack and professional 35mm motion picture film become available.

1951 – Last year Kodak manufactures professional 35mm motion picture film in the U.S.

1951 – After this date, all camera negative separation films (Technicolor camera negatives, master positives, matrices, and release prints) are produced in triacetate. Most film produced before this date in the U.S. is unstable.

1960 – Polyester sheet film, X-ray film, and aerial film become available.

1960s– During this decade, most Technicolor™ films are on polyester support matrix films.

5. *Why should I be concerned about nitrate film?*

As it deteriorates, nitrate gives off highly acidic nitrogen oxide gases, particularly nitric oxide, nitrogen dioxide, and others, which either escape into nearby areas—threatening staff, buildings, and collections—or stay captured in the sealed storage area. Unless allowed to escape, these gases build up, causing an autocatalytic reaction that speeds decomposition of the original nitrate materials. Since the reaction produces heat, which further acts on the available gases and humidity, the environment around the nitrate rapidly becomes toxic. Nitrate poses a variety of problems, including:

- ***Health problems*:** All nitrate film deteriorates naturally over time, unless kept in very cold storage. Deteriorating nitrate film gives off gaseous byproducts, including nitrate oxide and nitrogen dioxide gases, which may threaten researcher and staff health. Health threats include:

  – eye irritation

  – headaches

  – nausea

  – rashes

  – respiratory irritation

  – skin irritation

  – swollen glands

  – vertigo

  All human exposure to nitrate should be limited in duration and monitored for side effects. Staff working with nitrate must keep track of and limit the number of hours of exposure and use special equipment when working with nitrate. See Section C.7 for details.

- ***Safety problem*:** As nitrate decomposes, it releases heat (an exothermic reaction) and acidic gases, including nitric oxide and nitrogen dioxide. In the presence of high humidity or water vapor, the nitrogen dioxide deterioration byproducts can produce nitric acid, a very corrosive compound. Large quantities of nitrate, particularly bulk quantities of roll film (20,000 linear feet or more), motion picture (20 films or more), or X-ray film (875 X-rays or more than 75 pounds), when housed together, will deteriorate at an ever-accelerating rate due to the build up of heat and acidic gas deterioration byproducts. See Section C.7 for guidance on how to work with nitrate.

If you store quantities of deteriorated nitrate, it may spontaneously ignite at temperatures of 100°F (38°C) or higher. Undeteriorated nitrate ignites at about 266°F (130°C). **Burning nitrate produces toxic gases, such as carbon monoxide and nitrogen peroxide that pose a severe threat to life.** These toxic gases have killed many individuals in theaters, clinics, and storage structures. In 1929, gases from burning X-rays during a clinic fire in Cleveland killed 125 people.

Since nitrate contains chemically combined oxygen, it produces its own oxygen as it burns. Once burning, nitrate roll film or motion picture film is almost impossible to extinguish as the center of the film burns at the same speed as the exterior due to the nitrate's ability to use the chemically combined oxygen. Nitrate is a serious threat to the safety of all people that work in the same building, all collections stored in the building, and all historic structures nearby. Nitrate can burn in a closed film can, under water or sand, and despite modern fire suppression systems including dry chemical and foam fire extinguishers, halon, carbon dioxide fire systems, and similar extinguishers. See Section D for guidance on how to avoid nitrate fires. Nitrate can also suffer from the standard deterioration problems of film, such as mold, insect infestations, and vermin infestations, all of which pose additional health hazards. See *Museum Handbook***,** Part II, Appendix R: Curatorial Care of Photographic Collections.

- ***Structural safety problems*****:** As well as being toxic, nitrate fires are known for their intensity and explosive force. Nitrate burns at a combustion rate 15 times greater than that of wood. While burning, nitrate produces toxic and flammable gases—including carbon monoxide and nitrogen peroxide.

  Just five pounds of nitrate (1 reel of motion picture film or 125 negatives larger than 4" x 5" in size) can release over 25 cubic feet of carbon monoxide. These gases are produced at such a rate that they place tremendous pressures on building structures, frequently leading to structural collapse. Nitrate fires usually burn until all fuel is consumed, often accompanied by explosions.

- ***Collection problems*****:** As it deteriorates, nitrate gives off gases that deteriorate other materials, such as paper, leather, fabric, and wood, as well as stone and some metals. The nitric acid created as the result of nitrate deterioration corrodes metal, makes gelatin binders (part of the film image-bearing emulsion) sticky, and fades silver images.
  Even when in refrigerators or freezers, nitrate should not be housed in general museum or archival storage areas, work spaces, or general office spaces for more than five years) as some fumes are still given off. Nitrate is a threat to the survival of collections housed in the same or nearby buildings. See Sections C.11 and C.12 for guidance on how to house and store nitrate.

6. *What values do nitrate films have for parks?*

Nitrate negatives and motion picture film forms the largest portion of the visual record of the early 20th century. This material has value for a wide variety of purposes, including:

- ***Informational value*****:** Nitrate film provides meaningful data and information essential for tracking how parks have changed over time including:

  – activities and events

  – archeological sites

  – buildings and restoration of structures

  – geology

  – historic landscapes and vegetation

  – human impact on ecosystems and fauna

  Nitrate captures the ephemeral, transforming it into a record that can be interpreted, evaluated, utilized as data, and transformed into information and knowledge. Don't lose this information through neglect or disposition. High quality copies can have almost as much informational value as original nitrate. If you have a high quality copy, such as an interpositive copy or a duplicate negative in good condition, you don't have to keep the original negative if it has only informational value.

- ***Artifactual value*****:** Materials that are rare, interesting, or outstanding examples of photography or filmmaking have artifactual value. Some nitrate negatives, for example, such as those by Ansel Adams, Lewis Hine, or Carleton Eugene Watkins, are important artifacts in their own right because of their excellence as visual objects.

  Nitrate with high artifactual value will generally have some of the following characteristics:

  – fine composition

  – sharp focus/resolution (unless purposefully impressionistic)

  – good tonal values

  – excellent depth of field (clear focus and image depth in both foreground and background areas)

  – lack of obvious blemishes such as smudges and dust spots

  – representation of the subject matter in a visually arresting, interesting, or surprising way

  – good contrast (clear bright highlights and deep dark shadow areas)

– good range of clear details, even in the dark shadow and bright highlight areas

These high artifactual value nitrate materials must be preserved as major assets until they become so deteriorated that they have lost their functionality and become a threat to other materials. Poorly composed, unfocused, and muddy images would not qualify as having high artifactual value. Generally speaking, high quality copies **don't** capture all the artifactual value of an original photograph. Copy and keep undeteriorated original nitrate that has high artifactual value.

- ***Evidential value*:** Some nitrate negatives serve as either legal or historical proof of an activity, event, occupation, or action, such as law enforcement footage of an illegal activity. The state and federal laws have specific requirements for how evidential materials must be maintained prior to a court case. Such legal requirements might include:

  – an unmanipulated image that has not been dodged, burned, retouched, tinted, or airbrushed, either in the darkroom or afterwards

  – documentation on when, where, how, why, and by whom the image was taken and what it documents

  – a record of a continuous chain of custody by the creator (photographer or his or her employer)

  This evidential nitrate should be kept for its value as legal and historical evidence, although while still active, it is unlikely to be found in museum collections. Legal records may eventually become unnecessary; however, **historical proof is always necessary**. Nitrate film that serves as historical or legal proof must be copied with particular care to ensure that it doesn't lose its usefulness as evidence. You may need to consult with a lawyer or historian before disposing of these legal or historically evidential materials, even after copying. In some cases you may be bound to maintain the original in perpetuity, or at least until it is deteriorated beyond stage 3. See Section B.13 for a description of the stages of deterioration. Copy and keep this original nitrate film. Consult your solicitor for guidance on preserving the evidential value of the original in your copy.

- ***Associational value*:** Some nitrate has importance for its relationship to a notable individual, group, event, place, or activity, such as the images taken by or of presidential family members, famous authors, famous generals, or other notables. Associations might include:

  – an individual or group who created, owned, or was shown in the image, such as Franklin D. Roosevelt

  – an activity, such as a parade, staff-training, or a celebration

  – a movement, such as Suffrage, Emancipation, or Impressionism

  – a geographical locale, such as a particular park site

– an era or event documented, such as the Spanish-American War or Inaugural Day

Generally speaking, associations are more powerful for original materials than with copies. Maintaining the original nitrate will maintain that direct link to the associated individual or group. Copy and keep undeteriorated original nitrate with high associational value.

- ***Administrative value*:** Some nitrate is essential for the day-to-day operation of the parks. This includes nitrate film that documents museum collections; nitrate film used as resource materials for park publications; and nitrate film that serves as documentation of land boundaries, flooding, or forest fire damage. Generally speaking, these materials eventually become part of the park museum collections because of their informational content, if, for example, they contain baseline data on ecosystems. These materials, once copied, inspected, deteriorated, and deaccessioned may be disposed of as NPS hazardous waste according to Environmental Protection Agency (EPA) guidelines. Work with a NPS hazardous waste coordinator. See C.16 and C.17.

B. Identification and Evaluation of Historical Nitrate and Cellulose Ester Film

1. *What transparent flexible film bases have been produced?*

During the late 19th and early 20th century, there were a number of transparent film bases created, including:

- ***Cellulose nitrate (nitrate)*:** Described in Section A.1.

- ***Cellulose ester (acetate) family of safety film bases*:** The cellulose ester family of film bases is usually referred to as triacetate, diacetate, or acetate or is simply called safety film. Though developed to be permanent film bases, unfortunately these films were no more stable than nitrate. Their maximum life expectancy (LE) is 100 years at an average room temperature of 70°F. The major difference between the nitrate and cellulose ester family of film bases is that the cellulose ester films are **not** as flammable. Because of the presence of acidic decomposition byproducts, these cellulose ester film types should be isolated, reformatted, and placed in cold storage as they deteriorate. **Most 20th century color film (slides and negatives) is cellulose ester, even film and transparencies being produced today.** Manufacturers such as Agfa, Ansco, Defender, DuPont, Hammer, and Kodak have produced or are producing cellulose ester films. See Sections B.2-B.4, and B.6.

  – ***Cellulose acetate (acetate, cellulose acetate propionate, and cellulose acetate butyrate)*:** Developed about 1935, these were the first of the "safety" cellulose film types used to replace nitrate. The major improvement over nitrate was an ignition temperature above 800° F.

- ***Cellulose diacetate (diacetate)*:** This is the second of the safety cellulose film types, used to replace nitrate film and acetate around 1937. Like acetate, diacetate is no longer-lived than nitrate. Diacetate films discolor, shrink, and become progressively more brittle over time. Storage environment, particularly temperature and humidity, greatly affects the life of this film. Cellulose diacetate began to be replaced by triacetate in 1948.

- ***Cellulose triacetate (triacetate)*:** This is the last of the cellulose ester films that replaced nitrate around the 1950s. It was first available in 1948 as motion picture film and commonly in use by 1949. As early as 1960, reports began to filter in that cellulose triacetate film was not permanent when stored under warm and humid conditions.

- ***Polyester (polyethylene terephthalate)*:** This refers to a clear neutral plastic film used for film bases since the 1950s. Polyester is a long-lived and durable film base. Films marked "Estar" or "Cronar" are polyester. Manufacturers such as Agfa, Ansco, Dupont, and Kodak produce or have produced polyester films. Polyester is not particularly flammable, does **not** give off dangerous gases, and has a maximum life expectancy (LE) of 500 years.

2. *Does cellulose ester film deteriorate?*

Yes. All flexible films in use before 1950 deteriorate. As cellulose ester films age, deterioration lowers the pH of the cellulose ester's emulsions (image-bearing layer), causing fading and film-base deterioration. Like nitrate, these films become brittle as they age. Cellulose ester film may develop crystals or bubbles on the emulsion surface of the images.

The classic cellulose ester deterioration patterns are "channeling," in which the film image layer (emulsion) forms raised blisters and tunnels on the film base and "vinegar syndrome," described in Section B.3 below. Ultimately, the only effective preservation solutions are reformatting and inspection of the original, followed by cold storage of any undeteriorated originals of continuing value. For more guidance and a rating system for comparing the various types of value, use, and risk, see *Conserve O Gram* (*COG*) 19/10, "Reformatting for Preservation and Access: Prioritizing Materials for Duplication."

3. *What is the vinegar syndrome?*

As the cellulose ester films (acetate, diacetate, and triacetate) deteriorate, they chemically decompose, producing acetic acid. Acetic acid is the cause of the well-known "vinegar" smell frequently noted around collections of acetate, diacetate, and triacetate. Like nitrate, the decomposition is autocatalytic, meaning that the presence of acidic decomposition byproducts near the original film will speed further decomposition. Using sealed or closed containers hastens this deterioration process by maintaining deterioration byproducts and acetic acid gases next to the film. Like nitrate films, cellulose ester films should be isolated for cold storage. Handle cellulose ester film carefully, as acidic gas byproduct build-up near the film can also be a health hazard.

4. *What does deteriorated cellulose acetate, diacetate, and triacetate film look like?*

Most cellulose ester film types deteriorate in the following characteristic ways:

- ***slight film curl*** (***Note*****:** This is also exhibited by nitrate from the 1889-1903 era)
- ***vinegar-like or acetic acid smell***, which grows stronger as the film deteriorates
- ***film shrinkage***, which can change the film's dimensions
- ***film embrittlement,*** although it doesn't turn amber-colored like nitrate
- ***some warping and planar distortion***, so that the film is no longer flat, but instead has raised areas
- ***bubbles*** in the film emulsion
- ***channels of raised film emulsion*** on the film surface (as the film emulsion separates or lifts from the film base it produces channels, tunnels, and large blister-like features)
- ***silvering-out*** or metallic mirroring or image tarnishing that begins to occur in the densest image areas

  Note**:** Only nitrate has rainbow effects that appear in the darkest and most silvered-out areas of the image. Acetate, diacetate, and triacetate films lose image detail and look dark and reflective when they silver-out; they don't have rainbow-like-patterns.

5. *How do I identify nitrate materials?*

There are several ways to identify nitrate materials, including:

- ***By date of manufacture*****:** Table 1 in Section A.4 provides a review of the dates during which various types and format of film were most commonly used. Most film negatives and motion picture film made in the United States before 1951 are suspect as being potentially nitrate. Additionally some negatives and films made in France during World War II were nitrate.
- ***By internal evidence*****:** Internal evidence is the best way to identify nitrate. There are several common types of internal evidence, including:
  - ***Edge markings*****:** Edge markings or edge prints are actual words on the borders of film that indicate the film name or type. Some manufacturers edge-marked their nitrate film with the word "nitrate," while they marked other film with specific brand names or types of nitrate film, such as "Eastman Nitrate Film." **If** you are dealing with an original negative, you can depend upon the "nitrate" edge marking. ***Note*****:** The marking "safety film" indicates that the film is cellulose ester (acetate, diacetate, or triacetate), while films marked "Estar" and "Cronar" are polyester.

Occasionally, when copying nitrate film to a safety base the nitrate edge markings also were copied. These copies of nitrate on safety base would have both "nitrate" and "safety" edge markings, thus alerting you to their "safety" status. So, the presence of the word "nitrate" as an edge marking is **not** conclusive proof that the material is nitrate if you are dealing with a copy image. Look for V-shaped notch codes (punches taken out of an image border in a particular configuration to indicate the film type to photographers working in a darkroom) in addition to the word "nitrate" for more conclusive proof that the image is nitrate (see notch codes below). Your best use of edge markings is to look for the word "safety." Assume that pre-1950 film or negatives not marked with the word "safety" are nitrate. Also assume that unmarked film produced prior to 1950 is nitrate, until you can test it.

Flexible film-based negatives (not glass, paper, or metal based negatives) and motion picture film produced between 1890-1950, which don't have the words "safety film" marked on them, generally are nitrate. Use this distinction as one easy way to identify nitrate.

– ***Notch codes*:** Notch codes are small punches taken out of the border of nitrate, developed to help photographers identify the film type in the dark room. These codes varied over time by manufacturer, process, and format of film. Kodak "V" notch codes, used in combinations of up to three notches, designated that the film was nitrate. When the earliest safety film appeared, the outermost notch became a rectangular "U." After 1949, Kodak reused the old "V" notch codes for safety film. Notch codes provide uncertain guidance and are best used in conjunction with other internal evidence.

– ***Odor*:** Nitrate film has a pungent nitric acid smell as it deteriorates and may have a camphor-like odor when it burns. These odors should not be confused with the vinegar-like acetic acid smell of deteriorating acetate, diacetate, and triacetate safety film.

– ***Yellowish-brown base color*:** As it deteriorates, nitrate film changes in color from clear and transparent to a distinctive dark amber tone. To determine if the base has this tone, look along the border or edge of the film where there is no emulsion or cut a small chip from the edge of the film and place the film chip in water. After about 15 minutes, when the emulsion has softened, scrape it to see if the film is amber in color. If it is, the film is probably nitrate.

– ***Base brittleness*:** Deteriorated nitrate is very brittle. You may cut a tiny chip off the border of a piece of nitrate film and try bending it. Compare the film's resilience to that of a piece of contemporary film by flexing it gently. Nitrate will be significantly more brittle.

– ***Emulsion stickiness*:** Check the image's emulsion border for stickiness. Emulsions on nitrate that has reached stage 2 of deterioration or higher may be sticky or softened. (See B.13 for a review of nitrate deterioration stages.)

– ***Emulsion mirroring or silvering out*****:** Both nitrate and acetate film turn mirror-like or look like tarnished silver—usually in the densest image areas. However, in nitrate the mirroring may appear as a black rainbow, while in acetate there is no rainbow-effect.

– ***Emulsion cockling and buckling*****:** As it deteriorates, nitrate shrinks. This shrinkage causes the negative emulsion to buckle and lift-off the cellulose nitrate base. Early safety film (acetate, diacetate, and triacetate) also has an emulsion shrinkage problem that causes the emulsion to separate from the base and form long web-like channels. Channelized film, in which the emulsion lifts off the base to form raised honeycomb-like cells or tunnels, is **always** cellulose ester.

– ***Film gauge***: Though motion picture film has come in a wide variety of gauges, nitrate was not available in all of them:

standard 8mm (never made in nitrate)
super 8mm (never made in nitrate)
16mm (never made in nitrate)
35mm (the most common nitrate gauge)
70mm (less common nitrate gauge than 35mm)

Use the internal evidence indicators above with care, as they may be inconclusive. You may need to test the material to determine if it is nitrate

6. *How do I determine whether film is nitrate, cellulose ester (acetate, diacetate, triacetate) or polyester?*

You can use any of four tests to determine the composition of photographic negatives, transparencies, or motion picture film in your collection:

- ***The polarization test*** identifies polyester film.
- ***The burn test*** identifies nitrate film.
- ***The float test*** identifies all film types.
- ***The diphenylamine test*** identifies nitrate film.

Before using these tests, attempt to identify the nitrate by one of the techniques described in Section B.4 above. Or, use the polarization test (see Section B.7) in conjunction with the techniques described in B.4. While each of the four film tests has particular advantages and disadvantages as described below, **only the polarization test is non-destructive.** Therefore, the polarization test is the preferred test for use with NPS museum collections. Don't try to undertake the destructive tests (burn test, float test, or diphenylamine test) without training and appropriate facilities, such as fume hoods or an acid/organic vapor cartridge breathing apparatus that has been fitted to the user.

7. *How do I use the polarization test?*

The polarization tests can help you determine if film is made out of polyester. Place the film to be tested between two photographic polarizing filters or two pairs of polarized sunglasses. Twist or "cross" the filters or glasses so that they allow light to pass through them. Project a strong light through the pair of "crossed" polarized filters (or polarized sunglasses) and film. If the film is polyester-based, the shimmering full spectrum of rainbow-like patches will appear on the film. If the film is one of the cellulose esters or nitrate, you will simply see dimmed light, but no rainbows. As the only non-consumptive film test, **the polarization test is preferred over the other testing options.**

8. *How do I use the burn test?*

You can distinguish nitrate from safety film through the use of the burn test (a consumptive test). Cut a small snippet of film from the border (not the image area) of a negative or motion picture film. **Use a fume hood if one is available or an acid/organic vapor cartridge breathing apparatus that has been fitted to the user.** If you have no fume hood or apparatus, go outside of the building, far from any venting nitrate fumes, gasoline, or other flammable materials. Hold the film carefully by the corner using a hemostat or pair of long-handled tweezers.

Light the film snippet using a match.

- ***Nitrate film*** will burn brightly and consistently with an intense white-to-yellow flame. Fire should consume the nitrate snippet completely. Some nitrate film will have a camphor-like odor as it burns, although formulations varied during creation.

- ***Safety film*** will smolder and go out when the match is removed, leaving a melting or dripping mess behind and an acetic acid, vinegar-like odor.

You will need experience before you can use this test as a conclusive measure. On your first few attempts, work with film that has already been identified in order to experience the testing characteristics of both film types.

9. *How do I use the float test?*

Another way to distinguish nitrate from safety film is the float or trichloroethylene test (a consumptive test). Trichloroethylene is a dangerous volatile chemical and a known carcinogen, so avoid touching the trichloroethylene or breathing in the chemical's vapors**. When working with trichloroethylene use a fume hood and wear neoprene gloves** or work outdoors using an acid/organic vapor rated cartridge in a rated breathing apparatus fitted to the user and neoprene gloves. Never carry this open chemical through your storage, work, or reference areas.

Take a 6 mm x 6 mm chip (snip) of film to be identified from a film border. **Be sure to cut only the non-image area**. Place the film chip in a beaker or test tube of trichloroethylene. Place a lid on the beaker and shake it or press the film chip down into the fluid until it is thoroughly wet. The film will either float, sink to the middle of the beaker, or sink to the bottom of the beaker.

- Cellulose ester (cellulose acetate, diacetate, and triacetate) safety films float at the top of the beaker.

- Polyester film floats at the middle of the beaker.

- Nitrate film sinks to the bottom of the beaker.

After the test you must work with your hazardous waste coordinator to store and/or dispose of the trichloroethylene and the test strips according to EPA guidelines.

10. *How do I use the diphenylamine test?*

Perform the diphenylamine test (a consumptive test) very carefully as the solution contains about 90% sulfuric acid. Obtain a solution of diphenylamine and sulfuric acid, as described in the Canadian Conservation Institute's "The diphenylamine spot test for cellulose nitrate in museum objects," *CCI Notes* (17/2). Place a small film chip (from a border or non-image area) on a microscope slide and add a drop of the prepared diphenylamine solution. After 60 seconds, if the film is nitrate, it will turn a deep blue. Both cellulose ester and polyester films will either remain clear or turn a very pale blue, not a vibrant, deep blue.

To confirm the test result, apply two additional drops of the solution to the film chip and wait another minute for the film to turn deep blue. Conduct this test under a fume hood or outdoors wearing an acid/organic-vapor rated cartridge in a rated breathing apparatus fitted to the user, as **the sulfuric acid may irritate your mucous membranes.**

11. *What determines the speed of nitrate deterioration?*

Nitrate begins self-destruction at the moment of creation. **Nitrate film self-destructs at an unpredictable rate.** The only way to estimate when nitrate will be unusable is to have a conservator conduct the consumptive tests listed in Section B.14 on each individual sheet or roll of film—hardly a practical alternative. Several factors cause chemical or mechanical deterioration of nitrate, including:

- ***Manufacturing and processing history*:** During the early days of mass photographic processing each batch of photographic film had a slightly different composition. Factors affecting the life of the image include:

  – the nitrate composition

  – the nitrate thickness

  – the emulsion quality

  Residual processing chemicals, such as sodium thiosulfate and silver complexes, affect the life of the image but seem to have little to do with the actual life of the nitrate base. You may test for residual processing chemicals (particularly thiosulphate) in a variety of ways, ranging from using test strips to hiring a lab to conduct chemical tests, such as the methylene blue test. See Sections B.15 and C.15.

- ***Storage and housing environment*:** The storage and housing environment involves a wide range of factors that may affect the rate of deterioration, including:

  – air contamination and pollution

  – housing envelopes, sleeves, folders, and boxes

  – insects

  – light

  – mold

- relative humidity
- rodents
- storage equipment
- temperature
- ventilation
- water

See Sections C.11 and C.12 for information on how to house and acclimatize nitrate and cellulose ester films.

- ***Handling*:** Abusive handling can cause scratches and abrasion, while direct hand contact can deposit oils, which ultimately lead to emulsion staining. Avoid using nitrate frequently for duplication purposes as this places great stress on a negative. Never project nitrate. Reformat frequently used materials to provide access, duplication, and archival preservation master copies. See *COG* 19/10, "Reformatting for Preservation and Access: Prioritizing Materials for Duplication," for further help in determining what nitrate to reformat first.

12. *Is nitrate deterioration predictable?*

No. Although nitrate does go through five sequential stages of deterioration, without sophisticated chemical testing by a professional, it is impossible to predict how long the negative will exist in each stage. Film that has lasted for 60 years at stage 1 (relatively good condition) may go through stages 2-3 in only a few months, depending upon how the nitrate is stored and handled. Cold storage and regular inspection of nitrate is essential if collections are to be preserved.

13. *What are the stages of nitrate deterioration?*

There are five stages of nitrate deterioration.

- ***Stage 1*:** Film base discolors to a light amber tone.
  - Image fades.
  - A faint acidic or nitric acid smell may be detectable.
  - Image may stain, totally or in part, or exhibit "mirroring," where it becomes dark and reflective.
  - A black, rainbow-like iridescence may be visible, not unlike an oil slick.

  (*Note*: Even the best preserved nitrate is now at least in stage 1 deterioration.)

- ***Stage 2*:**
  - Emulsion may soften.

- Negative may become sticky, attaching itself to paper sleeves or other film.
- Film base may become brittle.
- Film base amber color may deepen.
- A slightly stronger acidic or nitric acid smell may be apparent.

Note**:** In many cases stage 2 is the last stage at which nitrate can be copied or reformatted.

- ***Stage 3*****:**
  - Emulsion may begin to separate from the base.
  - Nitric gas bubbles appear between the film base and the emulsion (image-bearing layer).
  - Film base is very brittle and deep amber in color.
  - Significant "mirroring out" or mirror-like, reflective black staining is apparent, often with a rainbow-like appearance.
  - Nitric acid smell is strong.

- ***Stage 4*****:**
  - Emulsion begins to flow.
  - Sticky froth appears on the negatives.
  - Film sticks to nearby housing or negatives.
  - Image surface is easily damaged.
  - Nitric acid smell intensifies.

  (Note**:** Film in this deterioration stage should be disposed of as hazardous waste. See C.16 and C.17.)

- ***Stage 5*****:** ***(Note*****:** Film in this deterioration stage should be disposed of as hazardous waste. See C.16 and C.17.)
  - Emulsion turns into an acrid brownish or tannish powder that is highly acidic.
  - Film shatters or breaks easily, as the nitrate base is **very** brittle.
  - Film can self-combust if stored near high temperatures or sparks. ***Note*****:** This is a rare condition in still negatives except for those of the largest sizes housed without sleeves.

14. *What chemical tests can be used to predict whether nitrate life has been exceeded?*

Two chemical tests can indicate whether nitrate should be immediately destroyed or not. These tests are:

- the Alizarin red heat test
- the Micro-crucible test

Don't attempt to do these tests yourself without a sophisticated chemical laboratory and excellent training. Send film to be tested to an outside chemical laboratory, which will provide you with the results and a recommended date for retesting.

15. *What tests can be used to predict the life of cellulose ester films?*

The Image Permanence Institute developed A-D test strips® for use in determining the level of cellulose ester film deterioration. Similar to pH test materials, the strips indicate the level of degradation in individual films. Use the strips to determine if storage conditions are adequate and to help you set reformatting priorities. The strips are available from the Image Permanence Institute (one package contains 250 detector strips about 1 1/2" x 3/8", a color-reference pencil, and instructions), Rochester Institute of Technology, 70 Lomb Memorial Drive, Rochester, NY 14623-5604; Tel: 716-475-5199; Fax: 716-475-7230.

Place an individual strip in the container of the film to be tested (within a motion picture can, bag, box, sleeve, or cabinet). ***Note*:** Wear neoprene gloves to do this if you are working with deteriorated film. You may wear latex or cotton gloves if the film is undeteriorated. After exposure, the test strip color is compared to the reference pencil, which is printed with four bands of color, numbered from 0 to 3. The four bands of color correspond to the four levels of acidity. The reading indicates the extent of deterioration. ***Note*:** A-D test strips® are not useful indicators for polyester film deterioration. Some organizations, including the National Archives, however, are using them for indicating deterioration in **both** cellulose ester films (acetate, diacetate, and triacetate) **and** nitrate.

16. *How do I ensure the long life of cellulose ester films?*

Long life of cellulose ester film depends upon cool temperature, controlled relative humidity, a well-ventilated storage space, and good housing, as well as appropriate handling. The film age and type (acetate, diacetate, or triacetate) doesn't determine the speed of deterioration, though the original manufacturing, processing, storage, and handling history does affect the film life. Lowering the temperature to 2°F (-18°C) can extend by 200 times the life expectancy (LE) of film stored at 80°F. At 70°F the LE is approximately 100 years from the date of manufacture. Lowering relative humidity to 20% from 50% or higher can triple or quadruple the film LE.

The ***IPI Storage Guide for Acetate Film*** created by the University of Rochester's Image Permanence Institute can be used to predict life of acetate film at specific temperatures and relative humidities. Separate all nitrate and cellulose ester films from each other, from other film types, and from all deteriorated films of any kind. House these films in cold storage within the cold storage system configuration described in Sections C.11 and C.12. Place cellulose ester films in a cool, dry, well-ventilated space (ideally 0°F, 30% RH) housed separately from all other materials and office spaces to slow deterioration byproduct build-up. Use copies for reference and access.

Access the originals only when a new set of interpositives and copy negatives must be produced. If cold storage is not possible, house the materials off-site in cold storage. See Sections C.3, C.11, and C.12 for further guidance.

17. *Where can I get help on these issues of nitrate and cellulose ester identification and deterioration analysis?*

You can get help from SO and regional staff, Harpers Ferry Center (HFC) Division of Conservation staff, and from colleagues at your state university and state and local archives and libraries, as well as from contract archivists and curators.

C. Management of Nitrate and Cellulose Ester Films

1. *Do I have to keep nitrate film?*

Yes. You must keep nitrate film at stages 1 and 2 of deterioration (Section B.13) that has high artifactual, evidential, and/or associational value. Keep any nitrate film, regardless of value, if it has not yet deteriorated to stage 3 or beyond and has not been reproduced, inspected, and the reproduction approved. If you are uncertain about the value of film, keep it until an archivist can determine whether it has high artifactual, associational, or evidential value.

You may dispose of:

- ***film with little or no artifactual, associational, or evidential value*** as long as it has been reformatted and the copies have passed inspection

- ***film of informational or administrative value*** after high quality copies have been made that clearly reproduce **all** the information in the original and have passed inspection (If you are uncertain if all the information is conveyed in the copy, keep the original until an expert can check the film and copies to determine if the copies pass inspection.)

- ***all film in stages 3-5 of deterioration*** after you deaccession it, regardless of its original value

Work with your hazardous materials coordinator to dispose of badly deteriorated nitrate as hazardous materials according to the Environmental Protection Agency (EPA) Waste Codes and guidance. Don't attempt to do this by yourself. If your park has no hazardous materials coordinator, talk to your SO or regional curator or work with your local fire department to arrange a multi-park or regional disposition effort.

The only nitrate you must keep permanently after producing high quality copies that have been inspected is nitrate in deterioration stages 1 and 2 that has high artifactual or associational value and material of continuing evidential value. If you are inexperienced in judging value, keep all stage 1 and 2 nitrate film and make immediate arrangements for an experienced archival appraiser to determine whether to keep the originals.

See *COG* 14/8, "Caring for Cellulose Nitrate Film"; 19/10, "Reformatting for Preservation and Access: Prioritizing Materials for Duplication"; 19/12, "Contracting for Reformatting of Photographs"; and 19/13, "Preservation Reformatting: Inspection of Copy Photographs"; and Sections A.6, B.6, B.11, B.13, and B.14 for further guidance. Also see *Museum Handbook*, Part II (*MH-II*)**,** Chapter 6: Deaccessioning, for guidance.

2. *Do I have to keep other deteriorating film types, such as cellulose acetate, diacetate, and triacetate?*

No. Deal with other deteriorating film types as you would nitrate, although cellulose ester films don't pose such major safety hazards, as they are **not** a fire risk. Some individuals are sensitive to the acetic acid given off by the cellulose ester films. If health or safety issues become a factor, such as those caused by badly deteriorated collections, mold, insect or vermin infestation, or a chemical spill, follow the nitrate guidance.

Keep all original materials of high artifactual, associational, and evidential value in cold storage. Reformat and inspect your deteriorating items **before** they can no longer be used. After deaccessioning contaminated items, work with a NPS hazardous waste coordinator to dispose of them according to EPA guidelines. See Sections A.6, C.14, C.16, and C.17.

3. *What special storage requirements must my facility meet?*

Don't store nitrate, acetate, diacetate, or triacetate in:

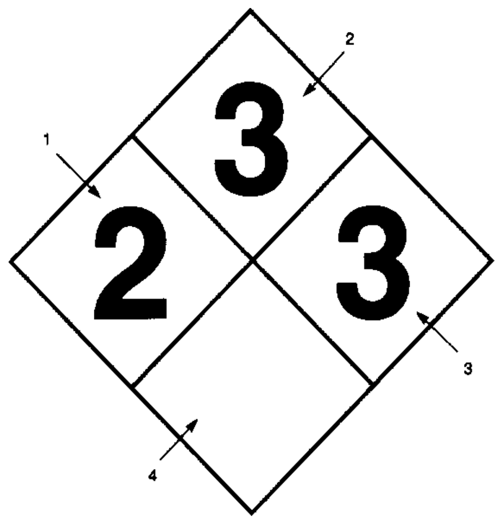
- office spaces
- attics
- general museum storage spaces
- historic buildings
- near windows or doors
- near light or heat sources
- in spaces with poor ventilation
- in spaces with no air conditioning
- in spaces without deluge sprinkler systems

For short-term storage of five years or less, house the collections as described in Section C.12, then place them in frost-free food freezers. This is **not** a recommended long-term solution because the deterioration byproducts may eventually build up in the freezer or refrigerator, causing health and safety hazards.

For long-term storage of more than five years, apply the National Fire Protection Association (NFPA) standards, particularly *NFPA 40, Storage and Handling of Cellulose Nitrate Motion Picture Film,* to all cellulose ester and nitrate film formats. No separate NFPA standards currently exist for still photographic negatives. Parks should not plan to store nitrate film for the long term on park grounds.

NFPA 40 is a rigorous standard that will result in very high-quality cold storage vaults with excellent venting, environmental controls, and fire resistance. However, the cost of applying this standard exceeds $30 a square foot. NFPA 40 standards for vaults include stringent requirements for ventilation, refrigeration, heating, air conditioning, fire resistance, fire suppression, and temperature readouts. The vault will also require constant monitoring, much electricity, and scrupulous management to ensure environmental stability. **Parks wishing to build a nitrate storage vault should not do so in or near historic structures or in the same building as visitor centers, staff offices, or collections.**

Label all nitrate storage areas and freezer vaults with the National Fire Protection Association (NFPA) Hazard Warning Symbol for nitrate shown in Figure M.1 below. Make sure that you notify all local fire stations of the presence and location of nitrate accumulations in your park. ***Note*****:** If you are planning to store only cellulose ester films (which like nitrate should be housed in separate packaging and placed in containers separate from that of nitrate or polyester films), you simply need temperature, humidity, ventilation, and lighting control. See Sections C.11 and C.12 and *COG* 14/4, "Caring for Photographs: General Guidelines."



1 – Health Hazard (BLUE)
2 – Flammability Hazard (RED)
3 – Reactivity Hazard (YELLOW)
4 – Special Hazard (WHITE)

Figure M.1. National Fire Protection Agency Hazard Warning Sign for Cellulose Nitrate Film

4. *What other options do I have if I don't want to store film in my park?*

Consider the following options:

- ***Rent a cold storage vault*****:** Hire a cold storage vault outside of the park, such as the Bowers or Iron Mountain facilities in Pennsylvania or Bonded Film Storage in Fort Leigh, New Jersey (201-944-3700) and W.R.S. in Pittsburgh, Pennsylvania (412-937-7700). Although these facilities don't meet the optimum requirements, they do offer improvement over standard office and museum storage.

  Note**:** Henry Wilhelm states in *The Permanence and Care of Color Photographs,* on page 342, "At the time this book went to press in late 1992 . . . there was no commercially available humidity-controlled, low-temperature (0°F [-18°C] and 25% to 35% RH) film storage rental space available anywhere in the world." For more current information on cold storage suppliers, equipment, enclosures, and facilities that rent cold storage space, see the list in *Tools of the Trade***.**

- ***Use a NPS facility*:** Move your film to a NPS storage and collections management facility with monitored cold storage, such as the Western Archeological and Conservation Center in Tucson or the San Francisco Maritime Museum.

- ***Cooperatively share a vault*:** Share a cold storage vault with a state, federal, or local agency, such as your state archives or library or a local university.

- ***Sublet cold storage space*:** Sublet cold storage space in a vault owned by another organization.

- ***Ask for help*:** Request cold storage space from the National Archives and Records Administration (NARA) or your Regional Archives Center, also operated by NARA.

5. *How should I manage nitrate that I must keep in the park on a short- or long-term basis?*

When managing nitrate, do the following:

- ***Know the law,*** particularly EPA, state, and local ordinances about the keeping and destruction of nitrate. Read the various standards and recommendations in the bibliography.

- ***Talk to your local fire department and safety-related park staff.*** Ensure that they know where the nitrate is located in the park and the quantities and condition of the nitrate. Label the nitrate storage areas clearly with the NFPA Hazard Warning Symbol for nitrate to facilitate effective fire fighting. See Figure M.1.

- ***Isolate and label the materials*** in a safe, humidity-controlled venting cold storage facility (0°F [-18°C] and 30% RH) far from museum storage, work, exhibit, and office areas.

  – Your best option is to use separate storage packets (nitrate separated from cellulose ester) with the nitrate packets housed in a separate environmentally stable vented cold storage chamber (vault room) by itself that meets NFPA standards.

  – Your second best option is to use separate storage packets (nitrate separated from cellulose ester) in environmentally stable cold storage with the nitrate and cellulose ester in the same cold storage vault. This option is perfectly acceptable as long as the temperature and humidity are both controlled (0°F (-18°C) or cooler and 30% RH), there is some venting, and a back-up power source is available.

  – Your third option is to use separate storage packets (nitrate separated from cellulose ester) protected by Molecular Sieves (dispersed molecular traps that absorb gaseous residues) with the temperature and humidity at least somewhat controlled in food freezer-type cold storage as described in Sections C.11 and C.12. Deteriorating materials should be duplicated and removed ASAP. This option is acceptable as long as the temperature and humidity are controlled and there is a back-up power source.

– Your fourth and least desirable option is to use separate storage packets (nitrate separated from cellulose ester) protected by Molecular Sieve materials in standard museum storage. Use this only for short periods as film materials are prepared for duplication prior to cold storage.

Standard food freezers or refrigerators, whether frost-free or not, do NOT meet fire code standards because they are not vented, don't stop the build-up of toxic gases, and don't meet the need for a powerful deluge-type, wet-pipe fire extinguishing system. Such storage is NOT acceptable for permanent nitrate storage.

- ***Duplicate materials*** following American National Standards Institute standards and archival best practices. (See *COG* 19/11, "Preservation Reformatting: Selecting a Copy Technology," and 19/12, "Contracting for Reformatting of Photographs.") ***Note*:** Digital copies are **not** preservation copies. See Section C.14.

- ***Inspect duplicates*** of the original materials carefully for accuracy, completeness, and technical quality. (See *COG* 19/13, "Preservation Reformatting: Inspection of Copy Photographs.") Make new copies if any don't meet standards and reinspect. Repeat if necessary until high quality copies are achieved. See Section C.15.

- ***Evaluate the remaining nitrate's condition.*** If it is stage 3 or worse, work with a NPS hazardous waste coordinator to dispose of it according to EPA guidelines. See Section B.13 for a review of the stages.
Keep materials with high artifactual, associational, and evidential value. (See Section A.6 and *COG* 19/10, "Reformatting for Preservation and Access: Prioritizing Materials for Duplication," for guidance.)

- ***Deaccession and dispose of film*** deteriorated to stage 3 or beyond, film with no relevance to the park's SOCS, and well-copied items with only informational/administrative value. Transfer them to another institution after deaccessioning if they have value or dispose of them. See Sections C.16 and C.17 and *MH-I***,** Chapter 6: Deaccessioning, for guidance.

- ***House materials with high artifactual, evidential, and associational values*** in appropriate housing and storage containers in cold storage. See *COG* 14/6, "Caring for Photographs: Special Monochrome Processes," and Sections C.11 and C.12 below.

- ***Manage the cold storage facility*** carefully. Ensure that you have a back-up power source and a power outage alerting system in case of power failure. Inspect the contents every six months (see below). Check the cold storage facility weekly to ensure that there is no power outage or mechanical fault. Never store food or other materials in a film cold storage vault. Maintain monitoring records of the cold storage environment (temperature and RH).

- ***Inspect a different 10% of all retained nitrate, acetate, diacetate, and triacetate every six months*** for deterioration. Check RH indicator strips of materials in cold storage to identify punctured or torn bags requiring replacement and re-drying of their special humidity-controlling enclosures. See Sections C.11 and C.12 for details on how to house materials for cold storage. Replace all punctured bags and re-dry the special boards being used as humidity buffers. Check the contents of punctured bags or bags whose humidity indicators detect humidity greater than 40% RH. Look for blemishes, silvering out, and other deterioration patterns described in Sections B.4 and B.13.

Remove negatives carefully from sleeves and look at them on a light table. To inspect motion picture film, unwind it slowly onto another reel with a smooth even pressure. If you find some seriously deteriorated items, arrange for their **immediate reformatting**, inspection, and disposal. ***Note*****:** If more than 70% of the nitrate viewed during inspection is deteriorated, you should then inspect all of the remaining nitrate.

- ***Move the nitrate, acetate, diacetate, and triacetate to a remote cold storage facility if the power in your cold storage facility should go off for more than 48 hours.*** A nearby backup cold storage facility should be listed in your park's disaster and emergency operations plans. See *COG* 14/8, "Caring for Cellulose Nitrate Film."

6. *Should I isolate and handle cellulose acetate, diacetate, and triacetate in the same way?*

Yes. First reformat all acetate, diacetate, and triacetate film of value and inspect the copies. Place the undeteriorated originals that have high artifactual, evidential, and associational value in cold storage to slow deterioration and minimize the deterioration byproduct gases. Don't place these cellulose ester materials in the same cold storage chamber as nitrate unless the chamber is kept well ventilated and very, very cold (0°F [-18°C] or cooler and 30% RH).

House the film as described in C.11 and C.12. Don't place cellulose ester films in work spaces, museum storage, reference spaces, or office areas because they also give off acidic deterioration gas byproducts that may pose health hazards for some individuals. For more guidance, see the *IPI Storage Guide for Acetate Film* in the bibliography.

7. *What should I do when working with nitrate to avoid health hazards?*

First, isolate nitrate far from other collections, research rooms, and staff work and office spaces. When handling nitrate there are a number of routine precautions you should take:

- ***Maintain a log*** of who works with nitrate for health monitoring.
- ***Stop working with nitrate immediately*** if you experience any shortness of breath or eye or skin irritations.
- ***Wear protective clothing,*** including:
  - latex or cotton gloves for undeteriorated film; neoprene gloves for deteriorated film
  - a long-sleeved, washable smock
  - goggles, if working with deteriorated film

- an acid/organic vapor-rated cartridge in a rated breathing apparatus fitted to the user

- ***Wash regularly*** all clothing, gloves, goggles, and work surfaces used for nitrate work; don't wear dirty or reused gloves

- ***Don't wear contact lenses*** when working with nitrate. Gases may build up under your lenses causing eye injury.

- ***Limit your work with nitrate*** to three hours per day.

- ***Position a fan*** so that the airflow blows fumes towards an air outtake valve or open window and away from you.

- ***Never rub your skin, hair, or eyes*** with a nitrate contaminated gloved hand.

- ***Never inhale fumes*** from nitrate or cellulose ester film.

- ***Work in a cool space*** far from any sources of heat, flames, or sparks.

8. *How do I avoid health hazards with cellulose ester films?*

Handle cellulose ester film as you would nitrate. Work only in a well-ventilated room to avoid breathing problems caused by acidic byproducts related to vinegar syndrome. (See Section B.3.) If the room lacks good ventilation, place a fan so it blows on you and position yourself in front of an air outtake register or open window, so the fumes are sucked away from you. Wear neoprene gloves if the film is deteriorated, or cotton or latex gloves if the film is in good condition. If the film is deteriorated and the ventilation is poor or you are sensitive to cellulose ester film, wear an acid/organic vapor-rated cartridge in a rated breathing apparatus fitted to the user. Don't wear contact lenses around cellulose ester film.

9. *How should I mark nitrate and cellulose ester films?*

Individual copy negatives and interpositives may be marked on their reverse edge (on the back in an area that is the reverse of the border of the image) with a photographic marking pen that has neutral pH carbon ink and has passed the Photographic Activity Test (PAT). The PAT is described in *COG* 14/2, "Storage Enclosures for Photographic Prints and Negatives." Consider using the Pigma Ink pen by Light Impressions for marking.

Remove all images before writing on an envelope or sleeve. Let image labeling dry thoroughly before re-inserting images in sleeves or envelopes. Generally mark only minimal information (the negative number or catalog number) in very small characters on the non-emulsion side in the non-image area. Never mark in the actual image area or on the reverse of the image. Label envelopes and sleeves on the seamed side, or if using a four-fold sleeve, label on the top of the fold area.

10. *What common factors affect the life expectancy of nitrate and cellulose ester films?*

Of all the factors affecting nitrate life, temperature, relative humidity, ventilation, handling, and housing systems and equipment are perhaps the most significant. Recent studies by Peter Adelstein and others indicate that the nitrate storage environment, particularly temperature and humidity, are crucial to safe handling and long nitrate life. For every 10°F decrease in storage temperature, the film life is almost doubled. Lowering relative humidity to the 40-60% range from the 70-80% range doubles the life of the film. For long-term storage, 20-30% RH is recommended.

11. *What materials and systems should I use to house my nitrate and cellulose ester?*

Use housing that meets the *American National Standards Institute (ANSI) Standard IT 9.2-1991, Photographic Processed Films, Plates, and Papers-Filing Enclosures and Storage Containers***,** that is a high alpha-cellulose clamshell box made of acid-free materials with reinforced seams**.** Select high-alpha cellulose, four-fold paper sleeves that pass the photographic activity test. Transfer the label and caption information onto this folded side, and place the emulsion so it faces the non-fold side. Place the emulsion side of negatives away from the labeled side of the sleeve to avoid label loss if the film deteriorates. If you use a slide-in sleeve, treat the seamed side like a flap so that the emulsion is away from the seam on the unlabeled side. Use buffered sleeves for cellulose nitrate and for black-and-white cellulose ester film, but use unbuffered sleeves for all color film.

For long-term storage, place your rehoused collections in polyethylene bags or polypropylene film cans within drop-front storage boxes within a second layer of polyethylene bag inside a cold storage vault. Use zeolite materials (dispersed molecular traps that absorb gaseous residues) to protect your film from the buildup of acidic gas byproducts that hasten film destruction if the items are:

- particularly precious
- very large format (8" x 10" and larger) or in large quantity (more than 35 pounds)
- unable to be placed immediately in a cold storage vault
- in a vault with poor environmental controls

Zeolite materials include MicroChamber™ packaging or FPC® Molecular Sieve packets. The packets are placed inside each film container. The packaging is used just as acid-free packaging is normally used. Zeolite materials without cold storage don't by themselves provide adequate protection from deterioration. They simply capture gaseous byproducts that speed deterioration; they don't stop deterioration. Don't reuse zeolite or other housing materials or old containers of any sort. If a film can or box is deteriorated, replace it. Zeolite is an excellent storage material, but may be too expensive for many uses.

The use of the double-bag or Safecare®-type housing system (which includes polyethylene bags, humidity conditioned mat board, RH indicator strips, and boxes) for cold storage of film protects it from condensation, mechanical damage, and handling damage. ***Note*****:** All of the materials found in the Safecare® system are currently found in the *Tools of the Trade*.

If you use venting, hazardous-material freezer(s) for long-term housing without zeolite housing or FPC® Molecular Sieve packets, keep nitrate and cellulose ester films in separate packages within the freezer(s) as described here and in C.12. When possible, also house and store deteriorated film separately from non-deteriorated film. Keep film freezers far from office, museum storage, work, or reference spaces (at least not in the same building and not in any historic structure). Ideally, all vaults and freezers should be checked for collection deterioration at least every six months.

The combination of the two systems—zeolites to control outgassing and Safecare®-type storage systems to control condensation, mechanical damage, and handling damage during cold storage—is ideal. This combination provides maximum protection although the cost may be excessive. Cold storage and the Safecare® system of polyethylene bags, board, and humidity indicator alone are an excellent and relatively inexpensive storage option. A third system is the use of heat or pressure seal bags constructed of layers of foil, paper, and plastic. These bags form an excellent moisture barrier but can't be easily reused after opening, nor are they transparent for examining the condition of the film. These sealed, multi-layered bags are also significantly more expensive than the polyethylene bags.

For long-term storage, house each type of material (deteriorated nitrate, undeteriorated nitrate, deteriorated cellulose ester films and undeteriorated cellulose ester films) separately in its own cold-storage package. Never mix deteriorated and undeteriorated materials or cellulose ester and nitrate materials in the same package. When housed in a cold, dry environment (0°F [-18°C], 30% RH), in dark storage, with low-levels of gaseous pollutants, and a good air circulation/ventilation system, nitrate negatives will endure.

Container selection is also important. Using acidic housing, tightly sealed housing, or no housing hastens nitrate destruction by allowing gas buildup in containers or storage spaces. Except when housed in cold storage or with zeolite materials, place nitrate in vented storage in order to allow the nitric oxide gases to escape. Even cold storage rooms should be explosion proof and vented without internal electrical components other than lighting and humidity/temperature gauges. See Section C.3 for information on short- and long-term storage.

12. *How should I prepare my collections for cold storage?*

Don't rehouse materials for cold storage until **immediately** before storing them. Long-term storage at room temperature in sealed containers or plastic envelopes or sleeves may be damaging. If a film can or box is deteriorated, replace the container. Don't reuse old containers. Ideally, select vented polypropylene cans for film. To implement this system place sleeved film (either buffered or zeolite materials) within cold storage kits configured like the Safecare® system, which works as follows:

- ***Step1*****:** Condition the film by storing it at 40% RH for several days to limit the possibility that condensation will form within the sealed bags when the bags are placed in the cold storage.

- ***Step 2*****:** Rehouse the images in acid-free sleeves or envelopes or in vented polypropylene film cans. ***Note*****:** If you have adequate funds, use zeolite sleeves for negatives and place FPC® Molecular Sieve packets in the boxes housing the film or film cans when you have either rapid deterioration or less than optimum environment controls or you have materials of exceptional artifactual value.

- ***Step 3*****:** Place the sleeved or canned film within a polyethylene bag with a RH indicator strip, then gently press all the air out of the bag before sealing.

- ***Step 4*****:** Oven-dry (200°F for 3-5 minutes) or microwave-dry (full power for 30 seconds, then turn and repeat) a pre-cut mat board; then allow it to cool.

- ***Step 5*****:** Label a 13" x 10" x 1½" drop-front storage box with the collection name, catalog number, "hazardous nitrate," and any other useful information.

- ***Step 6*****:** Place the cool oven-dried mat board in the bottom of the storage box. Don't overfill the box.

- ***Step 7*****:** Check the bag seal to ensure it is tight and complete.

- ***Step 8*****:** Place the bagged film on top of the mat board. Don't place more than one type of film (nitrate, deteriorated cellulose ester, undeteriorated cellulose ester) in a single box.

- ***Step 9*****:** Place a second oven-dried mat board on top of the bag holding the film. Close the box lid.

- ***Step 10*****:** Place the box inside the second polyethylene bag, add the second RH indicator strip, then press all the extra air out and seal it. Check the RH indicator strips every six months or so.

Sealed materials housed in cold storage in this way should be stable for up to 15 years before you must re-dry the mat board and replace the RH indicator strips. When you remove materials from cold storage, allow them three hours to acclimatize before unsealing. Acclimatize the materials by placing them on an open rack for even heat transfer **before opening the bag.** Wipe off any condensation from the outer bag before opening it.

If you rehouse the image in cold storage, oven dry the mat boards again before replacement. Check all polyethylene bags for holes prior to reuse. Replace all bags with poor seals or holes. Don't place packaged materials directly on the floor of the cold storage facility or on closed shelves directly under pipes. Label the freezer with the NFPA Hazard Warning Symbol for nitrate. See Figure M.1. If you use FPC® Molecular Sieve packets, house the film as described above, but use double polyethylene bags to contain the film storage can or negatives

13. *How should I clean dirty films?*

Never try to clean film in stages 3-5 of nitrate deterioration or any film with a sticky, soft, flowing, flaking, or powdering emulsion. If you must clean cellulose ester or nitrate film, don't use water or solvents, but you may use compressed air or brush the film gently with a soft, clean, and wide camels hair brush. If any damage is noted, stop immediately. Wash the brush regularly and allow it to dry thoroughly before resuming work. Ideally, use several brushes, so you won't have to wait for them to dry before resuming cleaning. Generally, clean only for duplication purposes.

14. *How should I reformat my nitrate and cellulose acetate, diacetate, and triacetate?*

Work with a photographic contractor who is a specialist and understands the fire and safety hazards involved in nitrate duplication and has experience copying deteriorating nitrate or cellulose ester film. Ask your state librarian or archivist for local recommendations.

- Work with a NPS or other expert or your regiona/SO curator to select a reformatting technology, prepare your contract, and implement a quality control program.

- Select a contractor who has scanning laser or cathode ray tube cameras, which don't have hot, quartz-iodine light bulbs.

  – Select items to be reformatted based on the park's Scope of Collection Statement and the film's value, use, and risk. See Section A.6.

  – Select a reformatting process.

  – Write the contract. Insist on the use of long-lived film with a polyester film base, small grain, long tonal range, and good resolving power. Cite the processing standards in the contract.

  – Clean the film, if necessary, using a brush and compressed air. See Section C.13 above.

  – Pack the film for shipment.

  – Inspect the returned copies side-by-side against the original on a light table with color balanced bulbs. Visually inspect the film for completeness. See *COG* 19/13, "Preservation Reformatting: Instpection of Copy Photographs."

  – Have a professional test the film density, resolution, and residual thiosulfate of the copy (densitometric tests and methylene blue tests).

  – Reduplicate any images not meeting inspection and testing standards.

  – Reorganize the copy film to match the original order of the original film. See *MH-II*, Appendix D: Museum Archives and Manuscript Collections, Section J.

  – Label and rehouse the reformatted copies. See Section C.12 above.

  – Store copies as described in *MH-I*, Appendix R: Curatorial Care of Photographic Collections.

  – Analyze the original film's deterioration state. See Sections B.13 and B.15.

  – Rehouse any originals to be kept in appropriate materials, polypropylene bags, and cold storage after acclimatization at 40% RH. See Sections C.11 and C.12.

  – After deaccessioning, work with the park's hazardous materials coordinator to destroy selected deteriorated originals according to EPA standards. See Section C.1 for guidance on what to destroy and Sections C.15, C.16, and C.17 on how to dispose of it.

  – Set up standard operating procedures to limit access to negatives collections except when making new negatives, answering FOIA requests, or meeting other legal requirements, such as subpoenas.

- Be particularly careful to warn all personnel involved in handling, shipping, or caring for nitrate about the need to keep it cool and away from sparks and ignition sources.

- Don't expect to use digital copies effectively as preservation copies unless your park has developed a professional electronic records migration strategy. Such a policy involves systematic retensioning (rewinding and production of a new tape pack) annually or biannually, data refreshing every three to four years, and migration (copying to new format or media) each time the hardware or software changes (at least every five years). When setting up such a migration strategy, you should plan to keep your large digital master file off-line in non-proprietary and uncompressed formats. You will use derivative usage files online rather than your master files.

- Follow the specific guidance in *COG* 14/8, "Caring for Cellulose Nitrate Film"; 14/4, "Caring for Photographs: General Guidelines"; 19/10, "Reformatting for Preservation and Access: Prioritizing Materials for Duplication"; 19/11, "Preservation Reformatting: Selecting a Copy Technology"; 19/12, "Contracting for Reformatting of Photographs"; and 19/13, "Preservation Reformatting: Inspection of Copy Photographs."

15. *How should I inspect reformatted nitrate that has been returned?*

Follow the techniques for visual inspection, and densitometric, resolution, and residual chemistry testing described in *COG* 19/13, "Preservation Reformatting: Inspection of Copy Photographs." Once the copies have been approved, check the original nitrate's deterioration state. If it is at stage 3 or beyond (see Section B.13), deaccession the nitrate and work with the park or region's hazardous materials coordinator to dispose of the film as hazardous waste according to the EPA guidelines. If the film is at stage 1 or 2 of deterioration, and it has high artifactual, evidential, or associational value (see *COG* 19/10, "Prioritizing Material for Reformatting"), then place the collections in appropriate housing and put them in suitable cold storage after acclimatizing them. See Sections C.11 and C.12. Otherwise, deaccession and dispose of the material.

16. *Do I have to deaccession reformatted nitrate negatives?*

If the nitrate negatives are in…	***Then…***
Stage 1 or Stage 2 of deterioration,	reformat them and inspect the copies. Once you have approved the copies you can dispose of the originals. Don't deaccession the negatives, as you are preserving the images as stable, high quality surrogates.
If the nitrate negatives are in…	***Then…***
Stage 3, Stage 4, or Stage 5 of deterioration and you will be unable to reformat them,	deaccession them and dispose of them as an immediate threat through your hazardous materials coordinator. Negatives that have deteriorated to this level have lost their informational value.

Refer to *MH-II,* Chapter 6, Deaccessioning, for information on deaccessioning nitrate negatives.

17. *Can I destroy reformatted nitrate negatives?*

You can destroy nitrate negatives that have been reformatted if:

- they have only informational or administrative value
- you have a high quality copy that has been inspected to current standards

Don't destroy nitrates that have high artifactual, evidential, or associational value. See Section A of this appendix for definitions of these types of value.

Destroying nitrate negatives that have only informational or administrative value and that have been copied to current standards isn't a deaccession. This is because you still have the image.

18. *How do I document reformatted nitrate negatives?*

Document the reformatting of nitrate negatives in ANCS+. For collections in the Collections Management Module, use the Notes field in the Images supplemental record. Enter the replacement negative(s) in this supplemental record.

For collections in the Archives Module, use the Original Duplicates supplemental record. You can use this record at any level in the module. Enter the replacement negative(s) in this supplemental record. Use the location field in this supplemental record to enter the nitrate location.

Use the following, or similar, wording to document the reformatting of nitrate negatives.

If the original nitrate has been destroyed, note:

Original nitrate(s) replaced on (date) *by* (name) *with* (film type, for example, polysulfide toned black-and-white gelatin silver continuous tone film on polyester base) *and checked for quality by* (name) *on* (date). *Original nitrate destroyed on* (date) *by* (name/title of hazardous materials coordinator).

If you are keeping the original nitrate, note:

Original nitrate(s) replaced on (date) *by* (name) *with polysulfide toned black-and-white gelatin silver continuous tone film on polyester base that has been checked for quality*. *Original nitrate was separated and removed to* (location that includes cold storage company, cooperator, or park; address; and phone number).

19. *How do I dispose of nitrate?*

Don't do this by yourself. Instead of throwing hazardous nitrate in the trash or burning it, work with your park or regional hazardous waste coordinator to arrange for the disposition of nitrate and deteriorated cellulose ester film according to EPA guidelines. If you have no hazardous materials coordinator, contact your regional/SO curator for help in locating a NPS hazardous materials coordinator who can assist you or work with your local fire department.

20. *When should I keep original nitrate?*

Don't destroy nitrate if you:

- don't have hazardous waste training and facilities
- don't know the EPA guidelines and your state and local laws on nitrate disposition
- find that your nitrate has high artifactual, evidential, and/or associational value (See Section A.6 and *COG* 19/10, "Reformatting for Preservation and Access: Prioritizing Collections for Duplication.") ***Note*:** If deteriorated beyond stage 3, the nitrate no longer has informational and administrative value. See Section B.13 for an overview.
- find that your nitrate has not yet been duplicated and inspected and the original is in stage 1 or 2 of deterioration (See B.13 for an overview.)
- don't know the values or deterioration state of the original (See Section A.6 and *COG* 19/10, "Reformatting for Preservation and Access: Prioritizing Images for Duplication.")

21. *How do I train my staff to handle, house, store, and manage nitrate and cellulose ester film?*

Work with your regional/SO curator to provide:

- training courses
- details and cross-training under the guidance of trained visual archivists for hands-on experience
- tours and visits to state archives and libraries
- training manuals and Web access

22. *How should I answer requests for access to nitrate?*

Nitrate poses a significant health hazard for researchers. ***For health and safety reasons, researchers should work with copy prints, not nitrate or deteriorated cellulose ester films.*** If you receive a Freedom of Information Act (FOIA) request for nitrate or deteriorated cellulose ester film, work with your FOIA officer, regional public relations officer, regional/SO curator, and park superintendent to determine how to proceed without risking the health and safety of staff and researchers.

D. Prevention of Nitrate Fires

1. *What causes nitrate fires?*

At temperatures of 100°F (38°C) or above, quantities of deteriorated nitrate can self-combust, although undeteriorated nitrate doesn't burn until it reaches 266°F (130°C). Self-combustion is caused by the combination of high environmental temperature, low RH, lack of ventilation, flammable material, and a heat producing (exothermic) reaction due to deterioration byproduct gas buildup leading to accelerating deterioration and ever-higher temperatures.

Other, more common causes of nitrate fires include:

- ***sparks*** from:
  - smoking
  - equipment
  - faulty wiring
- ***excessive heat*** from:
  - radiators and space heaters
  - skylights and windows
  - poorly vented attics

2. *How do I prevent a nitrate fire?*

There are several simple rules:

- ***Learn the standards:*** Before housing quantities of nitrate in any structure, obtain the latest National Fire Protection Association NFPA 909, Standard for the Protection of Cultural Resources Including Museums, Libraries, Places of Worship, and Historic Properties. Read it thoroughly and apply it with care. Contact the association at 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101; Tel: 617-770-3000.
- ***Limit quantities*** near public spaces, in general museum storage, in offices, or near heavy equipment, and other fragile, valuable, or flammable materials: Never store quantities of nitrate (more than 20 standard rolls or 20,000 feet of roll film—either motion picture film or professional still photographic negatives on the roll—or 35 pounds or 875 individual still negatives [>4" x 5"]).
- ***Rehouse nitrate*****:** House the film as described in Section C.11 and place it in cold storage that meets fire specification standards until you have a chance to reformat and inspect the resulting copies. Never reuse housing that has previously held nitrate film.
- ***Label nitrate clearly*****:** Indicate on all boxes, cans, and other containers, that the material inside is nitrate. Label all cabinets with the phrase, "Hazardous nitrate film is contained." Label the room doors with the NFPA Hazard Warning Symbol for nitrate. See Figure M.1.
- ***Inspect regularly*****:** Never warehouse nitrate. Inspect the film at least every six months. Monitor the cold storage vault weekly to ensure that it is still operating. If not, transfer the film to your back-up cold storage facility. See Sections C.5 and C.15.
- ***Dispose of deteriorated nitrate*****:** Never keep badly deteriorated nitrate (materials in deterioration stages 3-5). Once found, determine if the material is too badly deteriorated to copy (some stage 3 items may be copied). If too badly deteriorated to copy, deaccession and dispose of the nitrate as hazardous material.

- ***Don't project nitrate*:** Never allow projection of nitrate film.

- ***Don't allow ignition sources nearby*:** Never allow any smoking or other sources of ignition or heat (for example: no space heaters or halogen lights) in or near any space where nitrate is housed. The only heating sources allowed in or anywhere near nitrate is steam or water pipe heat kept below 15 psig.

3. *At what temperatures are nitrate materials dangerous?*

According to Photographic Conservator Henry Wilhelm and Eastman Kodak, older deteriorated nitrate film is capable of self-combusting at temperatures as low as 100°F (38°C) when housed at that temperature for prolonged periods. Fires at that temperature, however, are not common. High temperature coupled with the heat generated by the decomposition of gases that can't escape and a low relative humidity can cause these 100°F fires.

Various factors might have halted the self-combustion of these deteriorated nitrate films, including:

- higher relative humidity

- venting of the deterioration gases

- lower ambient temperature

See Sections C.3, C.5, and C.11 for specifics.

Self-Combustion Danger Alert Table	
Temperature	**Type of Material**
100°F (38°C)	Older deteriorated nitrate (stage 3 and above) may spontaneously combust at this temperature.
104°F (40°C)	Motion picture film and large quantities of large-sized (>5" x 7") negatives may self-combust at this temperature.
266°F (130°C)	New undeteriorated nitrate may self-combust at this temperature.

Large quantities of nitrate, when housed together, will deteriorate at an ever accelerating rate due to the buildup of heat and acidic gases and may spontaneously ignite, producing toxic gases.

To prevent nitrate film deterioration, fires, and health hazards, don't store large quantities of nitrate in closed, non-venting packages unless you immediately place the packages in cold storage. Larger format negatives in any quantities should be individually rehoused in zeolite or in buffered paper with an open side next to Molecular Sieve packets. Keep all nitrate storage containers, open or venting, and away from other valuable materials. Ideally use cold storage and acid-free buffered or zeolite paper and Molecular Sieve packets configured as described in Section C.11.

4. *What materials pose the greatest risk of causing a nitrate fire?*

The materials at greatest risk of burning are:

- ***roll film*** (motion picture film or professional still negatives on a film roll that have not been cut up into individual images) in quantities of 20,000 linear feet or greater, 20 or more reels of motion picture film, or 35 pounds or more of large format negatives (that is roughly 875 negatives larger than 4" x 5"), aerial film, or X-ray film

- ***bulk packed nitrate***, particularly professional film, in large quantities (more than 35 pounds or 875 negatives) regardless of format

- ***trapped nitrate*** that is tightly sealed in a non-venting drawer or container that doesn't allow the heat and fumes to safely dissipate

- ***unsleeved negatives*** or items not housed individually in buffered paper or board housing materials that can absorb the acidic fumes, such as papers with buffering, Molecular Sieves, activated carbon, and molecular traps to absorb harmful molecules (Again, professional film is particularly dangerous.)

- ***any deteriorated nitrate*** in large quantities (more than 35 pounds), particularly nitrate deteriorated beyond stage 2 (See Section B.13 for a review of stages of deterioration.)

5. *What nitrate materials pose the least risk of causing a nitrate fire?*

Small quantities of undeteriorated still nitrate sheet film housed in individual buffered sleeves within vented or open containers don't pose as significant a hazard. Despite their relative safety, however, they must be housed long-term (more than 5 years) in cold storage as described in Sections C.11 and C.12, preferably outside of the park.

6. *What should I do in case of a nitrate fire?*

First evacuate the building and the area as nitrate burns explosively producing extremely toxic gases. Call the fire department **immediately** from another building. If you still have time, supercool the fire by directly applying large quantities of the coldest water or snow in any reasonable way possible from fire hoses to heavy equipment. **Don't get so close to a nitrate fire that you breathe in the toxic fumes.**

Prevention is the only truly safe way to stop a nitrate fire. Nitrate fires are rarely put out without first destroying the buildings that house them. While the direct causes of fires are often undiscoverable after a nitrate explosion, they appear most frequently to be heat buildup caused by the accumulation of nitrate deterioration gases due to inadequate housing, venting, and cooling. **Nitrate poses a significant risk to historic structures, staff, and collections.**

- ***Small Fire*****:** To extinguish a small nitrate fire, supercool the fire to below 320°F (160°C) through the application of snow, cold water, or carbon dioxide using any tools at hand, such as fire hoses, hoses, heavy equipment, and so forth. Stay at a safe distance from the fire so you won't be at risk of breathing toxic fumes. It may not be possible to put the fire out, as nitrate produces oxygen as it burns. Nitrate can burn under sand, water, halon, and other smothering-based fire extinguishing systems.

- ***Larger Fire*:** It may not be possible to put out a large nitrate fire, particularly if roll or motion picture film is burning in any quantity. Roll and motion picture film fires usually burn until they have totally consumed the film and the surrounding building

7. *What nitrate fires have occurred recently?*

In 1978, nitrate fires at both the International Museum of Photography and the National Archives cold storage facility in Suitland, Maryland, caused many millions of feet of historic motion picture film and still negatives to be destroyed, as well as the structures holding them. Among the works destroyed were the original motion picture negatives of such commercial works as *Strike Up the Band* with Judy Garland and Mickey Rooney.

8. *What do I do if my nitrate or cellulose ester becomes wet during fire fighting or cold storage?*

Wet nitrate film is at great risk for very rapid deterioration. Take the film within 24 hours to a local photographic salvage shop that works with nitrate or air dry or freeze it immediately. According to Deborah Hess Norris in *Disaster Recovery, Salvaging Photograph Collections*, image–bearing gelatin layers in deteriorated nitrate may dissolve in water, leaving only the nitrate base behind. In cellulose ester films, the water may be trapped in the channelized layers, leading to rapid deterioration. Some dyes in nitrate and cellulose ester films may run and bleed pink or blue onto other nearby materials.

Salvage nitrate and cellulose ester materials rapidly if exposed to water. Separate the materials from their housing and air-dry them immediately in a vertical position using clotheslines and wood or plastic clips, such as clothespins. Salvage and air-dry the housing as well in order to preserve the information it contains. Keep nitrate separate from all other materials in a separate room.

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Appendix N: Curatorial Care of Wooden Objects

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APPENDIX N: CURATORIAL CARE OF WOODEN OBJECTS

A. Overview

1. *What is covered in this appendix?*

This appendix deals primarily with the preventive conservation of wooden objects on exhibit and in storage. It discusses proper environmental conditions and details housekeeping procedures. In order to provide an understanding of how and why wooden objects react to the environment and to human intervention, the appendix includes:

- a discussion of the nature of wood
- typical fabrication techniques of wood objects, furniture, and associated materials
- types of deterioration that affect objects made of wood

2. *What types of wooden objects are found in museum collections?*

Park museum collections contain wooden objects in a wide range of forms:

- utilitarian objects, such as tools and farm vehicles
- religious objects, such as icons and altars
- furniture, significant for historical or decorative reasons

A large percentage of objects in NPS collections are composites—articles made of more than one type of material. Composite objects include:

- frames that house prints, documents, and paintings
- musical instruments
- rifles
- machinery, such as sewing machines and cameras

3. *How much care do wooden objects require?*

Both the nature of individual objects and how they are exhibited dictate how much and what kind of care is needed. Wooden objects are found under a wide range of exhibit and storage conditions.

- Furniture often is in open exhibits in furnished historic structures.
- Vehicles, totem poles, and gun carriages frequently are on exhibit outside, where they are exposed to the weather.
- Smaller objects may be more carefully exhibited in display cases in visitor centers and museums.

4. *Should I provide on-site care myself or contact a conservator?*

This appendix includes a discussion of how you can assess the condition of wooden objects and when to seek the advice of a conservator.

B. The Nature of Wood

To understand the behavior of wood and its requirements for long-term preservation, you should be aware of the physical and cellular structure of a tree. You will then know why wooden objects react to particular environmental conditions. Some wooden objects from prehistoric sites, such as tools from dry caves in the Southwestern United States, remain in excellent condition, while other wooden objects deteriorate rapidly. The condition of these objects depends on the type of environment in which they were housed.

1. *What is the structure of a tree?*

A tree can be described as a bundle of vessels, its walls composed of cellulose glued together with lignin. New cells grow around the circumference of the tree, forming a ring just within the bark. Wood cells are longer than they are wide and are oriented parallel to the long axis of the trunk and branches. The term *grain* in this appendix refers to the direction of the vessels. "Cross grain," then, refers to the horizontal plane, while "along the grain" refers to the vertical plane.

Looking at the end of a log or a cross-section of a tree, you can see an inner and an outer zone. The outer zone called *sapwood* is lighter than the inner or *heartwood* zone. These two zones serve distinct functions in the living tree and have very different characteristics that influence the behavior of wood even after it has been fashioned into objects. Sapwood is composed of newer living cells, which transport sap or water to the leaves and which store nutrients. As sapwood ages and becomes heartwood, *extractives* form within the cell walls, giving it color, durability, and dimensional stability. The chemical defenses found in the extractives help protect heartwood lumber from biological attack. Lumber from sapwood has no such protection.

2. *What are the three planes common to trees and lumber?*

Lumber has three planes, which are illustrated in Figure N.1:

- cross section
- radial section
- tangential section

The surface exposed in a cross-section is referred to as *end grain*. Because the cell cavities are exposed in end grain, water is both easily absorbed and given off. The surface is hard and prone to splitting. It does not take stain or finish well and cannot be sanded smooth.

The radial plane extends along the long axis of the tree, more or less perpendicular to the growth rings. The grain pattern on this vertical or edge grain is usually straight and regular. Boards cut along this plane are dimensionally stable and distort very little in response to changes in ambient relative humidity. They will also stand up to abrasion and weathering.

The tangential plane extends along the long axis of the tree and forms a tangent with the concentric growth rings. Boards cut along this plane will swell, contract, and become distorted at twice the rate of those cut on a radial plane.

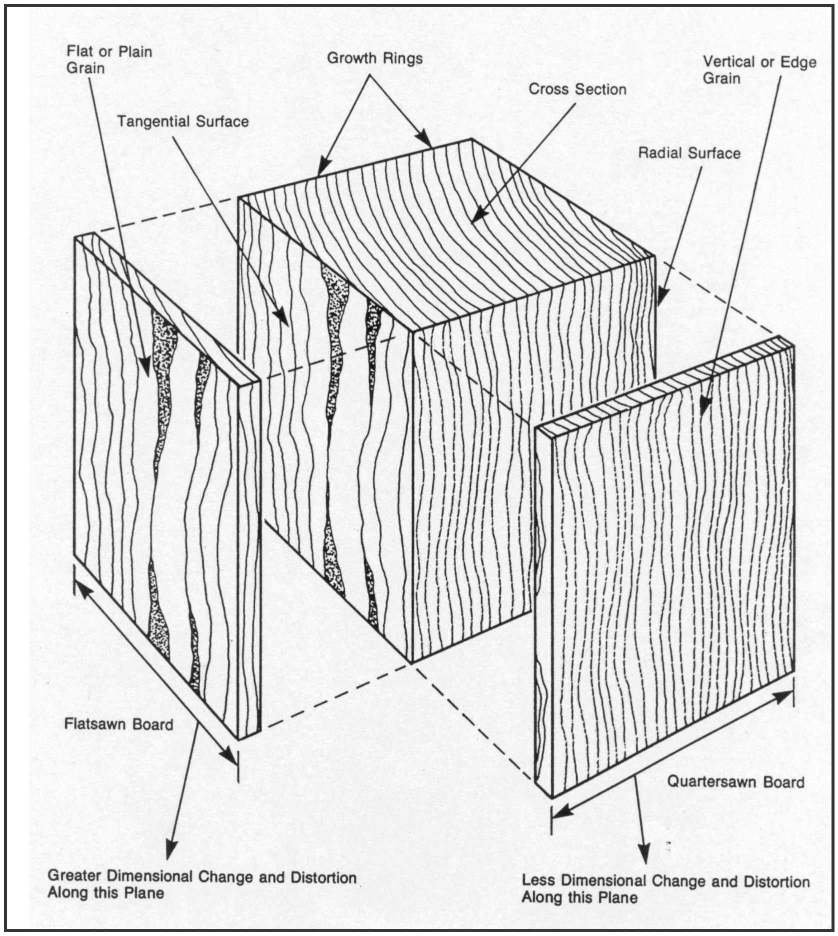


Figure N.1. The Three Principal Planes or Surfaces of a Typical Block of Wood: Tangential, Radial, and Cross Section

3. *What effect does water have on wood?*

There is a very strong molecular attraction between water and the cellulose in wood (called *hygroscopicity*). In freshly cut wood, water is found in both vessel cavities and cell walls. As the wood dries, the water in the cavities evaporates, but as long as the bound water remains in the walls, the wood will stay at the *fiber saturation point* and will not shrink. The moisture content at saturation is about 25%. When below this point, the wood will respond to changes in ambient relative humidity. Air-dried wood will reach a moisture content of 10%-12%, while kiln-dried wood will reach a moisture content of about 7%. This kiln-dried wood or the objects fashioned from it will absorb water vapor if placed in an environment with high relative humidity.

Wood will eventually arrive at equilibrium with its environment, neither absorbing moisture (swelling) nor giving off moisture (shrinking), as long as the RH remains constant. See Figure N.2 for a graph that illustrates the relationship between relative humidity and equilibrium moisture content in wood. This graph can help you calculate the amount of contraction or expansion that may occur in wooden objects.

When moisture is absorbed and released, the cell walls expand and contract. The cell length, however, remains nearly unchanged. Therefore, dimensional change in wood is not uniform in all planes (see Figure N.1). While movement **along** the longitudinal plane (the long axis of the tree) is negligible (only about .1%), movement **across** this plane is significant. Along the tangential plane, dimensional change is the greatest, averaging about 8%. Along the radial plane, dimensional change averages about 4%.

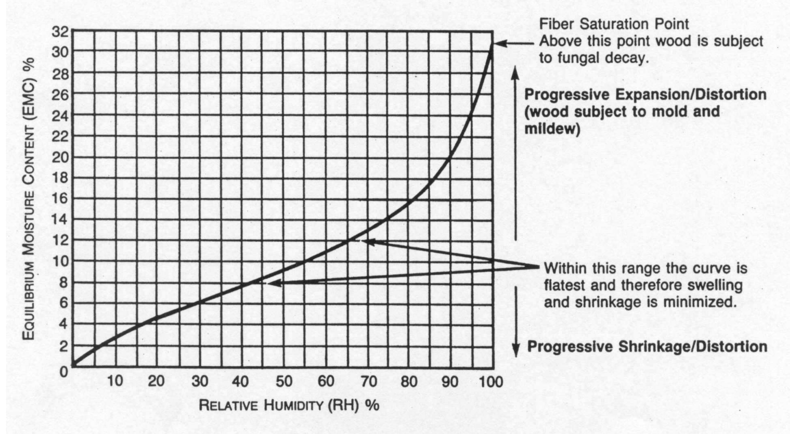


Figure N.2. Graph Illustrating the Relationship Between Relative Humidity and Equilibrium Moisture Content of Wood

4. *Do all types of wood react in the same way?*

No. The extent of dimensional change varies from species to species, making some kinds of woods more desirable in the making of furniture and wood objects. Teak, mahogany, and redwood are among the more stable woods. Walnut and cherry, popular woods with furniture makers, fall in the middle of the range.

5. *Where is the difference in dimensional change evident in museum objects?*

The rim of a turned bowl over time will move out of round, becoming slightly oval in shape because of the difference between tangential and radial shrinkage. For the same reason, turned feet become oval, and square legs take on a diamond shape on many pieces of furniture. Rungs and stretchers may become loose in chair legs because of the differential in shrinkage along and across the grain. Veneered surfaces may split or buckle because the grain orientation of the veneer is different from that of the underlying wood.

C. Agents of Deterioration

Wood decays both in nature and in museums as a result of:

- physical deterioration
- chemical deterioration
- biological deterioration

1. *What's involved in physical deterioration?*

There are three direct causes of physical deterioration.

- changes in relative humidity
- weathering
- human abuse

2. *How do changes in relative humidity cause physical deterioration?*

Shrinking and swelling, caused by changes in relative humidity, have been addressed in the discussion of the nature of wood. Because this reaction is not uniform across all planes, boards may become distorted or warped. The type of distortion will usually depend on the shape of the board and the orientation of the wood cells. See Figure N.3 for an illustration of characteristic shrinkage and distortion.

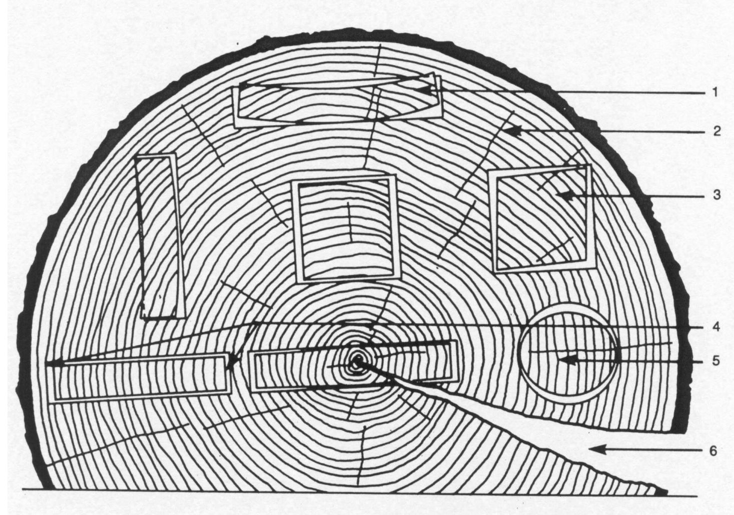
- *Cupping* is a deformation across the width of a board. It is often observed on wide, unrestrained boards, such as leaves on a drop-leaf table. This cupping can occur in the initial seasoning or later on in the life of an object. It can sometimes be caused by applying finish to only one side of the board. It may also occur when different microclimates are present on opposite surfaces. For example, the surface of a table leaf in the sun or near a radiator will become dryer than the surface underneath.

- *Checking* is also a result of uneven shrinkage. Stress can cause cells along the grain to separate, usually at the end grain or near the surface. Checking usually occurs during the initial seasoning, however, it can also occur if the relative humidity drops rapidly. Checks may extend just a short distance, causing only visual damage to the object, or they may extend an inch or more into the board causing actual structural damage.

- *Radial cracking* almost always occurs in logs that are left to dry. A pie-shaped crack will open from pith to bark edge to relieve the stress caused by the differential in shrinkage between the radial and tangential planes. Wood used in making objects that require a wide cross section, such as large bowls and three-dimensional sculpture, must be dried very slowly and carefully. Even with this precaution, the objects will always be prone to radial cracking.

- *Diamonding* is caused by the difference between tangential and radial shrinkage. A piece of lumber originally square (or rectangular) in cross section will become diamond-shaped.

A straight-grained, unrestrained board can usually withstand moderate fluctuations in relative humidty without damage. Because furniture is often made from various members that are connected across grain and are restrained from natural expansion and contraction by glue and nails or screws, the stress can become strong enough to cause the wood to split.



1. Cupping
2. End grain checking
3. Diamonding
4. Cross grain shrinkage
5. Distortion of cylindirical form
6. Radial cracking

Figure N.3. Characteristic Shrinkage and Distortion of Wood (Viewed from the Transverse Plane)

3. *What effect does weathering have on wooden objects?*

Wooden objects housed outdoors are subject to physical erosion from the action of rain and wind-driven particulates, though that erosion generally does not exceed ¼ inch of unprotected wood surface per 100 years. The weathering process also includes photochemical degradation. The wood surface generally takes on a silver-gray color and a striated texture as the softer earlywood wears away and the harder latewood is exposed. Ultraviolet light breaks down the lignin in the cell walls, which is then washed away by the rain. The silver-gray surface, which is only a few millimeters thick, is actually more resistant to biological attack than non-weathered surfaces.

Many wooden objects now in indoor museum collections spent their useful life outdoors. As long as the objects are free of fungal and insect damage, the weathered condition can be considered stable and the appearance should be preserved as part of the historical evidence.

4. *What types of deterioration are attributed to human abuse?*

Physical damage to wood objects in museum collections can result from improper handling and housekeeping procedures, and poor storage or exhibit conditions. Physical damage will occur more often in collections exhibited in furnished historic structures where the objects are exposed to more soils and dust in the environment and therefore require more frequent cleaning.

Poorly done repairs are another common cause of damage to wooden objects. Nails may split the wood and mar the surface; glue may leave misaligned surfaces and residue; original finishes may be removed mistakenly. Future conservation treatment may be made more difficult by the use of irreversible materials.

5. *What are the agents of chemical deterioration?*

There are five basic agents of chemical deterioration:

- ***Light*** causes deterioration of the cellular structure of wood, breaks down the lignin component, and bleaches its colors. The most harmful component of light is ultraviolet (UV) radiation. Light damage to wooden objects in furnished historic structures is most commonly caused by sunlight streaming through unshaded windows. It can also occur from excessive artificial light used to illuminate exhibits. Not only is light harmful, but the heat it generates also does damage, especially when lighting fixtures are placed inside exhibit cases.

- ***Acids*** may deteriorate the cellulose in wood causing it to become brittle. Acid rain on outdoor objects can be a problem.

- ***Alkalies or bases*** degrade the hemicellulose and lignin component of wood and cause the wood to separate into individual fibers. Alkaline solutions are more damaging, as a rule, than acidic solutions.

- ***Salts*** can also result in defibration of the wood tissue, but exposure to salt is less common. It may be seen in wooden objects used in food preparation and in objects exposed to a maritime environment.

- ***Fire*** is the most dramatic and by far the most damaging form of chemical deterioration. Wood is a readily flammable material.

6. *What are the biological agents of deterioration?*

Wood is subject to deterioration from a number of biological agents. Damage to wooden museum objects often occurs before the object is placed in the museum setting and may happen even before the wood is sawn into lumber.

- ***Bacteria,*** which consumes the starches stored in ray cells, generally affects only water-saturated wood and is therefore not a problem in most museum collections. However, wood that has been made more permeable by bacteria previously can be vulnerable to fungal activity.

- ***Fungi*** cause more biodeterioration in wood than any other agent. Because fungi have no chlorophyll, they must live on other organic material. The plant consists of thin, thread-like material called *hyphae* that mat together to form *myceliu.* Fungi produce large numbers of *spores*. Three types of fungi affect wood:

  – *Mold fungi* live principally on the surface of wood and discolor it. However, they don't consume cellulose and therefore don't weaken the wood.

  – *Stain fungi* invade the cell structure of sapwood and live on stored carbohydrates.

  – *Decay fungi* actually consume the cellular structure of wood, totally destroying it in some cases. These fungi produce enzymes that break down the cells. The two major types of decay-causing fungi are brown rot and white rot. Brown rot consumes cellulose, leaving a brown color and checking both along and across the grain. White rot consumes both cellulose and lignin, causing the wood to lose color and crack along the grain. Decay fungi, consequently, cause abnormal shrinkage of wood tissue.

Fungal spores are found in virtually every environment. In order to germinate, however, they require air, heat, moisture, and nutrients. By controlling these conditions you can prevent fungal growth on wooden objects in your collection. Ideally, relative humidity should be kept between 45% and 55%. RH must never exceed 65%.

Temperatures high or low enough to effectively stop fungal growth are impractical in a museum. However, maintaining a temperature of 68° F or below will retard the growth of mold. Decay fungi are problems only when the moisture content is at or above the fiber saturation point. The wooden object would have to be in contact with water to reach a moisture content over 30%. See *Conserve O Gram* 3/4, Mold and Mildew: Prevention of Microorganism Growth in Museum Collections, and Chapter 4: Museum Collections Environment.

- ***Insects*** both feed on wood and excavate it to shelter themselves. See Chapter 5: Biological Infestations, for a lengthier description of wood pests and instruction in integrated pest management.

  – *Beetles* do the most damage to furniture and wooden objects, particularly in temperate climates and an environment of high relative humidity. The adult lays its eggs in pores or checks in the wood surface. After the eggs hatch, the larvae excavate tunnels through the interior of the wood, eventually pupate, and then bore holes to the surface to fly off. The larval stage may last up to 10 years.

  – *Termites,* though less of a problem than beetles, can do considerable damage to stationary structures. Drywood termites, found primarily along the southern and southwest coasts of the U.S., do not need moisture and feed on the dry wood they infest.

  – *Carpenter ants* do not eat wood, but excavate large chambers for their colony.

  – *Carpenter bees* bore large chambers and use them for their eggs, but do not actually consume the wood.

- ***Marine organisms*** are a significant problem in wooden ships and other underwater artifacts. *Shipworm* and *gribble* are two of the most destructive marine organisms. Shipworm is a mollusc that lives on wood and plankton and makes channels in the wood up to 2.5 cm in diameter. Gribble is a small crustacean, barely 1/8" long, that tunnels narrow channels close to the surface of the wood.

- ***Rodents*** damage wood by their gnawing to get food and salts from the surface of wood or to get through to the food stored within. Museum furniture, such as pie safes and jelly cupboards, may have large holes through their backboards. Wooden food vessels that may contain food remnants on the surface or in the pores are vulnerable to rodent damage. Removing the food, however, also removes important evidence of historical or cultural use.

- ***Birds***, mainly woodpeckers, are a threat to outdoor wooden objects. They are drawn to wood that may have insect infestations.

D. The Nature of Furniture

Most furniture originally served both functional and decorative purposes. Once in a museum collection, furniture no longer needs to be functional. The conservator and curator, therefore, focus on preserving the decorative and historical aspects of the piece. A single piece of furniture may be formed from several components, each requiring special knowledge and treatment. These components may include joinery, metal fasteners, adhesives, veneer, finishes, hardware, and upholstery.

1. *What are the common types of joinery?*

Almost all furniture is made from two or more pieces of wood, joined together in some fashion.

- The ***mortise and tenon*** joint is one of the most common and earliest joints used in furniture construction. The mortise is a hole chiseled into a piece of wood, while the tenon is the projection on the end of another piece of wood that fits into the mortise. Because these two pieces of wood are at cross grain to one another, different degrees of expansion and contraction can cause problems. The tenon should be slightly smaller than the mortise to prevent the mortise from splitting. These joints are typically held together with glue, though in country pieces, it was common to drive square pegs into round holes drilled through the joint. See Figure N.4 for an illustration of a typical mortise and tenon joint.

- ***Frame and panel construction*** prevents the splitting that often results when wide boards are constrained at their edges. In this technique the frame is made from relatively narrow boards joined at the corners with mortise and tenon. The inner edge of the frame is grooved to hold the edges of a wide panel, which is free floating and therefore able to expand and contract freely with changing relative humidity.

- The ***dovetail joint*** is another traditional technique, generally used to join the edges of wide boards. The edges are cut and chiseled so that they interlock. This technique was typically used on the sides of drawers and chests. Dovetail joints are commonly glued. See Figure N.5 for an illustration.

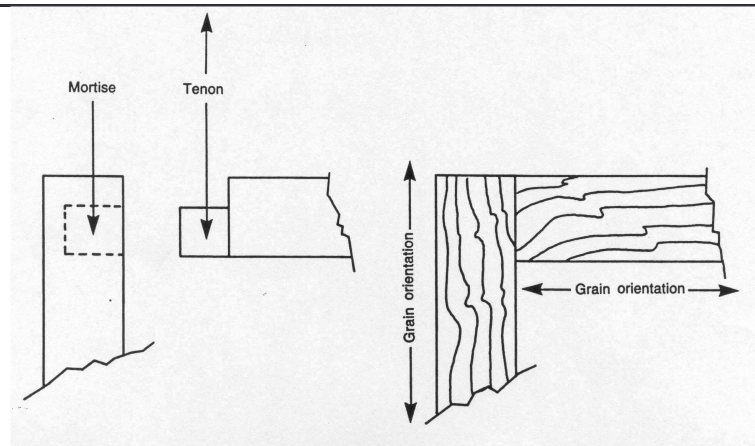


Figure N.4. Typical Mortise and Tenon Joint

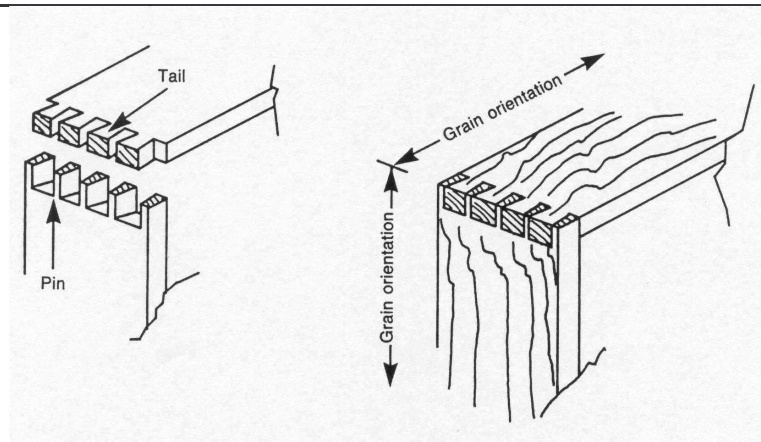


Figure N.5. Typical Dovetail Joint

2. *What should I know about metal fasteners?*

Various types of metal fasteners have been used in furniture construction, including nails, screws, and bolts. Hardware can be useful in dating furniture. For example, nails became more frequently used when they were first mass-produced in the late 1700s. Screws were not commonly used until the 1840s, when the technology to manufacture them with gimlet points was developed. (A gimlet point is one that can readily penetrate wood.)

Fasteners are most often made from ferrous metals, which corrode in high relative humidity. This corrosion can spread, damaging the appearance and structure of the wooden object. Severely corroded metal will expand, crushing and splitting the surrounding wood. *Corrosion jacking* is most likely to occur at the coast, where there is exposure to salts in the environment. Iron salts, often present at contact points between wood and ferrous metals, degrade and discolor wood. Woods with high tannic acid levels, such as oak, are very susceptible to damage from iron salts. Contact between some woods and metals also will accelerate the oxidation of the metal.

3. *What types of adhesives are used in creating wooden furniture and other objects?*

Adhesives, used alone or in conjunction with fasteners, come in three basic types:

- **Protein-based glues**

  Animal products are the primary ingredients in protein-based glues. Historically, the two most commonly used varieties were hide glue and fish glue. These were heated to a gel before use. The glue set as it cooled and the water content evaporated. Because this type of glue is readily resoluble and has a long setting time, it is often used in the conservation treatment of furniture and other wood objects.

  Though strong in a proper environment, protein-based glues are water-soluble and therefore fail in high relative humidity. At the other extreme, very low relative humidity, the glue will dry and crack causing the joint to fail. Casein glue, made from milk curds, is occasionally found in furniture and wood objects. It is more resistant to the effects of moisture than the other protein glues. Another disadvantage of these substances is the attraction they hold for insects.

- **Vegetable glue**

  Vegetable glues, such as starch paste, though seldom used for gluing wood joints, can be found adhering paper labels or paper coverings to wooden surfaces. Other types of vegetable glues, like gums and resins produced by trees, are commonly found on ethnographic wooden objects, but not in Western furniture. Like hide and fish glues, vegetable glues are sensitive to changes in relative humidity and are susceptible to biodeterioration.

- **Synthetic resins**

  Synthetic resin adhesives have become increasingly common since the 1940s. They harden either through the evaporation of a solvent, like water, or a chemical reaction between a hardener and a resin. Many post World War II objects in museum collections are constructed with these adhesives. Most synthetic resins form a very strong bond, are durable, and are relatively insensitive to environmental conditions. These qualities become disadvantages when objects need conservation treatment for it is nearly impossible to separate these joints without causing damage to the wood surface.

4. *What is veneer and what are the problems associated with it?*

Veneer is a thin layer of wood glued to a solid base material for decorative purposes. It ranges in thickness from 1/32" to 1/8". Older veneers were sawn by hand and are thicker than contemporary ones and often irregular. They were often attached with hide or fish glues. Expensive woods (for example, rosewood and mahogany) are typically used for veneering. Many small pieces of veneer are used in marquetry, inlay, and banding to create intricate patterns and pictures.

Generally the grain of the veneer on tabletops and other large, flat surfaces lies in the same direction as the grain of the underlying wood. In other areas the grains may lie perpendicular to each other, or as in marquetry and inlay, at almost any angle. Fluctuating humidity levels can cause severe damage as the woods expand and contract along different planes. See Figure N.6 for common applications of veneer.

Some areas of veneered furniture are more likely than others to receive damage. For example, the veneer on drawer rails and the bottom rails of case furniture, such as chests and sideboards, is very vulnerable. As the underlying wood shrinks, a lip of veneer forms along the top and bottom edges. The drawer, as it moves in and out, can easily snag the protruding veneer and tear it off. Dust cloths can catch on loose veneer and pull off pieces. Mops, brooms, and vacuum cleaners often cause irreparable damage to the lower edge of bottom rails during routine housekeeping.

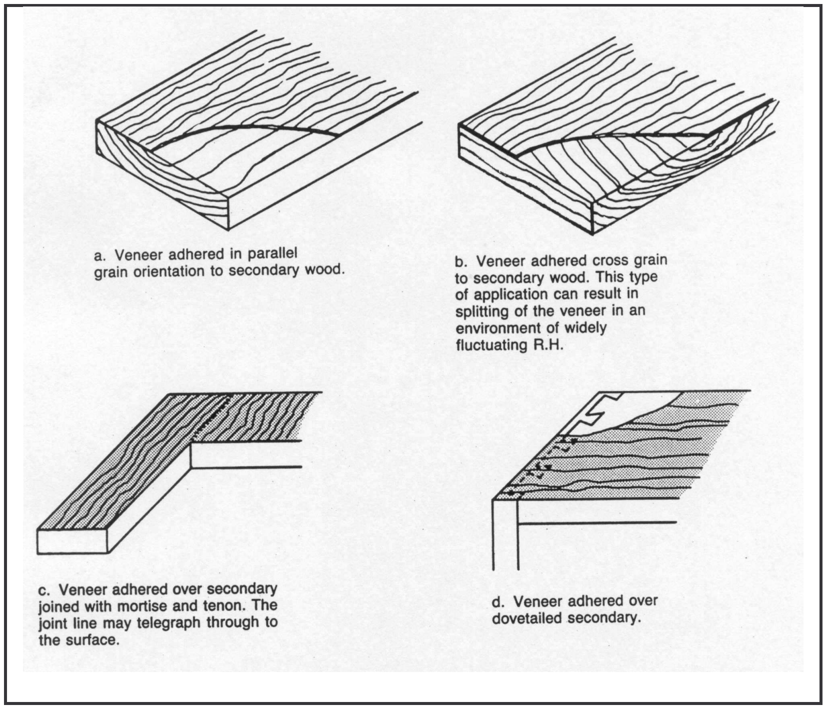


Figure N.6. Common Veneer Applications

5. *Why are finishes applied to furniture and wooden objects?*

Stains and dyes are often applied to wood to enrich or darken the color. They penetrate the surface but do not leave a film. Alcohol- and water-based stains are sensitive to light damage. Oil-based stain is more resilient.

Transparent or pigmented finishes are applied to wood for more than one reason. They are used aesthetically to bring out the color and grain pattern. In other cases the finish may be strictly utilitarian. They preserve the wood by protecting it from spills and light damage and by slowing the transfer of water vapor from the environment.

6. *What types of finishes are used?*

Among the most common finishes found on museum pieces are varnish, oil, shellac, wax, paint, and gilt.

- ***Liquid finishes***, including varnishes, oils, and shellacs, are divided into three broad categories: resins, polymers, and paints.

  – *Resins*, such as spirit varnishes, are either dissolved or dispersed in solvent. They harden as the solvent evaporates. Shellac is made from the resinous secretion of insects and is the most common finish found on furniture in park museum collections. It was particularly popular in the 19th and early part of the 20th centuries. Resins are susceptible to damage from water and alcohol.

– *Polymers*, which include most oil finishes, harden by means of chemical bonding (polymerization) and/or oxidation. Linseed oil and tung oil are commonly used oil finishes. They penetrate the wood but do not provide as hard a finish as resins. Linseed oil, particularly, darkens over time as it oxidizes. Misused in the past, in combination with turpentine and beeswax, it has caused damage to many museum pieces. Though serviceable in moderation, in excess linseed oil remains tacky, gathers dust, and severely darkens the wood. Oils are very difficult to remove without damaging the underlying finish. **Do not apply oil to finished wooden surfaces.**

– *Paints* consist of pigment particles in suspension in a binding medium and a solvent. Most paints are relatively stable, however, calcimine and distemper used during the eighteenth and nineteenth centuries were made with a protein glue binder and therefore dissolve in water. **These soluble finishes should be dusted only**.

A few finishes, such as oil-resin varnishes, are a combination of the two.

- ***Waxes*** are softer and more plastic than other finishes and are readily soluble in most organic solvents. There are few, if any, examples of objects with original wax finishes in park museum collections**. Do not clean a wax finish as you would a hard finish.** Consult a conservator for advice.

- ***Gilt*** may have been used as a decorative accent on furniture or as a finish over the entire surface. It was most commonly used on ornate picture frames. A gilt finish consists of a gesso layer, a sizing layer, and silver or gold leaf that is metal-hammered into extremely thin sheets. Silver and lesser grades of gold oxidize rapidly. Sometimes the leaf was painted with pigmented shellac to protect it.

  Gilt is the most fragile of all finishes, extremely susceptible to damage from rough handling and improper housekeeping. Skin oils can accelerate oxidation, so do not touch the gilt surface. The gesso layer is brittle and often cracked from the expansion and contraction of the underlying wood. Under very humid conditions the gesso will absorb enough water vapor to soften and expand so that it eventually chips away from the wood. **Dust these surfaces gently with a soft bristled brush and a low power vacuum held at least 1/2 inch away.**

7. *What is patina?*

Patina refers to the distinctive appearance of older finishes. It is used to describe a worn finish, but one with warm tones and satin luster. There is a fine line between patina and a damaged finish. It is important to recognize and protect an unstable finish that may deteriorate further under the existing environmental conditions.

8. *What happens to finishes as they age?*

The aging qualities of finishes vary. Oriental lacquer, for example, is very sensitive to moisture and light damage. Shellac, on the other hand, is relatively resistant to light damage because it allows the light to pass through and consequently harm the stain and wood beneath.

All finishes are damaged to some extent by exposure to high light levels because light accelerates oxidation. Oxidation prevents the finish from expanding and contracting freely with the wood beneath. Minute cracks, called crazing or "alligatoring," may result. Some light-damaged finishes are dull and chalky, while other more severely damaged finishes become unstable, flaking or breaking down into "islands" that lift at the edges.

Fluctuating relative humidity will worsen the condition of finishes made unstable by exposure to high levels of light. High humidity can cause white "blooms" and mildew damage on even stable finishes.

9. *What should I know about the hardware on wooden furniture?*

Drawer pulls, knobs, escutcheons, locks, and other types of hardware are typically made out of brass on decorative pieces and ferrous metal on functional pieces. Brass, an alloy of copper and zinc, will dull and darken as it oxidizes. Polishing brass can damage both the hardware and the surrounding wood. Rubbing with abrasive polishes eventually will wear away the surface of the brass. If the hardware is not removed from the piece for cleaning, the wood finish around and beneath the hardware will likely be damaged or even entirely worn away. Hardware that is not washed after polishing will often show a white or green residue. Green residue indicates the presence of ammonia, which will continue to react with the brass.

Pigmented shellac frequently was applied to brass to protect the shine and give it a more golden tone. This coating, however, is easily scratched. Occasionally the brass on very decorative pieces was given a thin coating of gold in a process called fire gilding. This bright, shiny gold layer will prevent oxidation, but like the shellac is easily damaged. Do not clean fire-gilded brass until you have consulted a conservator.

10. *What potential sources of damage should I look for in upholstered furniture?*

Like wood, upholstery is subject to deterioration from:

- high temperature, which can leave the fabric brittle
- high humidity, which promotes biological activity
- visible and ultraviolet light, which causes all fabrics to fade
- chemical reactions
- bacteria and fungi
- mechanical abuse
- termites and woodworms
- rodents

In addition, look for deterioration from agents that more typically attack textiles. See Appendix K, Section D, for a comprehensive discussion of these:

- pollution, such as dirt and pollen, industrial emissions, and smoke
- fiber-eating insects, such as moths, silverfish, cockroaches, and carpet beetles
- inherent vice, particularly the addition of metallic compounds during manufacture
- oxidation, which discolors white and natural cloths

See *Conserve O Gram* 7/4, Upholstered Furniture: Agents of Deterioration, for a more thorough discussion.

11. *Should I ever replace the upholstery?*

Yes, under certain circumstances. An upholstered piece in a museum collection may have been re-covered several times during its period of use. The current upholstery fabric may not be appropriate for the period of interpretation or it may be very worn. Because the wood frame might have been damaged by repeatedly attaching the upholstery with tacks, consider using a non-destructive technique when re-covering the piece. See Calinescu and others (1996), for an example of a low-interventive upholstery technique.

E. Preventive Conservation: Controlling the Environment

1. *What elements of the environment should be controlled?*

To provide a stable environment for wooden objects, control these factors:

- relative humidity
- temperature
- light
- ambient air quality

2. *What is the ideal relative humidity for furniture and other wooden objects?*

The ideal relative humidity level in most areas of the country for wooden objects is 50% plus or minus 5%. In dry climates, such as the southwest, 35% to 40% is acceptable. These levels are difficult to achieve in very dry climates because the moisture content in wood drops rapidly below 35% RH, causing splits. Below 30% the glue may desiccate, joints may loosen, and finishes will become brittle. Along the coast, 55% to 60% is acceptable, but above 70% mold and insects may become problems. When humidity is this high, glue may weaken, finishes may bloom, hardware will corrode, and wood fibers will swell excessively.

Rapid changes in relative humidity, as mentioned earlier, may cause severe damage to furniture. An increase in RH from 30% to 70% can cause wood to expand as much as 2% across the grain. In this case a 2-foot panel could expand almost 1/2 inch causing splitting, veneer loss, and joint failure.

Avoid temporarily heating, air conditioning, or humidifying spaces that house wooden objects. Do not turn off heat or air conditioning at night.

3. *Why is temperature important?*

Temperature is important primarily because it affects relative humidity. Though changes in temperature alone also will cause some expansion and contraction of wood, this is a relatively minor concern. Elevated temperatures will speed fungal and insect activity as well as oxidation. High temperatures associated with high relative humidity can cause some old finishes to become tacky.

- Consider installing a humidistat to override the thermostat in spaces housing wooden objects.
- Maintain the temperature at the lowest comfort level in exhibit areas and even lower in storage spaces, but be sure to keep it above freezing at all times.

4. *What effect does light have on wooden objects?*

Light will change the natural color of heartwood, making light woods darker and dark woods lighter. It will fade stains and embrittle finishes. It also will fade and embrittle the fabric or leather on upholstered furniture. The level for unfinished wooden objects should not exceed 300 lux. The light level for most finished wood objects should not exceed 200 lux. Objects decorated with fugitive stains and dyes and light sensitive fabrics, such as silk, are more prone to light damage and the allowable light level should be even less.

Limit exposure of wooden objects to both natural and artificial light:

- Install UV filters on windows and florescent lamps to reduce most of the harmful UV radiation.
- Use blinds, shutters, curtains, and roller shades in historic structures to reduce visible light.
- Use reproduction slipcovers to protect upholstered furniture.

5. *How can I control ambient air quality?*

Most modern museums have a variety of filters in their HVAC systems to clean the air and filter out dust and other particulates. In addition, many objects in these buildings are displayed in protective exhibit cases. Historic structures, on the other hand, seldom have good air filtering systems and the furniture is displayed openly. More particulates are generated simply because of the nature of the buildings. Not only is dust abrasive and therefore harmful to wooden surfaces, it is a source of food for mold and is attractive to insects.

F. Preservation Through Good Housekeeping Practices

1. *What housekeeping practices should I follow?*

The conditions in historic furnished structures require intensified housekeeping both in procedure and frequency. Good housekeeping is essential for aesthetic and preservation reasons. It should be carried out on a regular schedule. See Chapter 13: Museum Housekeeping, to learn about developing a museum housekeeping plan.

Keep this tip in mind when handling wooden furniture and objects:

Don't wear gloves when handling furniture with fragile veneer that might snag or when moving heavy wooden pieces requiring a sure grip. **Do wear them** when handling gilt finished objects or unfinished objects made from light colored wood that might stain.

> ***Frequent and proper housekeeping is critical for the preservation of collections in historic structures.***

2. *What are the best ways to remove dust?*

Because dust is not only abrasive but also attracts moisture, it should be removed periodically to prevent damage as well as to improve the appearance of objects. Remove it from the environment as completely as possible.

- ***Use a vacuum*** to remove the dust from wood surfaces if possible. (See *Conserve O Gram* 7/5, Dusting Wooden Objects, and *Conserve O Gram* 1/6, Choosing a Vacuum Cleaner for Use in Museum Collections.) Hold the brush attachment just above the wood surface. Use a soft bristled brush to sweep the dust out of crevices and intricately carved areas and toward the vacuum brush. Also vacuum upholstery. (See Appendix K for guidance.) **Keep the vacuum clean.**

- ***Use a clean cotton cloth*** when vacuuming is not an option. Turn the cloth frequently so that accumulated dust does not scratch the object's surface. Wash the cloth after every use. You may dampen the cloth with water or spray it sparingly with a light mineral oil product, such as Endust®, where low relative humidity creates a static charge, causing the cloth to repel the dust. If using water, be sure to dry the surface immediately. **Do not** use scented oil products.

- ***Don't use feather dusters.*** They scatter the dust rather than collect it. Broken feathers may scratch the surface.

- ***Don't wipe unstable finishes.*** This will cause more harm to flaking and lifting edges or surfaces that have loose veneer or splintered corners.

- ***Use compressed air*** on very fragile objects and irregular surfaces. Limit pressure to about 10 pounds and use away from exhibit areas.

3. *Do furniture and wooden objects require more than thorough dusting?*

Yes. Periodically these require cleaning to remove oils and grime. Objects in storage may need to be cleaned only every ten years while those on exhibit will require cleaning approximately every three years. More frequent cleaning may be necessary if visitors occasionally touch the pieces.

- Use mineral spirits, such as Stoddard solvent or naptha, on greasy types of soils and hand oils. First test a small inconspicuous area with a cotton swab dipped in mineral spirits. If the finish does not get tacky and no finish comes off on the swab, you may begin careful cleaning with a cotton cloth dampened with mineral spirits. Work in a well ventilated area and wear vinyl gloves. Turn the cloth frequently and wipe the object down with a clean, dry cotton cloth after cleaning. **Note:** Some 18th century pieces may still have their original wax finish. Consult your regional/SO curator and a conservator before cleaning furniture that you suspect has an original wax finish.

- Use soap like Vulpex®, Ivory®, and Orvus® and water to remove smoke and soot from stable finishes. Follow manufacturer's instructions for dilution. Never use detergent because it will leave a film on the surface. Again, test a small inconspicuous area before cleaning the entire surface. Wring the cloth well before wiping. When finished, wipe the piece again with a cloth dampened in clear water and then again with a dry cloth. **Do not moisten a damaged, veneered, or inlayed surface.**

Only furniture with a sound finish should be cleaned.

4. *Should furniture be waxed?*

Yes. The application of wax to clear finishes is recommended for these reasons:

- Wax enhances the appearance of the surface by filling in voids and small depressions, creating an attractive level surface.

- Wax helps protect the surface from abrasive dust and handling.

- Waxing makes dusting easier.

- It slows the penetration of water and water vapor, which will cause the wood to swell.

Note: Always rewax the finished surface after cleaning, since mineral spirits will dissolve and remove wax**.**

5. *What kind of wax should I use?*

The paste waxes recommended for use on wooden objects in museum collections are made with weak organic solvents, such as turpentine or mineral spirits. When the solvent evaporates, the wax film that remains is lustrous, slippery, and plastic. Waxes are derived from animal, vegetable mineral, and synthetic sources. Natural waxes, like beeswax, have been used for centuries. Most commercial paste wax products are mixtures of various waxes.

- **Don't use** paste wax made with strong solvents, such as xylene and toluene, because they can damage some finishes.

- **Don't use** liquid polishes. They do not offer the same protection as paste and most contain silicones. Silicone migrates into the finish and complicates any future conservation treatment.

6. *What precautions should I take when waxing furniture?*

Apply wax only to stable, clear finishes, such as shellac, varnish, and modern lacquer. **Don't** apply paste waxes to unfinished objects because it will penetrate into the pores. Wax applied to unfinished wood surfaces cannot be completely removed.

Cover the upholstered parts of the piece so that you don't accidentally get wax on the material.

Be careful not to get wax into cracks or splits in the wood. Later attempts to repair the crack with glue would be very difficult.

7. *How often should I apply wax?*

The frequency of waxing will depend on environmental factors, such as dust, relative humidity, and light, and on the amount of handling. When museum objects are used or touched, be sure to wax often enough to protect the underlying finish. Most wood objects in furnished historic structures, however, will require rewaxing just every one to four years. Objects in well-gasketed exhibit cases may only require waxing every ten years. As a general rule, rewaxing is not necessary if the existing wax layer can be buffed to a sheen.

8. *What is the recommended method of applying wax?*

Always follow these procedures:

- Clean the object to remove the existing wax. Waxing over dirty surfaces will produce a grimy buildup and eventually obscure the color and grain of the wood.

- Apply new wax sparingly with a clean, cotton cloth, rubbing first in a circular motion and then along the grain. Wait at least an hour or two for the solvent to evaporate and then buff the wax with another clean, cotton cloth. If the luster is uneven, repeat the procedure. ***Note:*** It is preferable to apply two thin coats rather than a single thick coat.

- On a carved or irregular surface, apply the wax with a soft toothbrush or shoe polish applicator and buff it out with a soft fiber shoe brush. Tape foam padding to the wooden ends of the brush to avoid damaging the object while buffing.

- Don't apply wax when it is hot and humid. The wax may turn white and cloudy. If this happens, remove the wax with mineral spirits and rewax when the environment improves.

- Remove white specks from pores and recesses left by light-colored waxes with a wooden pick or use a pigmented wax on dark wood.

Refer to *Conserve O Gram* 7/2, Waxing Furniture and Wooden Objects, for more guidance.

9. *What commercial brands of wax can I use?*

There are several good paste waxes on the market. These include Staples®, Butchers®, SC Johnson®, and Trewax®. Renaissance Wax®, a good synthetic with no perfumes or pigments, is frequently used on museum objects. It is durable and highly water resistant. It is recommended for smaller wooden objects, however it can be difficult to buff evenly on large, flat surfaces, such as tabletops.

10. *How do I care for the hardware on wooden furniture?*

The best way to care for hardware on museum pieces is to clean and polish it once and then spray it with a lacquer containing corrosion inhibitors. This treatment requires specialized equipment and the experience of a conservator, but applied correctly, the finish should last up to 20 years.

If this conservation treatment is not feasible, the following on-site treatment is the next best solution.

- First, remove the hardware if this can be done without damage. Tag it to document its original location. If it cannot be removed easily, slip Mylar® sheets behind the hardware, curtting out slits to get by bolds or bails.

- Determine the type of metal and clean it accordingly.

  - Clean brass hardware with alcohol or stoddard solvent, if necessary, to remove fingerprints.

  - Soak iron hardware for several days in kerosene to remove rust and dry it thoroughly. Dip badly corroded iron hardware into a metal preservative called Ospho to prevent further deterioration.

  - Softly brush gilded bronze with a weak solution of amonia and distilled water (1 part amonia to 40 or 50 parts water). Rinse it with clean distilled water and dry it with a warm, not hot, air-blower.

- After cleaning, you may polish brass hardware with a mild abrasive, such as artist's whiting, that **does not** contain ammonia. **Do not** polish gilded bronze. Be sure to remove all of the polish residue. Use a solvent and wash with distilled water.

- Last, wax all accessible surfaces of the hardware with a microcrystalline wax, such as Renaissance Wax®. Wax will retard oxidation, though not as effectively as lacquer.

See Appendix O for further guidance on cleaning, polishing, and coating metal objects.

G. Preventive Conservation

1. *How can I provide a protective environment for wooden objects in storage?*

Protecting objects in storage is much easier than protecting them while on exhibit. First of all, you can eliminate the warm temperatures and light that often cause damage during display. There are a few requirements, however:

- Storage spaces need to be easily accessible. When storing furniture, avoid areas with narrow stairwells and doors.

- Never store wooden furniture directly on concrete, stone, or brick floors. The end grain on furniture legs and feet will soak up moisture, causing fungal damage and staining. Store on shelves or blocks.

- When using storage shelves, place large and heavy objects on the lowest level. (Slotted metal angle storage systems can be adapted for furniture storage. Be sure to pad the edges.)

- Store wood frames on stationary or moveable racks, like those used to store framed paintings.

- Don't stack furniture.

- Don't store objects in the drawers of period furniture.

2. *What is the best way to move large pieces of wooden furniture?*

Because furniture is particularly prone to damage while it is being moved, it is important to carefully plan and execute any move.

- Examine the furniture carefully to detect any structural instability, such as broken or loose joints or splits that may not stand the stress of moving.

- Secure doors, drawers, and drop lids or leaves before moving the piece. Use cotton twill tape rather than twine to avoid scratching the finish. **Never use adhesive backed tape**. Remove drawers if weight is an issue.

- Remove marble tops and store them on edge while you move the base. Large marble tops may fracture from their own weight if held horizontally and supported only at the ends.

- Plan your route and measure doorways, stairways, and aisles along the way to make sure the object and the carriers will fit. (Measure the width of a couch or large chair by placing it against a wall and measuring from the wall out to the middle of the seat rail.)

- Use a dolly.

- Don't attempt to move heavy or awkward objects by yourself.

- Never slide furniture across the floor. Sliding puts too much stress on joints and fragile areas and can cause the feet or legs of dressers, tables, chairs, etc. to break.

- Grasp furniture for lifting where it is strongest, usually the lowest horizontal structural member. For example, lift a table by its apron, a case piece by its bottom rail, and a chair by its side seat rails, being careful not to dislodge the slip seat. Never lift a sofa by its arms—grasp the bottom rails, instead. Moving a particularly large and heavy sofa may require four people.

See Figure N.7 below for the proper moving techniques.

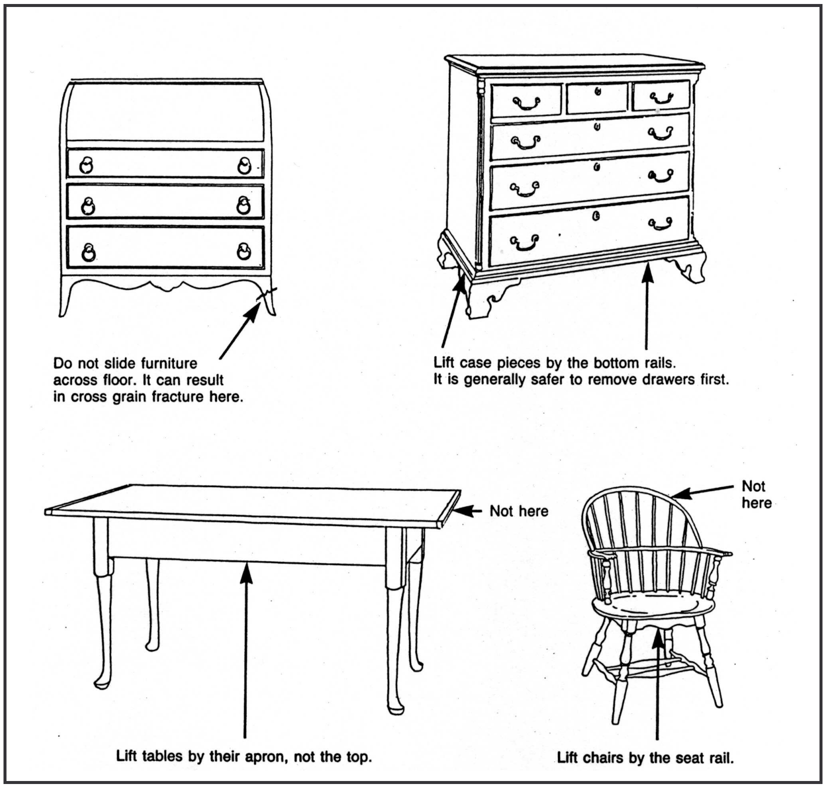


Figure N.7. Proper Techniques for Moving Furniture

3. *What should I do if a part of the wooden piece becomes loose or falls off?*

If small parts become detached because of glue failure, structural failure, or accidents during moving or cleaning, place them in a closable polyethylene bag with a label that documents the date, location from which the piece came, and the catalog number of the object. Keep the bag with the object, if possible, and contact a conservator.

If there is an urgent need to repair the piece, consult the regional/SO curator and seek permission to use a ***reversible*** glue (for example, hide glue) to reattach the part temporarily. **Do not tack the loose part back into place.**

If more than one piece becomes detached, it usually indicates a problem with either the environment or the housekeeping procedures. The object may be too unstable for exhibit. Seek conservation treatment as soon as possible.

4. *Is there a special technique for removing mold from wooden objects?*

Because mold growth is the result of environmental factors, your first step is to improve the environment.

- Lower the relative humidity level and increase the air circulation.

- Isolate the object from the rest of the collection and place it where it will receive more light.

- Use a HEPA vacuum to remove the mildew from the object and discard the bag, or brush it off, capturing the spores on a drop cloth. A dust mask or respirator may be necessary (see *Conserve O Gram* 2/13, An Introduction to Respirator Use in Collections Management). Dispose of the cloth in a plastic bag.

- Wipe the remaining mold from the object with a solvent-dampened cloth. Use a 50% mixure of alcohol and water on all but shellaced surfaces. Use mineral spirits to clean a shellac finish. Dispose of the cloth.

5. *How can I determine if a wooden object has an active beetle infestation and what should I do about it?*

Evidence of active wood boring beetles, the most common museum insects to attack wooden objects, is easy to spot.

- Examine the surfaces of the piece carefully for *flight holes*—the holes made by these insects as they exit. If there are “bright holes” with sharp edges, the infestation is probably current.

- Look for *frass*, a light-colored powder produced by the larva as it eats the cellulose. It may be found on the floor nearby or on the lower horizontal members of wooden objects.

- Check the windowsills for beetle carcasses during the spring.

- Listen carefully. Some species of wood boring beetles can actually be heard as they chew.

If you suspect an active infestation, isolate the object immediately. Place it on a dark paper or other surface, wrap it with polyethylene sheeting, and monitor it carefully for new frass accumulations. Be careful not to jar the piece, since movement may dislodge older deposits of frass.

Refer to Chapter 5: Biological Infestations, for guidance if you determine that beetles are currently at work.

H. Conservation Treatment

The preservation of wooden furniture and other wooden objects is the responsibility of both curator and conservator. The curator must know how far to go with hands-on housekeeping and when to call the conservator for advice or treatment.

1. *How do I assess the stability of a wooden object?*

Most furniture and other wooden objects in museum collections show evidence of much use and at least some damage. You must be able to determine whether or not that damage makes the object unstable.

An object should be considered unstable when further deterioration is likely to result if the condition is not corrected.

- ***Examine the object carefully for structural stability***. Look for:

  – glue failure

– mechanical joint failure

– missing and loose elements

– cracks and splits

– fungal or pest activity

Loose joints usually indicate environmental problems that have caused the glue to dissolve or become brittle and fail. Not only is conservation treatment needed to stabilize objects with loose joints, but also the environment must be corrected to prevent the problem from recurring.

Missing parts *may* cause structural instability. A lost finial will not; a lost leg will. If a crack or split occurs in a structural member that must support the weight of the object, conservation treatment is needed. If movement is possible on either side of the split, the object should be treated.

Make sure you can distinguish between decay fungi and mold and mildew. Decay fungi consume cellulose and lignin and will eventually cause severe deterioration. Mold and mildew, on the other hand, disfigure the surface of the wood, but do not cause instability. Decay fungi can be detected by the presence of cracks along and across the grain of the wood, a "dead" sound when tapped, loss of weight, a friable surface, and its characteristic odor. If the decay has not progressed too far, the wood can be consolidated during conservation treatment and a degree of structural stability restored.

Like decay fungi, insects can also cause severe damage to wooden objects. The presence of numerous exit holes on the surface of an object indicates the need for a thorough structural examination. See Section H.4 above.

- ***Examine the finish carefully***. Crazing may or may not require conservation treatment. If the finish is still tightly bonded to the wood surface, it is probably in fairly stable condition. If , however, the islands of finish are loose or are beginning to discolor along the edges, treatment is recommended.

- ***Examine the hardware***. Look for active corrosion. Dull, oxidized hardware is not necessarily unstable, but active green corrosion on brass or copper hardware should be corrected by conservation treatment. On ferrous hardware, a coating or red or red-orange rust also indicates active corrosion. If corrosion is not stopped, it will deteriorate the metal and may stain the underlying wood.

2. *How should I document the condition of furniture and wooden objects?*

Periodic documentation should be both written and visual. Measured drawings, sketches, and photographs are very useful when they accompany written descriptions.

- Note the occurrence of obvious damage, such as loss of veneer or scratches from cleaning equipment.

- Note deterioration that takes place over a longer period of time, for example, progressive crazing or fading of finishes. Take photographs and date them for comparison.

- Record the length and width of any split you might see. If it is larger on the next inspection, call a conservator for treatment.

- Compare your documentation of condition with the records from environmental monitoring. Seasonal variations in relative humidity may be responsible for the deterioration.

3. *What will a conservator do in the course of treating wooden objects and furniture?*

The conservator's treatment will be determined by the condition and intended use of the object. Typically a conservator will follow these steps:

- ***Examine the object thoroughly*** with the aid of microscopes and specialized photographic techniques to:

  – determine the stability of the structure and the finish

  – determine the causes of deterioration

  – look for evidence of insect and fungal decay

  – identify the type of wood, finish, and adhesive and joinery techniques

- ***Clean the object carefully*** by mechanical and chemical means to:

  – remove foreign soil buildup

  – remove stains and paint deposits

  – remove unwanted (post-period) surface coatings

The conservator preserves important signs of use.

- ***Make structural repairs*** by restoring structural integrity, but not necessarily appearance.

Repairs are reversible so that they can be removed if necessary.

- ***Replicate missing elements*** when desirable with in-kind materials and techniques or modern ones.

  The decision to replace missing elements is made jointly by the conservator and the curator. It will depend, in part, on the object's significance and whether or not the size, shape, and design of the missing element are known. Replacements should be:

  – documented in writing with accompanying photographs

- labeled with maker and date
- removable
- unobtrusive to the museum visitor, but discernable to the curator
- added with a minimum of damage to the object
- reasonable in cost

- ***Consolidate damaged fibers*** when the wood has been damaged by fungal activity, insect attack, or chemical action. Consolidants can be made from a number of natural or synthetic resins and a variety of solvents. The process, however, results in a visual change to the wood surface and is never completely reversible. Therefore, the decision to use consolidants should be carefully weighed.

- ***Preserve the existing finish*** or replace it if necessary. If the existing finish is original, or at least appropriate, and salvagable, preservation is the preferred course. Preservation may involve:

  - cleaning and waxing, if the finish is stable
  - partially dissolving the finish to lay it down if it is lifting and unstable
  - amalgamation of crazed surfaces
  - filling in areas of stain loss with a reversible finish

  Refinishing is preferred if the existing finish is either inappropriate or almost completely worn away. Conservators will use the least harmful means of finish removal and a new finish that is resoluble. A small area is usually left intact to document the finish history of the object. The curator and the conservator should carefully consider the decision to refinish.

- ***Apply a surface barrier*** to protect against moisture, dust, light, and staining. Wax is generally the choice for finished wood surfaces. In some instances, a sheet of acrylic may be used to protect wood surfaces from marring or abrasion.

I. Emergency Procedures for Wooden Objects

1. *What is the most common type of emergency?*

Most emergencies that affect museum objects involve water. Refer to Chapter 10 for guidance on emergency planning. See Chapter 8, *Conserve O Gram* 7/7, Emergency Treatment for Water-Soaked Furniture and Wooden Objects, and *Conserve O Gram* 21/6, Salvage at a Glance Part III: Object Collections, for emergency treatments for wood objects. You will probably need to contact a conservator to take care of the preservation problems created by any disaster.

2. *What preservation problems will I encounter during a flood?*

Water damage usually affects the finish and causes wood to swell. If there is standing water on the floor for a period of time, the water and any salts that may be dissolved in it will be carried up through the end grain of the feet and legs of furniture creating "tide" lines as the salt effloresces. Floods and water-damaged ceilings may deposit mud, plaster, or gypsum on furniture surfaces. The high relative humidity levels often result in mold growth. Upholstery fabrics will stain and probably shrink. Hardware will rust.

Moving furniture after a flood subjects it to even more potential damage. Move it only if necessary. Your focus should be on removing the water instead.

3. *What should I do in the event of a flood?*

Take action immediately:

- Remove all water on and around the object as quickly as possible. Lower the relative humidity level slowly to acceptable levels.

Dry out wet wood objects slowly.

  It may be necessary to cover affected objects with a polyethylene tent so they will not dry out too quickly.

- Remove drawers and open doors to dry all surfaces evenly. If drawers and doors stick because of swelling, **do not** force them open.

- Raise all objects off the floor so that the water will not migrate up the feet and legs.

- Use fans to improve ventilation and therefore decrease the likelihood of mold, but **do not** aim the fans directly at the furniture.

- Remove ferrous hardware to avoid stains, especially on woods with high acid levels like oak. Tag all hardware, furniture elements, and loose pieces as you remove them.

- Remove the outer fabric, padding, and support from very wet upholstered furniture. Saturated fabric left in place may split as it dries. The padding can be dried relatively quickly without damage. Feather cushions can be dried in a clothes drier at a low temperature.

- Gently sponge any mud or plaster from stable wood surfaces with clean, cool water. Rinse the sponge often. Gritty sponges and dry cloths will scratch the wood. Wait for a conservator's assistance to remove mud and plaster from fragile and unstable finished surfaces, such as gold leaf.

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Appendix O: Curatorial Care of Metal Objects

List of Figures

APPENDIX O: CURATORIAL CARE OF METAL OBJECTS

A. Overview

1. *What information will I find in this appendix?*

This appendix discusses historic objects made primarily of metals and their long-term care and preservation. The main topics covered in this appendix are:

- the nature of metals
- agents of deterioration
- handling, storage, and exhibit of metal objects
- working with a conservator when treatment is needed
- specific emergency procedures for metal objects

Note: This appendix does not cover metals recovered from archeological sites. Care of archeological objects is discussed in Appendix I.

2. *Why is it important to practice preventive conservation with metal objects?*

Metals are very reactive and many factors contribute to their deterioration, but a metal object's rate of deterioration can be slowed significantly with proper preventive care. Practicing preventive conservation will also reduce the need for costly and time-consuming conservation treatment.

3. *How do I learn about preventive conservation?*

Read about the agents of deterioration that affect metal objects so that you can create a preventive conservation plan. See Chapter 3: Preservation: Getting Started, and Chapter 4: Museum Collections Environment, for discussions of the agents of deterioration. Refer to the *Museum Handbook* Part III, Chapter 7: Using Museum Collections in Exhibits, for additional information.

4. *Where can I find the latest information on care of metal objects?*

There are a variety of resources for up-to-date information on metal objects including:

- NPS *Conserve O Gram* series
- World Wide Web sources listed in Section J
- Selected references in Section K
- Regional/SO curator or collections manager of a large metals collection
- Objects conservators

B. The Nature of Metals and Metal Objects

1. *What are metals?*

Metallic elements compose the largest proportion of materials that make up our planet. Metallic ores are refined by the application of energy to produce metals. The physical properties of metal include:

- luster
- hardness
- strength
- malleability
- temperature sensitivity

Different metals exhibit different physical properties. Historically, these various properties have been exploited in the construction and fabrication of metal objects and structures. Metals are frequently selected for applications in architecture, decorative arts, fine arts, and functional objects.

2. *What are some of the metals found in park collections?*

Among the metals found in museum objects are gold, silver, copper, tin, iron, lead, zinc, nickel, and aluminum. Metals are frequently combined in order to modify their properties or to obtain a metal that is most suitable to a given application. The process of combining two or more metals is termed *alloying*.

3. *What is an alloy?*

An alloy is created by melting one metal and then adding another metal to it. An alloy is a solid solution since the metal elements remain distinct, one suspended in the other. Examples of common alloys are *brass* (a mixture of copper and zinc), *bronze* (a mixture of copper and tin and other metals), and *sterling silver* (a mixture of silver and copper). By varying the proportions of copper and zinc in brass alloys it is possible to obtain a range of brass alloys with differing properties including color, strength, corrosion resistance, or working properties.

4. *What are surface treatments of metals?*

Surface treatment can be an important characteristic of a metal object. Frequently metals are finished to enhance the appearance of the object, to improve the functional performance (for example, corrosion resistance), or a combination of both. Surface treatments include polishing, plating, patination, coatings, heat treatments, and chemical coloring treatments.

5. *Is it important to identify different metals?*

Yes. Proper identification of metals is important to housekeeping procedures, accurate interpretive program information, storage and exhibit techniques, climate control, handling methods, and the conservation treatment process.

6. *How do I identify different metals?*

You can identify metals by color, weight, function, magnetic properties, or hardness. If you are unsure of the metal object's identification, consult a conservator or your regional/SO curator. To identify a metal object properly, you need to have a basic knowledge of the properties of metals and have a few tools and supplies. If you can't identify a metal, it is better to use more generic terms to describe it. For example, describe a metal as a white metal instead of running the risk of misidentifying it as pewter, silver, or nickel.

DO NOT use chemical spot tests or spark tests to identify metals. This can damage or destroy the object.

Metal	Color	Other Identifying Characteristics	Primary Alloys and Uses
Iron & Iron Alloys	Grey/silver, blue-black and red-brown color.	Some but not all iron alloys are magnetic.	**Cast Iron** (iron & carbon, 2% to 4%). Kettles, door hardware, fire-backs, stoves. **Wrought Iron** (pure iron & carbon, not more than .035%). Railings, nails, wagon hardware. **Steel** (iron & carbon, 0.15% to 2 %). Knives, tools, structural materials.
Copper & Copper Alloys	Yellow to rich browns. Surface may be patinated and vary in color from red, brown, black and blue to shades of green.		**Brass** (copper & zinc). Lighting devices, jewelry, scientific instruments, marine fixtures, cookware. **Bronze** (copper & tin). Bells, cannons, bearings. **Nickel Silver** (copper & nickel & zinc). Household decorative objects.
Lead	Pure lead and lead alloys where lead predominates, dull metallic blue in color.	Very heavy & very malleable.	Pipes, pump wells in ships, toys, roofs, bullets, and solder.
Silver & Silver alloys	White metallic appearance.	Sterling silver is usually hallmarked.	Numerous silver-copper alloys such as Sterling, coin silver, jewelry, and tableware.
Nickel	Gray to white appearance.	Metal is slightly magnetic.	**Nickel** is often used in its pure form as a plate for tableware, kitchenware, and decorative ornaments.
Tin & Tin Alloys	Dull gray.		**Pewter** (tin & antimony & copper). Kitchenware and plating for tin cans and toys

Figure O.1. Identification of Metals

7. *What is corrosion?*

Corrosion is the chemical or electrochemical reaction between a metal and its environment that produces deterioration of the material and its properties. It is the most commonly occurring problem of metal objects. Corrosion can take many forms depending on the metal(s) that compose the object, the manner in which they are fabricated, or the environment in which they are exhibited or stored. At times, the corrosion source may be from fabrication in the case of stress corrosion cracking in thin turned brass objects or contamination from solder flux in joined metals. In other instances, the conditions responsible for corrosion may be an integral part of the environment, such as a seacoast or polluted urban air.

8. *Is all metal corrosion harmful?*

No. The presence of a corrosion product on a metal object does not necessarily indicate active corrosion. Corrosion, tarnish, and patination are all examples of metal compounds, some of which are unintentional and considered disfiguring, while others are deliberately created for an aesthetic effect. While some forms of corrosion are more protective and stable than others, almost all are subject to failure at some critical relative humidity level or in the presence of certain pollutants. When metals are cleaned the surface can oxidize and be chemically stable.

9. *How can I identify active corrosion?*

Active corrosion can be identified visually by the following characteristics:

- color (wet or dry in appearance)
- powdery or flaky formations on the surface of the object and similar deposits around the base of the object
- loosely adhering formations, frequently appearing in patches on the surface as opposed to uniform, dense, well-adhered deposits
- continuing change or growth

10. *What are the characteristics of corrosion for different metals?*

Surface characteristics and colors of metals vary by alloy. Corrosion products also vary in color, depending on the alloy and cause of corrosion.

See Figure O.2 for additional information.

CAUTION! Lead acetate corrosion is a severe poison that can be fatal if swallowed, inhaled, or absorbed through the skin. If you see white, crystalline corrosion products on lead objects in your collection, assume that they are lead acetate and handle accordingly. Material Safety Data Sheets uniformly state that protective equipment for lead acetate should include goggles, lab coat, vent hood, and rubber or plastic gloves. This type of corrosion is often seen on lead bullets and toy soldiers.

Metal	Active Corrosion	Stable Surfaces	Causes of Corrosion
Iron & Steel	Orange to reddish-brown. Wet or glossy appearance. A surface that is scaling, flaking or pitting.	Compact blue-black and red-brown color.	High relative humidity, surface moisture.
Lead	Loose white powder in tiny spots or overall.	Smooth gray surface.	Weak organic acid vapors, from sources such as wood, cardboard, and vinegar.
Copper & Copper Alloys	Corrosion forms in small spots overall. Powdery green, blue, and white corrosion products that are generally over the entire surface.	Wide variety of colors: solid blue, green, red, brown, or black. Surfaces are smooth and tightly adherent.	High relative humidity, surface moisture, air pollution, salts from inappropriate cleaning and handling.
Silver and Silver Alloys	Slight gray dullness through blue/purple that deepens to brown/black as corrosion becomes thicker.	Smooth white metallic. A blue/purple surface can be stable if it occurs overall and the object is removed from the source of corrosion.	High humidity, sulfur compounds, etching from fingerprints, organic vapors.
Nickel	Nickel corrosion is reddish brown and is similar in appearance to rust. Green copper corrosion products indicate preferential corrosion from a copper alloy.	Smooth gray appearance.	High humidity and sulfur compounds.
Tin & Tin Alloys	White gray, dark gray to black. Nodules of white to gray corrosion that form under the surface layer in nodules that erupt through the surface exposing a light gray or white corrosion product.	Smooth gray surfaces.	High relative humidity, atmospheric pollutants, low temperatures.

Figure O.2. Identifying Active Corrosion

C. Factors That Contribute to Metal Object Deterioration

1. *What agents of deterioration affect metal objects?*

The primary causes of metal object deterioration in the museum or historic furnished house are:

- relative humidity
- temperature extremes
- atmospheric pollutants

- improper care and handling

2. *What is the best relative humidity and temperature for my metal objects?*

Keep relative humidity in metal collections as low as possible. Steels will not rust and brass will not tarnish below 15% RH. This is not a practical solution for metal objects in the historic furnished structure, but it may be for objects in storage cabinets or exhibit cases. Ambient temperatures between 60° and 75°F are appropriate for most metals. To inhibit active corrosion in salt air environments, metals should be housed in spaces with relative humidity levels no greater than 35%.

It is generally a good idea to avoid low temperatures for most metal objects. Low temperatures usually result in higher levels of relative humidity and the possibility of condensation on metal surfaces.

3. *Should I be concerned about atmospheric pollution?*

Yes, many forms of air pollution are corrosive. Polluted urban air and coastal environments are among the more severe areas. Dirt and dust may contain chemical compounds that will react with metals or trap moisture close to the metal surface. Sulfur and sulfur compounds are probably the strongest tarnishing agents. Sulfur is present in the air from burning of fossil fuels and is generated from products such as foam rubber, carpet padding, paints, wool, and felt.

4. *Does cleaning contribute to deterioration?*

Cleaning and polishing remove original metal. Over-cleaning often results from a desire to have metals bright and shiny, especially brass and silver objects on display in a historic furnished structure. Intense treatment often results in the loss of information from the object. In addition, metal cleaners may leave harmful chemical residues that can generate further corrosion.

D. Proper Handling and Storage of Metal Objects

1. *What do I need to know about handling metal objects?*

All of the general rules for safe handling of three dimensional museum objects apply to metal objects. Refer to Chapter 6: Handling, Packing, and Shipping, for general guidance on handling museum objects. Two special concerns for metals are the weight of the object and skin contact with bare metal surfaces.

- Metal objects can be heavy. The inadvertent placement of a heavy metal object on another object or on a period piece of furniture may result in dents, scratches, or staining.

- Transport heavy metal objects on carts or dollies.

- Most metal objects should not be handled with bare hands. Salts and oils from your skin can etch metals and may even cause permanent damage.

- Always wear clean cotton, latex, or synthetic rubber gloves when handling metal objects. Avoid cotton gloves if the decorative surface is friable. Avoid cotton gloves with polyvinyl chloride (PVC) nubs when handling metal objects. PVC residues from the nubs may cause oxidation or tarnish. Synthetic rubber gloves are not recommended for handling silver or copper alloys because some brands contain high proportions of sulfur and chlorides.

See caution in B10 on handling corroded lead objects

2. *Can I use a jeweler's cloth after handling uncoated metal objects?*

Yes. A jeweler's cloth can be used to wipe or buff away fingerprints on uncoated gold, silver, copper alloys, and highly polished steels, if an uncoated metal object is inadvertently touched. Select cloths that contain no abrasive, and rely instead, on the stiffness of the weave for their polishing effect. Any clean, soft cloth may be used to buff an object after handling.

3. *How should I store my metal objects?*

Follow these guidelines:

- To the extent possible, house metal objects indoors to reduce exposure to rain and temperature extremes.
- If possible, keep all metal objects together. Further isolation can be made according to metal type, object size, and object type.
- Never store metal objects directly on the floor or in close proximity to exterior walls. Avoid storing metal objects in attics and basements.
- Metals are normally immune to biological attack; however, the droppings of pigeons, mice, and even insects will cause pitting and corroding of a metal object's surface.
- Keep metals away from hygroscopic materials such as paper, textiles, and wood.

4. *What kind of shelving and cabinetry should I use?*

Follow these guidelines:

- Steel shelving is preferred over wood shelving because it is stronger and it does not emit harmful vapors. Line shelves with an inert, nonabsorbent material such as expanded polyethylene.
- The standard museum specimen cabinet provides excellent storage for metal objects. Depending on degree of seal, some of the newer museum storage cabinets can be used to create microenvironments using silica gel to control RH.
- For heavy metal objects such as cannon tubes and sculpture, polyethylene plastic pallets are available to prevent contact with the ground or floor.
- Loosely drape clear polyethylene over shelves to protect metal objects from water leaks and dust.

5. *What additional protection do metals need in storage?*

You may need to use microclimates to protect some collections. Consult with a conservator to determine which collections are most vulnerable. A conservator may recommend:

- ***Activated charcoal paper:*** Activated charcoal absorbs air pollutants.
- ***Silica gel:*** Silica gel can be used to reduce and to buffer the relative humidity of an enclosed space. The bags must be monitored and reconditioned as necessary. See *COG* 1/8, "Using Silica Gel in Microenvironments."
- ***Vapor phase inhibitors:*** These materials release a vapor that inhibits corrosion. **Note**: Many vapor phase inhibitors are toxic.
- ***Clear plastic boxes & bags:*** Various plastic boxes and bags can be used to create microenvironments and allow conditions to be monitored inside.

E. Exhibiting Metal Objects

1. *What do I need to consider when planning an exhibit?*

Conditions within the exhibit space are usually more subject to change than those in the storage space. This is especially true for historic furnished structures. The goal is to create an exhibit environment that is just as safe and controlled as possible. All of the general rules for safe display of three-dimensional objects apply to metal objects. Refer to the *Museum Handbook,* Part III, Chapter 7: Using Collections in Exhibits, and NPS *Exhibit Conservation Guidelines*, available from the Harpers Ferry Center.

2. *Are there any particular concerns for exhibiting metal objects?*

Consider the following:

- Cast and wrought iron objects are often exhibited in hearths, on mantles, or hung on the fireplace. Rainwater may enter through the flue, and brick and mortar will trap the moisture. In addition, chimneys are usually cold. All of these conditions promote condensation and corrosion.
- During seasonal transition periods, fluctuations of temperature and relative humidity can promote condensation and corrosion on metal objects.
- Frequent cleaning of exhibit areas may add moisture and potentially harmful vapors to the environment.
- Ensure that exhibit mounts are padded to prevent scratching

3. *Are there any specific situations that should be avoided when exhibiting metal objects?*

Follow these guidelines:

- Avoid leaving doors and windows open as gaseous and particulate pollutants can enter the exhibit area causing corrosion. This is a particular concern in urban areas.

- Avoid lighting fixtures such as fluorescent light ballasts or transformers that may generate ozone. Ozone will cause corrosion on metal surfaces.

- Avoid using hardwoods, such as oak, in exhibit cases because they can emit acidic vapors that corrode lead and silver.

- Avoid the use of adhesives, paints, woods, and textiles in exhibition cases and exhibition spaces unless they have been tested for off-gassing. See Chapter 4: Museum Collections Environment, for information on gaseous air pollutants and safe construction materials for exhibitions.

4. *What should I know about cleaning metal objects?*

Be aware that many proprietary cleaning products contain ammonia, weak acids or bases, solvents, waxes, and fats that may have an adverse effect on metal objects. Refer to Chapter 13: Museum Housekeeping, for additional information.

F. Conservation Treatment

1. *Why should I contact a conservator?*

All interventive treatment must be undertaken by a conservator trained to examine, analyze, stabilize, and treat objects. Conservators are trained in the treatment of specific materials. See Chapter 3: Preservation: Getting Started, and Chapter 8: Conservation Treatment, for information on choosing and contracting with a conservator. Be sure you check references and question the experience and background of any conservator you choose. Discuss any recommended treatments and be sure you understand what is planned and why it is necessary.

Only experienced conservators who agree to follow the AIC Code of Ethics and Guidelines for Practice should be allowed to treat NPS museum objects.

2. *What might a conservator be able to tell me about my metal object upon examination?*

When conservators examine metal objects they can tell you a number of things, including:

- the type of metal

- the type and source of any corrosion product

- the range of possible conservation treatments

3. *Should protective coatings be applied to metals?*

Protective coatings are often applied to metal objects to prevent or reduce the possibility of corrosion from high humidity, frequent handling, atmospheric pollution, and to reduce the need for aggressive cleaning such as polishing.

4. *Who should clean and apply coatings to metal objects?*

All metal objects are best left **untreated** until an objects conservator has had an opportunity to examine them. Cleaning involves the risk of over-cleaning, exposure to hazardous solvents and chemicals, and the consequence of higher corrosion rates on freshly exposed metal surfaces.

A conservator should specify the most appropriate coating for an object and determine who best can apply the coating. With appropriate training by a conservator, collections management staff can be trained to coat metals with wax. The scope of treatment may be expanded to include other barrier coatings or corrosion inhibitors. This type of treatment is especially good for objects stored or exhibited outdoors.

5. *What are some common metal coatings?*

The most common metal coatings are:

- waxes
- lacquers
- corrosion inhibitors

Some preventive conservation measures for metal objects require hands-on methods. Preventive measures should mitigate frequent handling of the object, be easy to apply and to remove, and be safe for both the object and the person applying the material. Wax is an example of such a material.

Before applying any surface coating it is very important to properly identify the metal surface. Ask an objects conservator to conduct a Collection Condition Survey that includes current condition and provides information about routine maintenance.

- **Waxes.** Waxes are easy to apply, relatively safe and easy to remove, and provide reasonably long-term protection to the metal surface.
  - Waxes may be natural or synthetic.
  - The metal object should be polished, washed, thoroughly dried, and buffed before waxing.
  - Most waxes suitable for use in an exhibit space can be applied at room temperature.
  - Be aware that waxes will collect dust, are a food source for some molds and fungi, and may blanche or turn white.
  - Avoid natural waxes such as bees wax, which may be acidic. Use instead manufactured microcrystalline waxes as specified by a conservator.
- **Lacquers.** Lacquers, like waxes, can be natural or synthetic. Generally, synthetic lacquers and waxes are considered to be more stable than those derived from natural products. The objections to protective lacquer coatings are not well founded. A common objection is that lacquers make a metal object look "plastic." Matting agents are available if necessary. Considering the difference in wear caused by frequent polishing or less frequent waxing, the lacquer finish provides the toughest and the longest lasting protection.
  - Lacquers are more difficult to apply and to remove than waxes.

- Lacquers are harder than waxes and will usually last for five to ten years before reapplication is necessary.

- Certain solvents used in lacquers, such as toluene or xylene, pose health hazards. An objects conservator should be consulted and asked to apply the lacquer coating or to train the staff in the use of these materials.

- Lacquers when properly applied will not adversely affect the appearance of an object.

- **Corrosion Inhibitors.** Corrosion inhibitors react with the surface of a metal object to prevent corrosion. Some corrosion inhibitors are available commercially and others can be obtained from chemical supply houses. They also may be incorporated into waxes and resins. This provides an additional degree of protection should the wax or resin be scratched. Most corrosion inhibitors are metal specific.

  Keep in mind that corrosion inhibitors are not fool proof. Any metal treated with an inhibitor is still subject to corrosion at or above the critical relative humidity for that metal. For that reason, coatings, inhibitors and environmental quality should be considered an integrated system requiring ongoing maintenance.

CAUTION! Many corrosion inhibitors are toxic.

G. Emergency Procedures For Metal Objects

Metals are very reactive materials. In an emergency situation, corrosion can cause irreversible damage to inorganic materials, complicating their salvage. If the metal object has survived a fire and the deluge of water, a flood, or a storm, the first course of action is to isolate it from other materials.

Be sure to:

- Implement security precautions for precious metals and objects of intrinsic value such as metal sculpture.

- Provide a secure dry storage area for all metal objects.

- Have an objects conservator prepare a Collection Condition Survey that documents each object's condition, recommends needed conservation treatment, and outlines remedial preventive conservation procedures.

- Rinse, sponge, and blot metal objects. Air dry.

- If the object has an applied finish, do not clean it. Air dry. Keep flaking surfaces horizontal.

Refer to Chapter 10: Emergency Planning, for information about planning for emergencies and minimizing damage.

In an emergency situation, do not attempt to perform interventive treatments on metal objects.

H. Special Considerations for Archeological Metal Objects

Considerations for the care and conservation of archeological metals are considerably different than for historic metals. Care of archeological metals is discussed in Appendix I.

I. Glossary

Abrasion: the wearing, grinding, or rubbing away of surface material by friction, usually through the action of particulate matter (e.g., sand) or as a result of rubbing by people, animals, or plants

Accretion: the accumulation of extraneous materials on the surface of an artifact, sculpture, or monument. It may include core materials, deposition of insoluble salts, or even the heavy accumulation of dirt, grime, pollutants, or bird droppings.

Acid deposition: the deposition of acidic constituents onto a surface. This occurs not only by precipitation, but also by the deposition of atmospheric particulate matter and the incorporation of soluble gases.

Acid precipitation: rain, snowfall, or atmospheric moisture below pH 7

Alloy: metallic material composed of two or more elements intimately mixed

Amalgam gilding: a process for applying gold to the surface of another metal, usually a copper or silver alloy, by forming a paste of mercury and gold

Annealing: a process of heating and cooling sheet metal, which has become work-hardened by hammering, spinning, or stamping, in order to relieve stress and to return the metal to a malleable state

Anode: the positive electrode of an electrolytic cell at which oxidation is the principal reaction. Electrons flow away from the anode. Usually the anode is where corrosion occurs and metal ions enter solution.

Bimetallic corrosion: corrosion resulting from dissimilar metal contact; galvanic corrosion

Brazing: a method of joining nonferrous metals using a nonferrous alloy that melts at a lower temperature than that of the metals to be joined. Brazing is similar to soldering; the distinction being that soldering is accomplished at temperatures below 800°F, and brazing is done above 800°F.

Bronze: an alloy of copper and tin and sometimes other elements

Bronze disease: copper corrosion in which chloride is the primary corrosive agent. It is rare, but may develop on archeological specimens or objects that have been recovered from the sea.

Burnish: a method to smooth rough surfaces of a metal by rubbing a hard stone or highly polished, harder metal over the surface

Casting: an object created by pouring molten metal into a mold

Cathode: the negative electrode of an electrolytic cell. Electrons flow toward the cathode in the external circuit. Corrosion does not occur at the cathode (see Anode).

Chasing: a metal finishing technique intended to sharpen or add detail on an object. For sculpture, the term is expanded to include all finishing techniques.

Checking: surface cracking in a checkerboard-like pattern often associated with the degradation of a protective coating

Chemical conversion coating: a protective or decorative nonmetallic coating created by treating the metal with an acidic or basic compound. Examples are coatings on iron produced by tannic or phosphoric acid.

Coating: a protective barrier, usually a synthetic resin or a wax, applied to a metal surface

Corrosion: the electrochemical degradation of a metal, due primarily to the loss of electrons and the recombination of metal ions with other electro-negative elements such as oxygen, carbon, sulfur, chloride, and nitrogen

Critical humidity: the relative humidity above which atmospheric corrosion rates of some metals increase sharply

Electrolytic cleaning (electrolytic reduction, electrolysis): a powerful method of cleaning metals used particularly if they are heavily corroded or salt contaminated. An object is wired to a low voltage direct current and is suspended between metal plates in a conductive solution.

Electroplating: the deposition of a metal from a solution of one of its salts onto a metal surface using an electrical current

Electrotyping: a process identical to electroplating. Electrotyping is used to build up thick metallic deposits on the interior of nonmetallic molds. It might be thought of as an electrolytic form of casting.

Embossing: raising a design in relief on a surface

Engraving: a decorative technique in which metal is removed by cutting into the surface with gravers

Etching**:** the production of patterns on a surface by the use of a corrosive chemical agent

Ferrous metals: composed of iron as the dominant metal

Filigree: decoration by means of thin, twisted wire soldered together into an openwork structure

Finishing: cleaning, polishing, patinating, and coating metal

Flux: a substance applied to metals being welded, soldered, or brazed to improve flow

Forging: shaping metal, usually steel and iron, by hammering while the metal is hot

Galvanic corrosion: accelerated corrosion of a metal because of an electrical contact with a more noble metal

Gild: to overlay with a thin covering of gold

Glass bead peening: dry blasting of a surface with glass microspheres

Graver: a chisel-like tool used for engraving metal surfaces

Inclusions: particles of impurities, such as mold materials, ferrous metal, or slag

Incralac: synthetic resin that contains the copper corrosion inhibitor, benzotriazole

Intergranular corrosion: preferential corrosion at, or adjacent to the grain boundaries of a metal or alloy

Inhibitor: a chemical substance that prevents or reduces metallic corrosion

Lacquer: an organic resin coating. The resin may contain matting agents or corrosion inhibitors. Some historic resins were pigmented.

Lost wax casting: a casting technique that utilizes a wax model or pattern. A refractory mold material is used to cover the wax pattern. The mold is later heated, the wax melts, and molten metal is poured into the resulting hollow.

Machining: shaping of metal with machines such as the lathe, planer, milling machine, drill press, and grinder

Metals: elements or mixtures of elements that possess high electrical conductivity and a lustrous appearance in the solid state

Mold**:** a form containing a refractory void (mold cavity) into which molten metal is poured during casting

Nonferrous metals: not composed of iron

Passive: the state of a metal surface characterized by low corrosion rates

Patina: a colored layer on the surface of a metal. This term is usually, but not always applied to copper alloys. The layer may be naturally occurring or artificially produced.

Planishing: a forming technique utilizing stakes and highly polished hammers to shape sheet metal

Plating: a thin layer of metal deposited on the surface of another metal

Raising: forming a hollow shape in metal by hammering on the outside surface over a dome headed stake or anvil

Repoussé: a technique whereby hammering from the inside produces raised areas on the outside of a sheet metal object

Rust**:** a corrosion product consisting of hydrated iron oxide. This term is properly applied only to ferrous alloys.

Sand casting**:** a casting technique that uses sand or sandstone as the refractory mold material

Sandstone casting: a casting technique that uses sandstone as the refractory mold material

Soldering: the use of alloys that flow at low temperatures to join two or more metal parts having higher melting points

Spinning: a metal forming technique in which sheet metal is rolled over a form on a lathe

Stamping: impressing a design into sheet metal with a metal die

Steel: an alloy of iron and carbon, with a carbon content between 0.15 and 2.0%

Stress-corrosion cracking: a cracking process that requires the simultaneous action of a corrosive agent and sustained tensile stress

Tarnish: discoloration of a bright metal surface by a thin film of corrosion products

***Tinning*:** covering a metal surface with tin

Tin Pest, Tin Disease: deterioration of tin caused by changes in the crystal structure at low temperatures (below 56°F)

Welding: joining two pieces of metal at a temperature close to their fusion point

J. Web Resources

American Institute for Conservation Disaster Recovery Page: <http://palimpsest. stanford.edu/aic/disaster/>.

Conservation OnLine, Resources for Conservation Professionals: <http://palimpsest.stanford.edu>.

Conserve O Gram Leaflets: <http://www.cr.nps.gov/museum/publications/index.htm>.

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Appendix P: Curatorial Care of Ceramic, Glass, and Stone Objects

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Figures

APPENDIX P: CURATORIAL CARE OF CERAMIC, GLASS, AND STONE OBJECTS

A. Overview

This chapter is an overview of three common materials found in many museums:

- ***ceramics***
- ***glass***
- ***stone***

These are all hard, yet brittle and fragile materials that have been used since ancient times. Objects made of ceramic, glass, or stone can be both decorative and practical. They can be as tiny as a bead or as large as an outdoor sculpture, but all these objects share some basic properties in common. To properly care for the ceramic, glass, and stone objects in your collection you need to understand their properties and how they can deteriorate. This appendix will address:

- how ceramic, glass, and stone objects are made
- common deterioration problems
- preventive conservation in caring for these objects
- storage
- basic treatment issues
- specialized procedures for packing and shipping
- basic procedures to limit damage after a disaster

For information on the particular needs of glass plate negatives and transparencies see *Conserve O Gram* 14/5, Caring for Photographs: Special Formats.

B. The Nature of Ceramic Objects

1. *How are ceramic objects made?*

Ceramic objects are made up of a mixture of natural materials that are combined, formed into shape by a variety of processes, and transformed by heat to create a solid, brittle substance not found in nature. Different firing temperatures produce objects with a vast range of hardness and porosity.

Most clay objects are a mixture of materials:

- Clay is a fine-grained mineral--the smallest particles produced by the weathering of certain rocks. Because of the shape and size of the small plate-like clay crystals, bulk clay is plastic when mixed with water. When heated to a high temperature it chemically and physically changes to a hard, brittle material.

- Adding fluxes such as soda, mica, potash, magnesia, or lime lowers the firing temperature of clay. These fluxes may also be found in natural clay deposits.

- Non-plastic additives (temper) are added to clay to reduce shrinkage and cracking during firing and drying. Temper also increases porosity in the finished object.

These basic materials are mixed together by the potter to produce a heterogeneous plastic mass that is then formed into the ceramic object.

2. *How are ceramics fired?*

A kiln is used to fire ceramics to change the physical and chemical structure and fuse it into a rock-like material. Kilns can vary from simple piles of fuel to complex multi-storied structures. However, all kilns work using the same basic principle. Each kiln is designed to:

- house the objects

- control the amount and duration of oxygen and heat

- hold the level of heat surrounding the object

The process of drying and firing is a series of controlled steps. After the object is formed it must be slowly air-dried. Much of the water (up to 25% of prepared clay) evaporates as the object dries. If the air-drying process is not done carefully, you may see shrinkage cracks in the object. After a day or two of drying objects to a "leather-hard" state, ceramics will maintain their shape, but the surface can still be easily worked. Often the potter will do final finishing, smoothing, polishing, and painting at this point. By the time air-drying has finished, most of the free water between the clay particles has evaporated.

Objects may undergo a single firing or multiple firings. Many archeological ceramics are fired a single time at temperatures ranging from 800-1400ºC. Potters may apply glazes to an air-dried object so that glaze and body vitrify together in a single firing. This process is known as "through firing." However, most glazed objects undergo multiple firings. First, the potter does a "bisque" firing by heating the object to about 600ºC to strengthen the object. The glaze is then applied to the cooled bisqueware. It is then returned to the kiln and fired again, this time to a higher temperature (above 800ºC) so that vitrification of the glaze and ceramic occur.

If overglaze decoration, gilding, decals, or enamels are used to decorate the surface, an additional low-temperature (600-900ºC) firing may take place.

3. *What does firing do?*

After clay objects are formed, they are heated to high temperatures or "fired." This action causes chemical changes to the clay. After firing, objects take on hard, brittle characteristics and don't lose these properties when wet. Different processes occur at different temperatures in the firing process. The firing process proceeds through a number of steps:

(1) Added vegetal matter burns off (200-600°C).

(2) Clay decomposition begins as water is lost from the structure (400-700°C).

(3) Carbon and sulfur are burned out (700-900°C).

(4) Sintering occurs as the heat is raised and particles in the ceramic object begin to join together at points of contact. Sintering gives cohesive strength to low-fired ceramics.

(5) Vitrification takes place at higher temperatures (depending on the mixture of clay and fluxes). During vitrification, melted particles flow together and the object as a whole will shrink. Vitrified ceramics are non-porous; not all ceramics are completely vitrified.

Ceramics are loosely divided into four groups. These groups are based on their firing temperature, clay type, and physical characteristics:

- ***Adobe or mudbrick*** is an unfired clay mixture. This material is often used for building, but mudbrick objects, such as cuneiform tablets and sculpture, are often found in museum collections.

- ***Earthenware*** is a low-fired clay mixture. These objects are fired between about 950-1100ºC. At this low temperature sintering occurs but not vitrification. Earthenware is generally soft and scratches easily. It is often red in color from naturally occurring iron in the clay; brown, black, and yellow are also common colors. Earthenware has the following characteristics:

  – It is porous and will readily absorb water unless glazed.

  – The structure is often granular in appearance with numerous coarse particles.

  – There is a clear distinction between the ceramic body and any glaze layer.

- ***Stoneware*** is fired between 1100-1350ºC. Stoneware objects are partially vitrified. Common colors for stoneware are buff, brown, and gray. Stoneware has the following characteristics:

  – It is partially vitrified and less porous than earthenware.

  – It is harder and denser than earthenware and does not scratch easily.

  – If tapped lightly, the body will give a distinctive ring.

  – The glaze and body are tightly adhered.

- ***Porcelain*** is fired at very high temperatures, usually above 1300ºC. Porcelain is made of a special clay called kaolin. This clay is difficult to work and must be fired under precise conditions. Porcelain can be formed into objects with thin, complex structures. Porcelain has the following characteristics:

  – The body is completely vitrified and impervious to water (non-porous).

  – The clay body is white and translucent and extremely hard and brittle.

  – When tapped lightly, the object rings with a higher tone than stoneware.

  – In cross-section, glaze and body are nearly indistinguishable.

4. *What surface treatments are used for ceramics?*

Potters frequently add materials to the surface of the ceramic body both to decorate it and to make it less porous. These materials are either fired on or applied after firing. Fired-on materials are usually more stable. These materials include:

- ***Glazes:*** These are vitrified surface coatings that vary widely in appearance and can be divided into three categories:

  – ***Lead glazes*** are made of the mineral lead oxide, mixed with other materials. Lead oxide melts at a low temperature. Lead glazes characteristically produce smooth, glassy surfaces, but can be easily scratched. Lead glazes can be a health hazard. Weak acids found in foods such as tomatoes, vinegar, and fruit juice can dissolve the glaze, releasing lead that can be ingested. However, if glass powder (frit) is added to the glaze using proper techniques, these glazes are non-toxic.

  – ***Alkaline glazes*** contain alkali fluxes such as sodium, lithium, or potassium. They are also fired at low temperatures. Alkaline glazes usually have brilliant colors and may craze or crawl. They are not very durable and scratch easily. If not adequately fritted, they can remain slightly soluble after firing.

  – ***High-fire glazes*** are primarily feldspar and are used on stoneware and porcelain. These glazes are glass-like and form a hard, smooth, and durable surface. The colors produced are generally more subdued than in low-fire alkaline and lead glazes.

- ***Slip or engobe***: A slip or engobe is a thin layer of colored clay that the potter applies on the surface before the first firing. It generally appears matte (not shiny like most glazes), but may be burnished to get a smooth lustrous look. A potter may also use a brush to apply decorative elements over the slip.

- ***Underglaze***: Underglaze painting is generally used to add fine detail. The potter paints these decorative touches onto the surface of ceramics after the first firing (bisqueware) (see Section B.5) and then applies a protective transparent glaze.

- ***Overglaze***: Overglaze is used to provide additional decoration to the surface. The potter can apply overglaze decoration in two ways. In one technique, the artist will brush details onto a background of unfired clay and fire the glaze and overglaze at the same time. In the other, two-step technique, the artist applies the overglaze after the glaze has been fired and fires the piece again at a low temperature. Objects produced with the second technique are not as durable as higher-fired glazes.

- ***Other materials***: Potters may apply other coatings or materials to ceramics, such as gesso, resins and waxes, or powdered minerals. These coatings are applied for a variety of decorative and functional reasons.

5. *How are ceramics formed?*

Potters will use one or more of these techniques to produce ceramic objects.

- ***Hand-built ceramics:*** These are crafted using the oldest methods of producing ceramics. Potters roll out flat slabs of clay and assemble a form by pressing the slabs together or they may pinch and manipulate a ball of clay into a small object. They can form coil-built vessels by first shaping long ropes of clay, coiling them into a basic shape and then pinching and shaping the coils into the final form.

- ***Wheel-thrown ceramics:*** The potter shapes the vessel on a rotating wheel. You can often identify these pieces by looking for a flat base with concentric striations on the surface. Vessels are sometimes coil-built and then finished on a wheel.

- ***Mold-pressed ceramics:*** These are made by pressing a slab of clay into an open mold. This technique is often used for shallow shapes (like plates) that are difficult to throw on a wheel.

- ***Slip-cast ceramics:*** This method is often used for delicate porcelain objects. The potter pours a slurry of clay into an absorbant plaster or ceramic mold. The water is drawn from the slurry leaving thickened clay behind. Delicate and complex objects can be made with this method.

6. *What flaws might I find in ceramic objects?*

It is important to recognize the flaws that may occur during the manufacturing process so you can separate flaws from damage or active deterioration.

- ***Ceramic body flaws:***

  – *Warping* may result from uneven heating or cooling during firing.

  – *Spalling* or *delamination* of parts of the clay body can result if the firing temperature is not high enough.

  – *Sagging* is caused by firing at a temperature that is too high for the clay body.

  – *Cracking* will occur if the object is cooled too quickly.

- *Bloating* occurs when heating is too rapid. The gases that are formed during firing don't have enough time to be released and are trapped in the body.

- ***Glaze flaws:***

  - *Crazing* is a fine network of cracks on the surface of the glaze. Crazing results when the glaze is under tension because it has contracted more than the clay body during cooling. It may develop immediately or sometime after firing. Overtiring or rapid cooling can also cause crazing. It is sometimes used as a decorative technique.

  - *Shivering* results when the glaze shrinks less than the clay body. The glaze may peel or flake off the surface.

  - *Crawling* describes the shrinking of the glaze into islands, revealing bare areas of clay. The defect occurs when glaze is applied over a dirty or greasy clay surface and does not adhere properly during firing. Potters may purposely leave areas unglazed.

  - *Pitting* in the glaze can vary in size from pinholes to larger spots. Pits occur when firing temperature is raised and lowered too quickly and volatile materials don't fully escape before the glaze solidifies. Pits may also occur if a vessel is fired at too high a temperature causing the glaze to boil.

  - *Blistering* results when air is trapped between the glaze and the clay body. These surface bumps are easily crushed. This problem often occurs when glaze is applied too thickly.

C. The Nature of Glass Objects

Glass has been used for personal adornment, containers, construction materials, and a host of other purposes throughout the last four millennia. In order to understand how to preserve glass objects, you must understand how they are produced.

1. *What materials make up the structure of glass objects?*

The basic materials of glass are silica and alkaline oxide (also known as flux). Silica generally comes from sand or crushed flint. The flux interacts with the silica and lowers the melting temperature. Typical fluxes include lead, calcium, potassium, and sodium oxides. Other oxides (iron, copper, cobalt, manganese, chromium and nickel) are added as colorants. When melted, this mix of materials flows readily to form various shapes.

Glass is a unique material—a rigid liquid. A liquid is an amorphous material that does not have an organized, crystalline structure. Most materials, such as metals, form a crystalline lattice as they cool from a liquid to a solid state. Molten glass, however, cools too quickly for this structure to form. The structure is "frozen" into a random network of molecules. Glass is rigid and brittle at room temperature. Depending on the materials included in the mix, it can be transparent, translucent, or opaque.

Glazes and enamels are also glasses with small differences in composition from bulk glass. Glazes are applied to ceramics; enamels are usually applied to a metal support. Glazes and enamels are generally opaque and fired at lower temperatures than glass.

Both hot- and cold-working techniques are used to make glass objects. Generally, the artist forms the object using hot-working techniques. Cold working techniques are used to embellish the surface.

2. *What are the hot shaping processes?*

There are six hot-shaping processes:

- ***Mouth blowing*** begins by gathering a lump of molten glass at the end of a hollow pipe. The worker blows air into the pipe by mouth or with a bellows (which may be automated). Metal tools such as shears or rods are used to help shape the object. Glass can also be blown into a metal, stone, or wooden mold. A mold-blown object may be further hot-worked after it is removed from the mold.

- ***Glass pressing*** is a technique in which molten glass is pressed into a mold with a metal tool. The technology for this method developed in the 19th century and made glassware widely available.

  You can sometimes identify pressed and molded glass by mold lines, though these lines are often ground and polished away.

- ***Core dipping or winding*** is the oldest technique used in making glass vessels. A core of organic material (for example, dung or straw) is mounded onto the end of a rod and coated with sand or clay. This core is dipped into molten glass or wrapped with coils of glass. To produce a consistent structure the glass is heated and rolled over a smooth surface. The core is removed after the glass has cooled.

- ***Pâte de verre*** means literally glass paste. Glass is ground to a powder and mixed with an organic adhesive so it can be molded or modeled much like pottery. After forming, the object is fired to burn away the organic adhesive and to fuse the glass paste. The resulting glass is usually opaque.

- ***Lost wax casting*** is a technique in which a wax model is created, covered with clay, and fired to melt out the wax. Molten glass is poured into the void left behind.

- ***Millefiore*** glass is produced when different colored rods of glass are wrapped with layers of colored glass and heated. The package of glass is rolled on a textured surface to work together and shape the layers. Each thick rod is then cut into short lengths that show a floral design in cross section. These lengths are then used to form objects.

Decorative details can be added to molten glass by fusing colored glass onto the surface of the object or by integrating glass threads or shapes into the body and then reheating.

3. *What cold-working techniques are used to decorate glass?*

Commonly used cold-working techniques used to decorate a glass object after it has cooled include:

- cutting or engraving the glass with a sharp point or cutting wheel
- chipping away the glass inside an engraved design outline
- acid etching a design in the glass (The glass surface is coated with wax and a design is cut through the wax. The piece is then dipped into hydrofluoric acid to etch the exposed glass. This technique has been used since the 19th century to decorate glassware.)

The final step with all these techniques is to polish away surface roughness and imperfections.

4. *What flaws might I find in glass objects?*

Flaws can be introduced during the manufacturing process. Learn to distinguish these flaws from active deterioration problems. Look for:

- ***Bubbles:*** They may also be added intentionally for decorative effect. A few isolated bubbles will not weaken a glass object, however, a cluster of bubbles might. The shape of the bubbles gives clues to the direction that the object was worked in the molten state.
- ***Inclusions or foreign bodies:*** These are more noticeable in translucent glass. Often these flecks come from contamination in the crucible or impurities in the raw materials. Small inclusions may disrupt the surface and look of an object, but they will not affect its strength.
- ***Compositional flaws:*** Sometimes these are not apparent for many years. The symptoms of deterioration from compositional problems are covered in Section E, Agents of Deterioration.

D. The Nature of Stone Objects

Stone in museum collections is often perceived as a material with few problems, but stone is brittle and can break or shatter. While generally, harder and tougher than many other materials found in collections, the agents of deterioration also can affect the preservation of these materials. It reacts with the environment in a variety of ways. Understanding the origin and production of stone objects in your collection will help you identify problems.

1. *What materials make up the structure of stone objects?*

Geologists divide rock into three broad categories:

- ***Igneous rocks*** are formed when magma cools and solidifies. They are generally hard and very stable because of their interlocking crystalline structure. Types of igneous rocks are granite, basalt, obsidian, and porphyry.
- ***Sedimentary rocks*** are formed by the solidification or cementing together of layers of organic and mineral sediments. They are usually more permeable and deteriorate more easily than igneous rock. Examples include sandstone, limestone, alabaster, and travertine.

- ***Metamorphic rocks*** are formed by transformation of igneous or sedimentary rocks with pressure and heat. The structure depends on the parent rocks. For example, marble is metamorphosed from limestone.

The durability of stone depends on its porosity, permeability, hardness, mineral content, and number and type of inclusions. Porosity is the amount of free space in a rock; permeability is the capacity of a rock to allow fluids to pass through it.

2. *How are stone objects formed?*

Stone-working tools and techniques have changed little through time. Although metal tools have replaced stone and, more recently, electric power has speeded up some processes, modern artists use the same basic tools to carve stone. Workers use heavier and thicker tools for carving hard, igneous stones (for example, granite), than for softer limestone and marble. They must also temper steel tools used on hard stones, hardening them by heating, cooling, and slow warming.

The carver holds a carving tool in one hand and uses a hammer or mallet to strike the tool. Stone surfaces are often polished to remove tool marks, but sometimes you can find traces on back surfaces or inaccessible undercuts that can be used to identify techniques. Sculptors use six basic tools:

- ***Point (punch):*** After selecting a stone, the sculptor uses a point for roughing-out the shape from the block. The sculptor holds the point at an oblique angle to the stone surface and hits it with a hammer. Larger masses of stone are removed, progressing from larger to smaller diameter points.

- ***Tooth chisel (claw chisel):*** Following the initial roughing-out, the sculptor uses the tooth chisel to remove more layers of stone and further define the form. The tooth chisel is used primarily on limestone, sandstone, and marble. The sculptor will start with a coarse chisel with well-spaced teeth and progress to a fine chisel with closely spaced teeth. You can identify the tooth marks angled in different directions. Using this tool gives the stone a raked or combed appearance.

- ***Bushhammer:*** Sculptors use a bushhammer on hard stone such as granite. The bushhammer is a series of points or teeth in one head (multi-pick) used to wear down or pulverize a hard stone surface. As when working with a tooth chisel, the sculptor progresses from coarser to finer toothed bushhammers. The bushhammer gives the stone a pitted, granular appearance.

- ***Flat chisel:*** To remove the marks of the tooth chisel and bushhammer, the sculptor often uses a flat chisel. The sculptor holds the flat chisel almost parallel to the surface of the stone and cuts across to remove the rough surface material. On concave surfaces, a rounded chisel edge may be used. Sculptors sometimes use only a flat chisel when carving soft stones or producing low-relief carvings.

- ***Abrasives:*** Rasps, rifflers, and files are abrasive tools. They are used to do rough finishing. Mineral and stone abrasives such as sandstone, pumice, and carborundum (silicon carbide) are used for shaping and smoothing. Sculptors used emery cloth, solid tin oxide, and sandpaper for finishing the surface. Whiting (calcium carbonate) is used for final polishing. A sculptor may stop at any point in the surface finishing process depending on the desired look.

- ***Drills:*** To split stone the worker drills a series of holes along a stone face and then hammers wedges into the holes. You may see evidence of this technique as a line of parallel vertical marks left by the drill on the face of the stone.

3. *Will I see different techniques used on archeological stone objects?*

Flaking methods were used to produce the stone tools found in many archeological sites. Flint or chert and obsidian were used for tools because they flake easily and give a sharp edge when fractured. You can identify the fracture face by the conchoidal fracture, a series of concentric arcs radiating from the point of impact. You can identify the point of impact by the bulb of percussion, a swelling caused by the compression of the blow.

There are two basic methods for detaching a flake:

- ***percussion flaking***, where the core or parent block is struck with another stone

- ***pressure flaking***, where heavy pressure is applied with a stone, bone or wooden tool

Early stone tools were also drilled and abraded with sand, just like wood, bone, stone or early metal tools.

4. *What different tools and techniques are used on contemporary sculpture?*

Though the basic tools used for modern stone sculpture are the same as those used in the past, the addition of pneumatic equipment speeds the process and makes working stone less physically difficult. Wire saws, diamond saws, and flame cutters are now available to cut and roughly shape stone.

Pointing is a contemporary mechanical process used to duplicate an original model. A pointing machine, a movable instrument with adjustable rods, mechanically measures a number of points on the original and transfers these to the stone block. Holes are drilled into the stone to the point and depth measure with the pointing machine. The stone between the drilled holes is chiseled away. Finer pointing is employed as the reproduction progresses.

Other mechanical aids are also used to produce reduced or enlarged products from a model.

E. Deterioration of Ceramics, Glass, and Stone

You can find general information on the agents of deterioration that affect ceramics, glass, and stone in Chapter 3: Preservation: Getting Started, and Chapter 4: Museum Collections Environment.

The agents of deterioration that can have the most profound effect on ceramics, glass, and stone in museum collections are direct physical forces. If ceramic or glass objects are dropped, they usually break. Most stone will chip, crack, or break if dropped. Cumulative damage can occur with improper handling—pieces can be chipped off and residues left from handling. Some ceramic, glass, and stone objects also have flaws, either inherent or from their previous use, that make them vulnerable to heat or moisture.

1. *How do ceramics deteriorate?*

Besides the obvious problems of breakage, ceramics can be vulnerable to changes in temperature and relative humidity. In particular, archeological ceramics may contain "soluble salts" that can crystallize at or near the surface and destroy decoration or even the ceramic structure. See *Conserve O Gram* 6/5, Soluble Salts and Deterioration of Archeological Material. Other historical objects (for example, salt containers or pickling jars) that held contaminants can suffer similar damage.

Unstable glazes may become crizzled and crazed, deterioration problems common to glass and discussed in more detail below.

2. *How does glass deteriorate?*

Most damage to glass is mechanical. It is easily broken and chipped. Water is the major chemical agent of deterioration for glass and the susceptibility of glass to deterioration depends greatly on its original chemical structure. Some deterioration processes are caused by similar reactions, but have different visual characteristics. Be aware of the following deterioration types:

- ***Crizzling*** is a fine network of surface cracks that turn glass translucent. Moisture in the air reacts with unstable glass containing too little lime (calcium oxide). The moisture causes potassium and sodium in the glass structure to leach out. As the structure weakens, small cracks appear.

- ***Weeping*** is caused by leaching sodium or potassium absorbing water on the surface of deteriorating glass to form sodium or potassium hydroxide. These compounds accumulate on the surface of the glass and may give it a greasy feeling. The hydroxides may also react with carbon dioxide in the atmosphere to form carbonates, which can absorb even more water.

- ***Crusty or waxy deposits*** on the surface, which may have a white crystalline appearance, are typically seen on ethnographic beadwork and may be a reaction of the glass deterioration products to oils in adjacent leather.

- ***Iridescence*** is a rainbow-like effect on the glass surface and is an indication of deterioration. The colors are visible when light is diffracted between the air-filled layers of deteriorated glass.

- ***Devitrification*** is the production of small areas of crystal growth in the otherwise amorphous glass structure. These crystals may be intentionally produced during production as they give glass good thermal shock resistance. Unintentional devitrification is caused by unstable glass with too much alumina or too much calcium.

- ***Solarization***, a process that can cause some glass to turn purple or brown, is caused by exposure to sunlight over long periods of time. This deterioration can sometimes be seen in old window glass.

3. *How does stone deteriorate indoors?*

Stone is affected by agents of deterioration—especially when it is not well protected in storage or it is put on exhibit. You must be aware of how damage can occur and how you can protect stone.

- ***Dirt and dust*** accumulate on horizontal surfaces and in nooks and crannies in stone objects. It disfigures the object and over time the dirt can penetrate porous stone and cause staining. High traffic areas will have greater accumulation of dirt.

- ***Oils*** from repeated handling will also cause stains. This is typically seen on protrusions such as noses or knees on sculpture that are accessible to visitors.

- ***Old coatings of wax or oil and old adhesive repairs*** may also discolor over time. Staining will be most noticeable on light colored stones and may have a blotchy appearance.

- ***Relative humidity*** that is fluctuating or too high can also cause damage. Fluctuating humidity can bring salts to the surface and cause spalling. High humidity can react with pollutants and damage stone, just like in an outdoor environment**.**

- ***People*** can cause a lot of damage to stone objects indoors. Breakage and chipping from handling are obvious examples. Graffitti from vandals, paint drips and smears from careless maintenance, and damage from splashed cleaning fluids are other examples.

4. *How does stone deteriorate outdoors?*

Stone is often exhibited outdoors where it is not well protected from the agents of deterioration.

Water causes most of the damage to stone stored or exhibited outdoors. Water can penetrate between the layers in sedimentary rock and push them apart. Water carries salts, such as chlorides, into the stone and as these crystals dry they can damage the surface of the stone (see *Conserve O Gram* 6/5). During the winter, when water freezes, the expansion of the ice can cause cracking, splitting, and spalling. ***Corrosion*** of metal components that may be attached to the surface, mounted into the stone, or used as interior supports in some cases causes severe damage. Copper corrosion will produce green stains; rusting iron produces brown stains. As metal corrodes it expands. Expanding internal supports can crack apart the surrounding stone. Also be aware that some solutions used to clean mounted metals may stain the stone support.

Atmospheric pollutants can react with water and cause damage. Carbon dioxide and water form carbonic acid that can dissolve calcium carbonate, a major component in limestone and marble. Other sources of acid that attack stone come from the reaction of water with chlorides, nitrates, and sulfur. Other chemicals from car exhaust and industrial pollution react with carbonates to create disfiguring brown and black layers on the surface or simply adhere to stone and discolor the surface. Abrasive particles carried by the wind can wear away surface detail.

Biological agents such as bacteria, algae, fungi, and moss grow on stone surfaces and inside cracks pushing them further apart. These agents also retain water and contribute to the damage caused by water and atmospheric pollutants. Their organic waste products can dissolve calcium carbonate. Biological agents can also cause staining. Birds can disfigure and damage stone with their waste.

5. *Should I move stone objects indoors?*

The best way to protect stone objects stored outdoors is to move them inside. This action radically limits the agents of deterioration that will contact the objects. However, be aware that moving an object indoors is a major environmental change and you should carefully examine the object before moving it. Monitor the object after it is brought inside. Most objects will dry out when moved indoors. As water is lost from the interior, residues left by pollutants, biological matter, cleaning agents, and soluble salts may begin to crystallize on the surface. Where previously they were washed away by rain, they can now cause damage to the stone and may require treatment. Mold may grow on dirt and biological waste accumulated on the surface when it was outside.

F. Preventive Conservation

1. *What special handling rules for ceramic and glass objects should I know?*

Follow these special rules when handling ceramic and glass objects:

- Handle glass and ceramic objects as little as possible.

- Before handling, examine the object carefully. Note any unstable repairs, loose parts, lifting glaze, hairline cracks, or vulnerable appendages.

- Don't wear cotton gloves to handle glass or ceramics because the surfaces are slippery. Use clean, bare hands or snug fitting latex or nitrile gloves. In particular, use latex gloves for lustreware, iridescent glasses, and gilded ceramics and glass. The moisture, oils, and acids left from bare hands will disrupt and eventually etch these delicate surfaces.

- Don't lift objects by handles, knobs, rims, or decorative motifs. ***Always use both hands to support the object uniformly.***

- Transport ceramic and glass objects in a padded container. Don't stack objects. Don't allow objects to knock together. If you are moving numerous objects, use a well-balanced and padded cart with a lip at the edge of the surface. Use plenty of soft tissue or cloth diapers to prevent objects from rolling and tipping.

- Transport detachable parts such as lids or bases separately. If there are loose (but not removable parts), slip tissue or polyethylene foam between the parts to prevent rubbing or bouncing.

- Carry thin, flat objects, such as mirrors or panes of glass, vertically. This position distributes the weight and minimizes the chance of cracking the object. If the object is heavy, you may need to use a dolly or hand truck and assistance from other people. Be sure the dolly has soft wheels and all surfaces are cushioned.

- Never apply tape or sticky labels to ceramic or glass objects. When they are removed, delicate overglazes, decals, and gilding may be removed as well. Tape and labels will also leave residues on the surface of the objects that may cause staining or attract dust.

Refer to Chapter 6: Handling, Packing and Shipping Museum Objects, for basic rules on handling museum objects.

2. *What special handling rules for stone objects should I know?*

Follow these rules:

- Wash hands and wear clean, white gloves.
- Always take care when placing your hands on a surface. Paint, gold leaf, and delicately carved areas can be damaged. Previously repaired areas may not be stable.
- Always carry one item at a time and never lift by projecting parts such as arms, legs, or wings.
- Use a cart when moving an object more than a few feet or when moving more than one object. Use padding, wedges, and blankets to stabilize objects and prevent them from touching and abrading each other.
- You may need to use a forklift to move large, heavy stone sculpture. Be sure you have enough help when moving large objects. Make sure straps or chains that secure the object are well padded and cannot slip and scratch the surface. Cover and pad protruding parts. Make sure the object is properly supported on the forklift before putting your hands underneath the object.
- Be sure that equipment used around large stone objects (ladders, scaffolding, other maintenance equipment) is used carefully.

3. *What environmental parameters should I use for ceramic, glass, and stone objects?*

See Chapter 4: Museum Environment, for a discussion of how to set temperature and humidity ranges for your objects. In general, objects should be maintained in a stable temperature and relative humidity with no more than +/-5% variation in a day.

A few types of ceramic, glass, and stone objects will need special consideration when developing their museum environment because of deterioration problems.

- ***Deteriorating glass objects:*** Unstable, weeping and crizzling glass and glass that appears cloudy or iridescent or is suspected of being unstable for some other reason should be stored in a stable microenvironment. The humidity must be tightly controlled: too high and deterioration will progress; too low and cracking may occur. Contact a conservator for advice on how to prepare a microenvironment to store unstable glass. See *Conserve O Gram* 1/8, Using Silica Gel in Microenvironments, for information on using silica gel to buffer the environment.
- ***Archeological ceramics and stone:*** Archeological ceramics and stone may have absorbed soluble salts from burial. (See *Conserve O Gram* 6/5.) These objects must be stored at a low and stable relative humidity. If fluctuations occur, the salts can move through the porous ceramic structure and crystallize near the surface to cause damage.
- ***Composite objects:*** If ceramic, glass, or stone objects are combined with other materials, particularly organic materials, use the environmental parameters recommended for the organic materials. For example, keep stone objects framed in wood in an environment that will preserve the wood. Store polychrome sculpture in a stable environment to protect the painted surface.

4. *What light levels should I set for ceramics, glass, and stone?*

Visible or UV light will not damage most ceramics, glass, and stone. Light will not deteriorate inorganic materials. Infrared (IR), however, can cause damage, by heating objects and by causing changes in relative humidity around the object. These RH fluctuations can cause salts to crystallize out or cause slight expansion and contraction of surfaces. Keep light fixtures outside of exhibit cases. Don't use spotlights directly on objects. See Chapter 4: Museum Collections Environment, for a discussion of light and light levels.

5. *How should I store stable ceramic and glass objects?*

Choose storage solutions that will minimize handling and thus the chance of breakage. Design the storage area so that access is safe, simple, and direct. See Chapter 7: Museum Collections Storage, for more complete information on storage design and choosing cabinetry.

- Cabinets should be in a low traffic area in the storage room to reduce the chance that people will bump into them.

- Store ceramics and glass on stationary shelves to avoid damage from vibration. Line shelves with closed-cell polyethylene foam (Volara®). Attach the foam with double-stick tape so it will not bulge or slide.

- If possible, choose museum cabinets with clear glass doors to allow visual access without handling. Don't store other light sensitive objects in these cabinets. All cabinets should have gaskets and close tightly to minimize dust accumulation. See *Tools of the Trade* for information about storage cabinets. See also, *Conserve O Gram* 4/3, Installing the Retrofit Gasket Kit.

- If possible, choose shelves that are only deep enough to accommodate a single object. This limits the need to move one object to retrieve another. Place small objects in rows with ample space to reach one object without touching another.

- Store the heaviest objects on the bottom shelves.

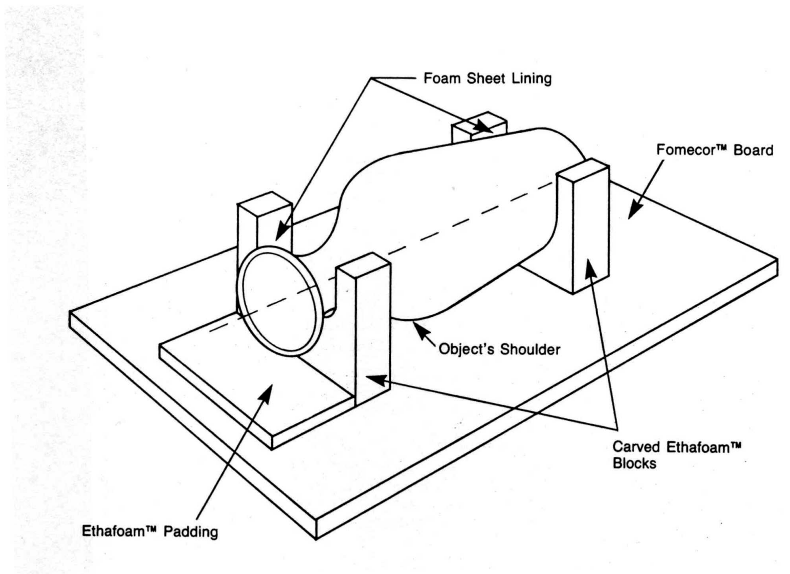
- Don't stack plates, cups, and bowls. If a critical lack of space requires stacking, place soft fabric, such as washed, white cotton flannel or polyethylene foam, between each object. Make sure the objects nest well and don't put pressure on each other.

- If objects are unsteady due to their shape or to damage, store them in a stable position using padding or foam blocks. See Figure P.1 for an illustration.

- Pieces of broken glass and ceramic objects should be kept together. Pad pieces so they don't abrade each other and keep them together in a tray or box.

- Use dust covers on open shelving. See *Conserve O Gram* 4/2, Dust Covers for Open Steel Shelving. If oversized objects must be stored in the open, they should be covered with a polyethylene bag or dust cover.

- Stabilize shelves by bolting them to walls and ceiling. Open shelving should have earthquake bars.



A top heavy or damaged object can be stored in an Ethafoam™ cradle. To make a cradle.

(a) Lay the object on its side, supported so it is level.

(b) Measure the curve of the base and the neck with a flexible drafting curve.

(c) Cut each curve into a 1" - 2" thick Ethafoam™ block. Use a long knife (e.g., bread knife) with a fine serrated edge. Thickness depends on the size of the object. The placement of the curve on the block should allow the shoulder of the object to touch, not rest heavily, on the mat. The foam blocks can be free standing or fixed to a Fomecor™ board so that each cradle is portable.

(d) Place padding or a thickness of Ethafoam™ underneath any projecting part of the object (such as the rim) as a barrier against bumping.

(e) Cut thin foam sheet for lining the cradle surfaces.

Figure P.1. Method of Stabilizing Objects in Storage

See *Conserve O Gram* 14/5, Caring for Photographs: Special Formats, for information on the special housing and storage needs of glass plate negatives and transparencies.

6. *Are there special storage concerns for unstable glass and ceramics?*

You may need to store unstable glass or ceramics in a microenvironment that keeps the relative humidity at a lower level than the general storage environment. Low RH slows the deterioration of weeping glass and ceramics with soluble salts.

Before taking this step, carefully discuss the need for this option and the design of your storage system with a conservator. Creating a microenvironment generally requires long-term maintenance, and if it fails, more harm may come to the objects than if you had done nothing.

You may create a closed microenvironment in:

- an individual container, such as a polyethylene box with a tight fitting lid (Rubbermaid®, Tupperware®)

- a fishtank with a plate glass top
- a single museum cabinet

Use silica gel buffered to 40% RH to control the microenvironment. See *Conserve O Gram* 1/8 for an explanation of how to buffer silica gel and how to figure the quantity of silica gel needed in your container.

Your storage system must isolate the object from the silica gel. ***Don't let the silica gel touch the object.*** Work with a conservator to develop the best storage system for your particular objects. You need to consider the following:

- How many objects do I need to store?
- What size are the objects?
- What shapes are the objects?
- How fragile are the structures of the objects?
- How fragile are the surfaces of the objects?

7. *What are the storage requirements for stone objects?*

Keep in mind the following points when developing a storage system for stone objects:

- Keep dust from the surface of stone objects. Dirt and dust can accumulate in the pores and darken the surface. Use individual polyethylene bags or muslin dust covers (see *Conserve O Gram* 4/2) to keep dust from settling on objects in storage.
- Keep objects away from open windows, air conditioning vents, and heat sources.
- Small objects, such as arrowheads and beads, should be stored in individual bags or boxes so that they are not easily lost.
- Large stone objects present problems because of their weight. Be sure your shelving units can support the weight of the object. Use polyester felt as a shelf liner for heavy stone objects because it will not compress as much over time as polyethylene foam.
- Store heavier objects on bottom shelves. This lowers the center of gravity and minimizes the danger of a rack toppling over.
- Don't allow any part of an object to protrude beyond the edge of shelving where it might be bumped.
- Don't store large sculptures directly on the floor. Create a low deck or use pallets at least four inches off the floor. Raising objects protects them from floor cleaning chemicals and minor flooding.

- Allow sufficient space between objects so that they can be easily moved and periodically inspected. Large objects especially need enough space so they can be handled without knocking other nearby objects. If heavy pieces are regularly moved, store them on dollies with lockable wheels.

- In earthquake prone areas, use earthquake stabilization techniques. Securely bolt shelves and cabinets to walls and floors. Attach restraining bars to the edges of shelves. Be sure overhead lights, pipes, and ductwork are also reinforced.

8. *What special preventive conservation concerns should I have for ceramic, glass, and stone objects on exhibit?*

Exhibiting an object puts it into contact with many more agents of deterioration. See *MH-III*, Chapter 7: Exhibits, for an overview of preservation concerns when objects are put on exhibit. *Exhibit Conservation Guidelines* by Toby Raphael is also a useful guide to incorporating preservation in your exhibit.

Work with a conservator and experienced designers and mountmakers to ensure exhibit techniques will not damage objects. Heed the following when designing a new exhibit or evaluating ways to improve your current exhibit.

- Make sure all objects are securely mounted so that they cannot fall if the case or pedestal is bumped. Construct mounts from stable materials and attach them so they don't put undue physical stress on the objects. Use seismic stabilization mounts in earthquake-prone areas.

- Don't direct spotlights on individual objects. Spotlighting can cause thermal shock as well as raise the interior temperature of the case.

- If sculpture is exhibited outside a case, be sure to provide a physical barrier so it cannot be touched. Use a pedestal or a deck to raise the objects up off the floor. Make the pedestal large enough that it cannot be easily ignored by visitors trying to reach the work of art.

- Busts and small stone objects must be securely mounted to prevent them from toppling over. A variety of techniques can be used to mount the object. Work with an experienced mountmaker and a conservator to design a safe mount.

- Don't plaster or cement stone reliefs directly into the wall. They will be difficult to remove later and moisture and salts from rising dampness can infiltrate the object from the wall.

- When cleaning objects on display, brush the dust off into a vacuum; don't use a cloth. See *Conserve O Gram* 8/1, Removing Dust from Ceramic and Glass Objects.

- If stone sculptures are exhibited outdoors, you should develop an annual monitoring program to watch for deterioration. Conduct a careful condition survey and document the sculpture with detailed photographs. Consider having a conservator conduct a Collection Condition Survey to give you baseline information and train staff in evaluating deterioration. If objects are deteriorating rapidly, they should be brought indoors. Consider putting a replica in place of the original. Refer to *MH-III*, Chapter 5: Three Dimensional Reproductions.

G. Care of Composite Ceramic and Glass Objects

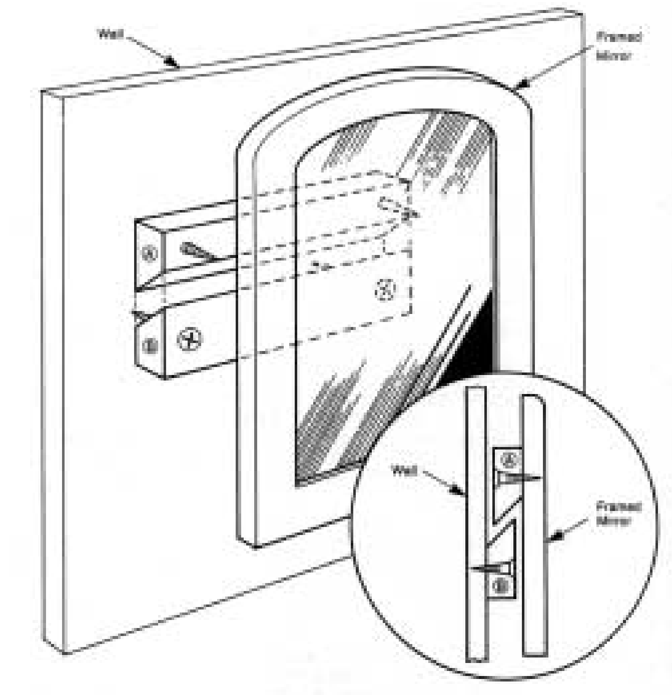
Composite objects are museum objects made of more than one material. These materials can react to the environment differently, setting up stresses that may cause the object to deteriorate more quickly than one made of a single material. Glass, in particular, was used in many types of composite objects and may be sewn or attached to a variety of materials. Be sure to take into account the preservation of all parts of the object. For example, never use water to clean glass beads sewn onto costumes. You may damage the attachment thread and the fabric or leather of the costume.

Two types of composite ceramic and glass objects that have special preservation concerns are:

- ***Mirrors:*** Look closely through the front of the glass to see if any silver-colored droplets or beads have formed on the back of the glass. Before the 19th century, mirrors were made reflective with a toxic mercury/tin amalgam. This coating can break down. Look for droplets collected at the bottom of the frame. Always wear disposable plastic gloves when handling mirrors you suspect may have a mercury coating. Contact a conservator to examine an unstable mirror.

  For all mirrors, examine the glass carefully. Do you see breaks or chips in the glass? Is the glass sticky (weeping glass), or does it have an overall network of very fine cracks (crizzling)? Is the coating on the back still reflective, or do you see black spots or streaks that indicate deterioration or peeling?

  Be sure the glass is securely attached to the frame and the frame is in good repair. Store heavy framed mirrors face up on well-padded shelves. Support the frame with padding. Make sure that all the weight is not resting on the mounting hardware or the glass.



To mount a heavy mirror:

(a) Place the mirror face down on a padded surface. Use additional padding in the flat and recessed areas to relieve any pressure on ornately carved areas.

(b) Measure the width across the back of the frame, approximately one-third down from the top.

(c) Locate a point on each side of the frame back into which the mounting board can be safely attached.

(d) Cut a rectangular clear pine board (e.g. 1" thick x 4" wide, though the actual dimensions depend upon the size and weight of the mirror) to the width of the frame back. Cut the board along the grain at a 45º angle to the edge. Paint all wood surfaces with one coat of two-component epoxy paint.

(e) Screw Part A into the back of the frame and Part B into the wall.

Figure P.2. Flush Mount for Hanging Heavy Mirrors

- ***Chandeliers:*** Look closely to identify parts that are fixed and parts that are free to move before cleaning or moving a chandelier. Ask the questions:

  – How secure are the hooks and joints?

  – Are there any missing prisms or other parts?

  Chandeliers on display in the open air, for example in historic houses, will need to be dusted occasionally. Use a scaffold or sturdy ladder to reach the chandelier so you can keep your hands free and safely move around the chandelier. Move furniture and other items on the floor away from the ladder. Dust prisms or moving parts individually so they don't knock into each other. Follow the instructions for dusting found in *Conserve O Gram* 8/1.

When a chandelier is not on view (for example, when a house is closed for the winter) or has been placed in storage, cover it with a muslin or polyethylene bag to keep it clean. Mark light switches or turn off the power at the fuse box so covered lights will not be turned on.

H. Treatment Issues for Ceramic, Glass and Stone Objects

The following section discusses particular considerations before any treatment is carried out either by park staff or a conservator. See Chapter 3: Preservation Getting Started, and Chapter 8: Conservation Treatment, for general information on working with a conservator. When you work with a conservator, you will need to make choices about the type of treatment that is appropriate for your objects.

If objects are not stored in closed cabinets, for example, on display in a historic house, trained museum staff should dust them. This basic maintenance will avoid the need for more difficult and more expensive cleaning in the future. Follow the instructions in *Conserve O Gram* 8/1, Removing Dust from Ceramic and Glass Objects.

1. *What should I consider before cleaning ceramic and glass objects?*

If objects are dirty enough to require washing, you should work with a conservator to develop a cleaning program. Before placing any ceramic or glass object in water, determine that:

- the ceramic is actually fired
- the glass or ceramic is intact
- there are no previous fills
- no surfaces are powdery, sticky, or crackled
- there are no stains that might migrate

If any of the above conditions is not met, don't wash the object.

2. *What should I consider before cleaning stone objects?*

Stone objects stored indoors should be regularly dusted. Don't wash stone objects. If stone objects are very dirty, get advice from a conservator. Don't use commercial cleaners without the advice of a conservator; many contain acids that can dissolve the stone. Problems that can occur with wet cleaning include:

- stains that move further into the stone, instead of washing out
- loss of polish on soluble stones such as alabaster
- movement of soluble salts that then crystallize and damage the surface of the stone as it dries

3. *How can I tell if an object has been repaired?*

You may be able to identify repaired areas using one of the following methods:

- Examine the surface with a magnifying glass in good light to identify breaks.
- Examine the surface with a hand-held ultraviolet light to identify cracked glaze, fills, adhesive lines, or painted surfaces. Different materials will fluoresce differently and some will not fluoresce at all, allowing you to identify damage and repairs that may not be visible to the naked eye.
- Test different colored areas on the surface in inconspicuous areas with a slightly damp cotton swab to confirm that they are truly glazed.

4. *Should old repairs be removed?*

Work with a conservator to decide whether or not to treat a previously repaired object. A conservator can give you a variety of options for any project. Old repairs should be removed only if they are unstable or obscuring or damaging surface detail, and if they are not an important part of the history of an object. If a heavily repaired object is stable, there is no reason to remove all the old repairs and redo them. You may want to consider doing cosmetic cleanup and restoration if an object is going on exhibit.

5. *What should I discuss with the conservators before losses are filled?*

If there are losses in an object, you will need to discuss with the conservator whether or not they should be filled or replaced. For example, a porcelain vase may have small chips along break lines or even small pieces missing. A stone sculpture may have lost a piece or had it stolen by vandals. Take into account the following before a fill is carried out:

- Is the object stable without the fill?
- Is the loss unsightly?
- Do you know what the loss area looked like previously?
- Do you want the fill to match exactly or only be of similar tone?
- Are available fill materials stable or will they discolor quickly?

Different choices will be made based on the stability of the object and aesthetic desires. In general, fine and decorative art objects are restored to a higher level than archeological objects.

6. *When are objects consolidated?*

Conservators consolidate objects when they have lost cohesiveness in their structure. Examples of objects that might require consolidation include:

- delaminating glass
- ceramics that have been seriously damaged by soluble salts
- stone with a flaking surface

Different consolidants are used for different materials and for different problems. A conservator will evaluate the problem and recommend a specific material and a specific technique for application that will stabilize your object.

I. Packing and Shipping Glass, Ceramic, and Stone Objects

See Chapter 6: Handling, Packing, and Shipping Museum Objects, for general guidance on packing and shipping objects. Since ceramic, glass, and stone objects are all brittle, sufficient padding must be provided to cushion the object from any shock. Always use double boxing when packing and shipping these objects.

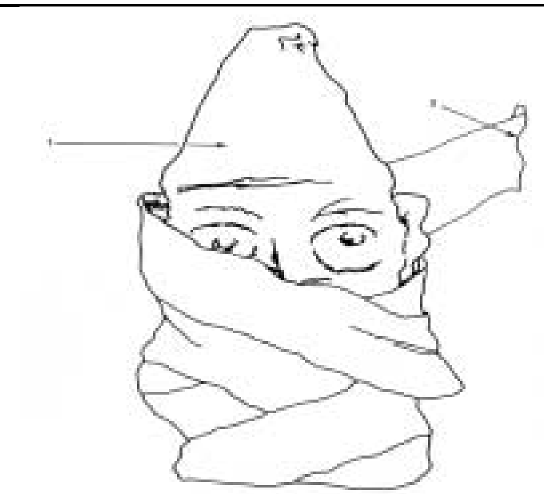
1. *How should I pack ceramic, glass and stone objects for shipping?*

In order to ensure that ceramic, glass, and stone objects are protected, they should be packed in individually contoured foam wells. Polyurethane is a good shock absorber, but it is an unstable material. Polyethylene foam is stable, but cut edges are very abrasive. When you use either foam for padding you must isolate the object from the foam with soft tissue or washed cotton flannel. Don't use buffered paper as it can be slightly abrasive to gilded or painted surfaces.

Objects with extremely delicate surfaces and appendages require special attention. Wrap long strips of soft tissue closely around the object to protect the surface. Fit unsupported areas (for example, handles and spouts) with soft tissue prior to overall wrapping. See Figure P.3 for an illustration of the technique to use for wrapping fragile objects. See Figure P.4 for an example of using layers of foam to completely surround, protect, and pad the object.

2. *How will I ship particularly heavy items?*

Heavy items like stone sculpture will require specially designed cases with interior supports at weight bearing and stabilizing locations. Pad all interior braces. Build in a pallet base so the object can be lifted with a forklift.

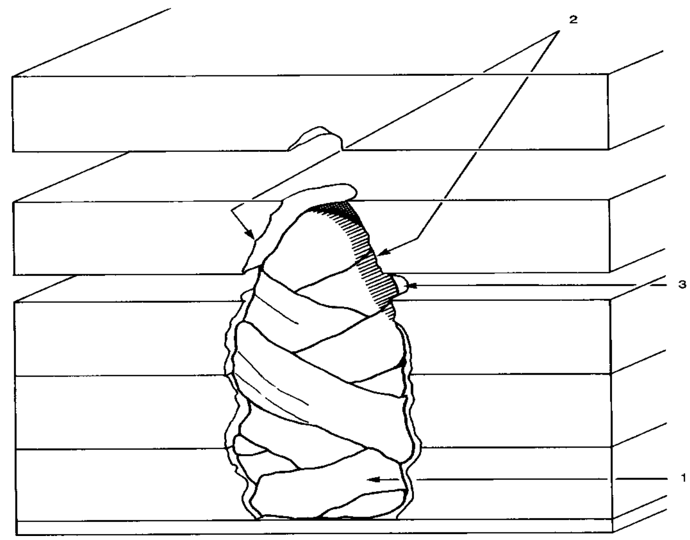


Object with a fragile or delicate surface (1)

Wrapping Technique (2)

(a) Cut soft tissue (does not have to be acid free) into long strips.
(b) Carefully wrap tissue strips around the object.
(c) Tape ends to tissue only.
(d) Repeat wrapping until object is completely covered with a few layers of tissue.

Figure P.3. Technique for Wrapping a Fragile Object



Fragile object that has been enclosed in mummy wrapping (1). The tissue wrapping protects the object's surface from abrasion that may be caused by the foam packing material. This technique works best when the top and front of the crate are removable. Follow these steps:

(a) Cut layers of Ethafoam™ (2) to completely fill the interior dimensions of the foam lined crate. Use a long knife (e.g., bread knife) with a fine serrated edge. The stack of foam is then cut in half vertically. Next, the contours of the object are cut in each half of the foam stack, one layer at a time. Nest the object in the center of the layers.

(b) Fill any gaps in the foam's center with tissue paper (3). *Caution:* Do not put pressure on the object.

Figure P.4. Layered Foam Packing for Fragile Objects

J. Emergency Procedures for Ceramic, Glass, and Stone Objects

See Chapter 10: Emergency Planning, for general information on planning for emergencies and responding to disasters.

1. *What special procedures should I follow for ceramic, glass, and stone objects after a disaster?*

The following procedures give some specific actions you can take to help preserve ceramic, glass, and stone objects immediately after a disaster.

- ***Water:*** If water is dripping onto objects, immediately cover them with plastic sheeting or bags. Water can cause stains and streaks. In particular, protect painted pieces, unfired clay, or deteriorated stone or glass. Don't seal the plastic completely as mold may grow.

- ***Severe weather:*** Move objects away from windows. Cover glass cases or tape the glass to prevent shattering and flying glass. Lay tall objects on their sides and pad so they cannot roll.

- ***Liquid attack*** (for example, acids, bases, or solvents): Vandals may throw or spill chemicals onto objects that are not protected by cases. Avoid contact with unknown liquids, but act quickly and try to identify the substance. Consult a conservator as quickly as possible to get advice and ensure that damage has been contained.

  Small, localized attacks should be rinsed well with water. Water will neutralize acids or bases and slow severe etching.

2. *How do I recover from a disaster with ceramic, glass, and stone objects?*

Air-dry wet ceramic glass and stone objects. If they don't have a damaged or rough surface, you can blot the surface gently with a soft cloth to remove excess water.

If an object is broken, keep people away from it. Photograph it *in situ* if possible. Keep all pieces together, carefully collecting them and placing them in a padded tray or box. Small pieces can be put in plastic bags. Collect even tiny chips. Don't try to fit broken pieces together as this will only abrade edges and prevent a good fit when the object is repaired. Don't allow pieces to rub together. Keep pieces clean; protect them from dust.

Contact a conservator to have the object repaired as soon as possible.

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Appendix Q: Curatorial Care of Natural History Collections

Appendix Q: Curatorial Care of Natural History Collections

A. Overview

1. *What information is in this appendix?*

Many parks have Scope of Collections Statements that call for collecting and documenting natural history specimens from the ecosystems in parks. This appendix is a brief introduction to the care of a wide range of specimens found in natural history collections. It contains information about:

- the preventive conservation approach for natural history collections in general
- basic descriptions of the variety of specimens you may find in your natural history collections
- descriptions of the common collecting techniques that have historically been used for natural history specimens

Note: Refer to the glossary at the end of this appendix for the definitions of specific terms.

This appendix will **not** give you information on proper techniques for care and storage of natural history collections. Information on preventive conservation for each type of collection will be contained in Appendix T: Care of Biological Collections, Appendix U: Care of Geological and Paleontological Collections, and Appendix V: Care of Environmental Research Collections, to follow. These appendices will give you information on environmental standards, handling, storage techniques, and shipping natural history collections.

Also, this appendix will **not** tell you how to collect and mount specimens yourself. These are skills requiring specialized education and training.

Preventive conservation is the best approach to caring for the vast amount of scientific data resident in natural history collections. Understanding basic collecting and preparation techniques will help you to understand preservation problems specific to natural history collections.

2. *Why are natural history collections important?*

Natural history collections form the basis for our understanding of the world. Scientists use natural history collections to look at questions of evolution and global change. As non-renewable resources, natural history collections document disappearing habitats, species extinction, and disappearing geological and paleontological sites. Natural history specimens document the presence of a species at a specific place and time.

Research enhances the value of these collections. A vast number of questions can be asked about our parks and the environment using natural history collections. As collections are studied and used, the information generated expands our knowledge of the parks and their relation to the broader environment. Collections that have been used for research can be used to document work, confirm conclusions, and develop new interpretations.

3. *What is the purpose in preserving natural history collections?*

Curators and collection managers maintain natural history specimens so scientists can access these specimens in the future to answer questions about the natural world. Collections document change in the natural world. Each properly documented specimen is a unique historical and scientific record. Each natural history collection may be valuable for scientific research.

Preserving the information contained in specimens is the primary goal of natural history conservation.

Preserve each specimen so that scientists can use it to:

- verify past research
- complement or facilitate current research
- encourage and enhance new research in the future

Use preventive conservation to care for scientific collections and maintain them for research by scientists. Focusing on the research potential of these collections doesn't mean that you can't use them for exhibition or teaching. However, you should first consider the research potential of any specimen when making a decision about its care and use. Research on natural history collections is as diverse as the specimens themselves. Review the importance of NPS collection-based research in Chapter 1: NPS Museums and Collections.

4. *What is preventive conservation?*

A specimen with an unknown collection, preparation, and treatment history cannot be used with confidence for any research. A preventive conservation approach ensures the integrity of the specimens for research by introducing as little change as possible. Preventive conservation also improves specimen potential for use in exhibits and educational programming. For an introduction to preventive conservation, see Chapter 3: Preservation: Getting Started. For a discussion of "minimal intervention," see Chapter 8: Conservation Treatment.

A preventive conservation approach allows access to all collections while minimizing the risk of deterioration and loss. Use this perspective while collecting, preparing, and maintaining specimens. Follow the maxim: "minimal intervention – maximum documentation."

Do as little as possible to a specimen and record whatever you do completely and accurately. Record this information in:

- field notes
- ANCS+
  - preparation/treatment supplemental record
  - preservation supplemental record

Good documentation distinguishes conservation treatment from simple meddling. The documentation requirements for any conservation treatment are discussed in Chapter 8: Conservation Treatment, and the American Institute for Conservation (AIC) Code of Ethics and Guidelines for Practice in Appendix D**.**

Good storage design promotes preventive conservation. Effective storage designs improve access, minimize unnecessary handling, and properly cushion and support specimens. Good storage protects specimens from agents of deterioration, such as pests, light, improper or fluctuating temperature and relative humidity, and environmental pollutants. Use storage materials that will not interact with the specimens. For more information on safe storage materials see the *Conserve O Gram* (*COG*) series and NPS *Tools of the Trade*.

Active treatments should rarely be performed on a specimen preserved for research. By simply cleaning a specimen you may remove information. Stabilize damaged specimens by means other than active repairs. In contrast, specimens intended for exhibits and educational programming may require repairs for both stability and aesthetics. Repair may be acceptable when it will improve the durability and visual appearance of a specimen for the public.

5. *How can I find the latest information on the care of these natural history collections?*

You can find information on natural history conservation in a variety of sources. Because this is a new and rapidly evolving field, it's important to be aware of new information as it is published.

Sources of information:

- NPS *COG* series includes a section titled "National History Specimens." Watch for updated information.

- The Society for the Preservation of Natural History Collections (SPNHC), a professional organization, specifically supports collections management and preventive conservation for natural history collections. The organization publishes a newsletter and a journal, *Collection Forum*, with information on preservation of natural history collections. SPNHC has published two books that are invaluable resources for any park with natural history collections: *Storage of Natural History Collections: Ideas and Practical Solutions,* edited by Carolyn L. Rose and Amparo R. de Torres and *Storage of Natural History Collections: A Preventive Conservation Approach*, edited by Carolyn L. Rose, Catharine A. Hawks, and Hugh H. Genoways. You can find more information about SPNHC at <http://www.geo.ucalgary.ca/spnhc/>.

- Many natural history disciplines support professional groups that publish specialized newsletters and journals with articles on new research and techniques. See Section F for some of these publications.

- Information on the use of natural history collections can be found in *Museum Handbook,* Part III,*(MH-III)* Chapter 1, Section F.

6. *What other NPS documents give me information about natural history collections?*

There are a variety of NPS sources that contain policy and guidance on natural history collections. You should acquaint yourself with the information in the following documents:

- Chapter 1: Museum Collections, and Chapter 2: Scope of Museum Collections, discuss what kinds of collections (including natural history) you should collect and why.
- Chapter 4: Museum Collections Environment, and Chapter 7: Museum Collections Storage, discuss the building envelope and how it can protect your collections.
- Museum Handbook, Part II (*MH-II*), Chapter 4: Special Instructions, discusses compliance with the Code of Federal Regulations (36 CFR 2.5). This regulation states the conditions under which the superintendent may issue permits to collect natural history specimens. See especially Section VI, Complying with Regulations for Cataloging Natural History Specimens.
- *MH-II*, Appendix H: Natural History, describes cataloging and labeling natural history specimens.
- *MH-III*, Museum Collections Use, discusses research use on existing collections. In particular, see Chapter 1: Evaluating and Documenting Use, Section F, Scientific Issues.
- Special Directive 91-4, Ensuring that Natural Resource Projects Fund the Curation of Collections, provides guidance on cataloging requirements for collectors. A new *Director's Order #24: Museum Collections Management*, will replace this special directive.
- New guidance on research and collecting permits, application procedures and related forms has been published in the Federal Register.
- *Director's Order #28: Cultural Resource Management Guideline*, Chapter 9, Management of Museum Objects, discusses the importance of field notes and other archival and manuscript collections that may help document and interpret museum collections.

7. *Where can I find information about the hazards found in natural history collections?*

Information about hazards found in natural history collections is abundant. Hazards come from preparation, storage materials, pest control methods, or may be inherent in the specimens. To find information about hazards, look at:

- references listed under Health and Safety in Section G, Selected References
- Chapter 11: Curatorial Health and Safety
- NPS *COG* leaflets on a range of topics, especially Section 2, Security, Fire and Curatorial Safety, and Section 11, Natural History Specimens
- the Internet, starting with Conservation OnLine (CoOL) <http://palimpsest.stanford.edu>, which has a section on health and safety.

B. The Nature of the Collections

The specimens in natural history collections are often diverse and complex. Natural history collections may be:

- organic (such as birds and mammals)
- inorganic (such as rocks and minerals)
- organic/inorganic composites (such as shells, some fossils, and bone)

Specimens are collected from a vast array of natural environments. The one thing most natural history specimens have in common is that they are usually ***prepared*** before being added to the collection.

1. *What is preparation?*

Most specimens come to museums through field collecting. But, whatever their source, all specimens undergo some field and/or laboratory preparation prior to becoming part of a collection. Preparation may entail the skilled excavation of fragile fossils from the surrounding matrix, or the complex chemical fixation of biological tissues to stop putrefaction. Whatever the preparation method, the reason collectors prepare specimens is to make them accessible for research and other use.

Research and other specimen use vary considerably depending on the collector. Research questions have changed historically. For these reasons specimens of the same kind (for example, bird study skins) may have been prepared by a variety of methods.

For biological collections, most basic preparation is done in the field within hours of the collection of the specimen. This ensures that they will not deteriorate before being taken to the laboratory for final preparation, analysis, and storage. Geological and paleontological collections are prepared both in the field and in the laboratory depending on the particular collecting environment and the needs of the specimen.

After preparation, a specimen may consist of several parts. For example, a small mammal specimen may become a study skin and a separately cleaned and stored skull, while the remainder of the body may be stored in fluid.
A matrix formed of various rocks and other minerals may surround a mineral specimen. Parts of the mineral specimen or its matrix may be prepared as separate specimens or as mounts for microscopic examination. You should be aware of the importance of diverse kinds of preparation techniques in natural history collections.

2. *Are there standards for preparation?*

There are no standards for preparation that apply to all specimens. The type of preparation depends on a variety of factors including:

- the kind of specimen
- intended research or other use of the specimen
- skill, experience, and research interest of the collector

- tradition

- available resources

In addition, there has been little research into the chemical and physical effects of many types of preparation. Because of all these issues it is impossible to develop a servicewide standard for preparation of an individual species. **There is no one right way.**

You can work with researchers during the permitting process to request that they use preferred techniques for your collections. See *NPS-77*: *Natural Resources Management Guideline*, Chapter 5, Program Administration and Management. For example, you can request that a collector use standard-sized glass jars with polypropylene lids lined with polyethylene for vertebrate specimens preserved in fluid. Be aware, however, that certain research issues may require that the scientists use different preparation techniques.

The natural history collection appendices following this one discuss the storage and care issues involved in the long-term preservation of natural science collections. You can use these requirements to help develop preferred preparation techniques for your collections.

3. *What kinds of natural history materials are particularly important?*

There are two kinds of materials that are especially important:

- **Type specimens** are the most important specimens in natural history collections. There are many categories of type specimens. The most important are the name-bearing types. ***Taxonomy*** is the discipline devoted to the identification, naming, and classification of organisms. Biological specimens are divided into scientific categories called ***taxa*** (singular taxon) and given specifically defined names (known as nomenclature codes). The biological sciences use Latin names rooted in the classification system begun in the 18th century by Carl von Linne (Linneaus). Mineralogy uses a system evolved from the 19th century work of James and Edward Dana. Researchers in both the geological and biological sciences use the concept of the "type."

  Type specimens must be designated in the first published description of the taxon. These are the specimens that are designated as the bearers of the scientific name of a taxon. Name-bearing types serve as international standards of reference in taxonomy. Scientists examine type specimens to verify identifications and to revise taxonomic classifications.

  The ***holotype*** is the most important name-bearing type. A holotype is the single specimen that is designated as the type in the first published account of a newly described taxonomic group. The account must be published in an appropriately reviewed scientific book or journal. There are a variety of other name-bearing types that are defined by the different scientific disciplines.

  Museums hold type specimens in trust to ensure their safekeeping, and equally importantly, their accessibility for research. **Type specimens are considered to be the property or heritage of the scientific community.** The scientific community considers it unethical for institutions to keep type specimens if they cannot adequately manage and preserve them.

- **Documentation** that accompanies scientific collections is as important as the specimens themselves. You should be sure to gather all documentation and data from the collector and incorporate it in museum collections along with the specimens. Section C discusses the wide variety of documentation that can be important to natural history collections. Labels or tags attached directly to specimens should be considered part of the specimens. Refer to Section E for more information on the care of labels and tags.

C. Natural History Collections

This section briefly lists and describes the variety of materials in natural history collections. It also briefly describes how collectors prepare and store specimens of different materials. The types of collections are broadly divided into four groups:

- biological collections
- geological collections
- paleontological collections
- environmental research collections

Specimens also have scientific documentation that is part of the park's archival collections.

1. *What kinds of specimens will I find in biological collections?*

Biological collections contain a wide variety of once-living specimens. Park biological collections document local ecosystems and their changes through time. This historical documentation is important to evaluate the effects of park policies on the natural environment. These specimens are divided in a variety of ways, which may vary from collection to collection. For example, invertebrates are separated between entomological (insect) collections and other invertebrate collections (such as mollusks or crabs).

The main divisions are:

- botanical specimens (plants)
- entomological specimens (insects)
- other invertebrate specimens (species with no backbone or spinal column)
- vertebrate specimens (species with a backbone or spinal column)

Examples of the types of specimens found in each of these types of collections appear below.

Microorganisms (bacteria, yeast, protozoa, viruses, diatoms, etc.) may be collected in parks, but are rarely, if ever, deposited in park collections at this time. They have very specific and technical care requirements that require specialized repositories. For more information on biological specimens, contact specific discipline specialists and refer to *MH-II*, Appendix H: Natural History.

2. *What groups of species will I find in botanical collections?*

Botanical collections contain a wide range of material. The more common groups are:

- bacteria
- algae
- mosses and liverworts
- clubmosses
- horsetails
- ferns
- conifers and other evergreens
- flowering plants
- fungi

See the *MH-II*, Appendix H: Natural History, for a complete list.

3. *What kinds of specimens and preparations will I find in botanical collections?*

Botanical specimens have been collected and stored in diverse ways. Variations depend mostly on the physical characteristics of the specimens but also on their intended use. These include:

- dried plants on herbaria sheets
- dried specimens, or partial specimens, or dissected parts in packets (fragment folders) sometimes attached to herbaria sheets
- lichens and mosses, dried and stored in folded paper or glassine packets and sometimes attached to herbaria sheets or stored in boxes
- dried specimens in boxes – large fungi, wood samples, pine cones, and generally anything dry that is too large for a packet and too bulky for a herbarium sheet
- specimens in fluid – often cacti and other succulents, or flowering plants, fruits, or other specimens where pressing would be difficult or desiccation would destroy tissues of interest, including diatoms, slime molds, fungi, algae, and phytoplankton
- wood samples
- seeds (sometimes in cold storage)
- pollen

- economic botany collections – agricultural seeds, cultivars that are dry or in fluid, plant products
- freeze-dried display specimens
- plant models – display or teaching models in a variety of materials
- living collections
- DNA/RNA extracts
- various microscopy preparations – stained tissues, scanning electron microscope (SEM) stubs or mounts

4. *What groups of species are in entomological collections?*

Park entomological collections contain invertebrates such as insects and arachnids.

- arachnids – mites, scorpions, spiders, ticks
- insects – ants, beetles, bedbugs, bees, butterflies and moths, cicadas, cockroaches, crickets, damselflies, dragonflies, earwigs, fireflies, flies, gnats, grasshoppers, leafhoppers, lice, mantids, mosquitoes, termites, wasps, water boatmen, and weevils, etc.

This is an incomplete list. See *MH-II*, Appendix H, for a more complete list of entomology specimens.

5. *What kind of specimens and preparations will I find in entomological collections?*

You will find entomological collections as:

- pinned specimens – including spread-wing specimens
- specimens on points – specimens mounted on paper or other materials attached to pins
- specimens in fluid – usually alcohol or formaldehyde
- specimens in envelopes or folded packets
- microscopy preparations
- eggs, egg cases, and cocoons (wet or dry)
- larvae and pupae (wet or dry)
- nests
- living entomology specimens (to study life cycles)
- economic entomology collections – species that inhibit or foster agriculture or health, pest species, products from insects

- cultural or art objects derived from insects that are cataloged under cultural resources and cross-referenced to park entomological collections —for example, a necklace decorated with an amber-trapped insect

6. *What groups of species will I find in other invertebrate collections?*

Invertebrates are animals without backbones or spinal columns. Entomological collections in parks are usually separated from the other invertebrate collections. These other collections have specimens from both land and water (terrestrial and aquatic) environments.

- brachiopods, corals, crustaceans – for example, lobsters – and a few other classes from the phylum Arthropoda
- echinoderms – for example, sea urchins
- mollusks – for example, snails
- sponges
- worms

7. *What kind of specimens and preparations will I find in collections of other invertebrates?*

Invertebrate specimens may be stored as:

- dry specimens – mollusk shells, corals, most echinoderms, exoskeletons of some crustaceans
- specimens in fluid – mollusks with or without shells, brachiopods, crustaceans, plankton, sponges, worms
- specimens or specimen parts as microscopy preparations – mounts from Scanning Electron Microscope (SEM) preparations, mounts on microscope slides, sections of shells
- shell art and craft objects that are cataloged under cultural resources and cross-referenced to park invertebrate collections

8. *What groups of species will I find in vertebrate collections?*

Vertebrates are animals with spinal columns or backbones. Vertebrate collections often include:

- amphibians – for example, frogs
- birds
- fishes
- mammals
- reptiles – for example, snakes

9. *What kinds of specimens and preparations will I find in vertebrate collections?*

Vertebrate specimens may be stored as:

- study skins – untanned skins filled with fibrous materials to approximate the shape of an animal; may contain some skeletal material

- flat skins – tanned or untanned
- taxidermy specimens
  - mounted skins – tanned or untanned skins on mannequins, positioned in a life-like manner; may also contain some skeletal material
  - trophy heads – mounted tanned or untanned skins, sometimes with horns or antlers
- spread wings of birds – dried, untanned, with bones in wings
- naturally mummified specimens
- freeze-dried specimens – complete specimens, or gutted specimens with some fibrous fillings
- fluid-preserved specimens – whole or partial specimens including embryos, larval fish, and some eggs; also includes cleared and stained specimens, such as specimens that have been chemically prepared to be transparent
- skulls
- post-cranial skeletons – articulated, partially articulated, and artificially articulated
- whole skeletons
- dissected parts preserved dry
  - bacula (the penis bone)
  - sectioned teeth
  - stomach contents
  - otoliths (a layered calcium concretion found in the inner ear)
  - hyoids (a bone or a structure formed from cartilage located at the base of the tongue)
  - scutes (plates or shells from armadillos, turtles, tortoises)
- frozen whole specimens – incoming material awaiting processing
- frozen tissues – usually organs preserved for molecular analysis
- scats (dried fecal material)
- regurgitated pellets

- casts, molds, and peels
  - teeth
  - skulls
  - marine mammals
  - fish
  - some reptiles and amphibians
  - animal tracks
- whole eggshells and fragments – bird, mammal, or reptile
- nests – bird, mammal, or reptile
- feathers
- various microscopy preparations
  - SEM mounting stubs
  - tissue sections
  - parasites – both internal and external
- tissues for DNA/RNA extraction
- DNA/RNA, nucleic and amino acids, and other materials extracted from tissues
- feather art (objects crafted from feathers, where the feathers are of interest to scientists)
- animal skin rugs or other objects where the skins are of interest to scientists

10. *What groups of specimens will I find in geology collections?*

Geology collections document geological processes and materials. They can be divided in the following overlapping material types:

- rocks
- surface process materials
- minerals
- organic materials

- extraterrestrial materials
- soils

11. *What kind of specimens and preparations will I find in geological collections?*

Geological collections often contain:

- minerals
- biominerals – amber, pearls, and other materials considered to be minerals that are derived from biological process, such as those in bone and shell
- synthetic minerals
- gems
- rocks
- powders
- drill cores
- frozen specimens – samples of ice or ice cores
- ore samples
- mining concentrates
- soil samples
- products from industrial minerals
- petrology specimens
- meteorites and other materials of extraterrestrial origin
- fossils – collected for mineral content
- various microscopy preparations – thin sections, micromounts, X-ray diffraction mounts, SEM mounting stubs
- jewelry and lapidary art that are cataloged under cultural resources but cross-referenced to park geology collections

12. *How are geological specimens stored?*

Most geological specimens are preserved dry and in a normal oxygen environment. A few minerals require desiccated environments. Some minerals are stored in fluids. Meteorites and other extraterrestrial samples are preserved in specialized gaseous environments. Some radioactive specimens may require specialized housings. There are also a number of light sensitive specimens that should be stored in the dark at all times. For more information on storage and housing of geological specimens, see *COG* 11/2, "Storage Concerns for Geological Collections," and Appendix U: Paleontological and Geological Collections.

13. *What groups of specimens will I find in paleontological collections?*

When considering paleontology collections, most people think of dinosaurs. However, a wide range of plants, insects, invertebrates, and vertebrates will be found in paleontological collections. All ancient biological organisms may be fossilized or preserved in some other manner. For a complete list of paleontology specimens see *MH-II*, Appendix H: Natural History, Paleontology.

14. *What kinds of specimens and preparations will I find in paleontological collections?*

Paleontological collections may include:

- frozen specimens – collected from permafrost areas
- mummified specimens
- vertebrate and invertebrate body fossils
- plant and seed fossils
- trace fossils
- vertebrate and invertebrate sub-fossil specimens (specimens still retaining organic material)
- compression fossils (organic remains flattened by the pressure of soil and rock above)
- mounted skeletons
- reproductions made for study or exhibits – casts, molds, peels
- palynology specimens (pollen)
- specimens in fluid – for example, microfossils in glycerin
- fossils sliced into sections
- specimens in jackets (field material still encased in the plaster or other materials used to protect them during shipping to the museum)
- soil samples – often intended for processing to remove small fossils
- amino acids, DNA, and other materials extracted from specimens

15. *How are paleontological specimens stored in collections?*

Most paleontology specimens are preserved dry, in a normal oxygen environment. Paleontological specimens are often removed from the field in plaster jackets. Before and after preparation, these specimens are stored on shelves or in cabinets. Some microfossils are stored in glycerin or other fluids. Be aware of any radioactive paleontological specimens and use cabinets vented to the outside to store these materials. See *COG* 2/5, “Fossil Vertebrates as Radon Source: Health Update.”

16. *What kinds of materials are in environmental research collections?*

Environmental research collections are specimens, samples, and analytical data collected to monitor levels of various elements and compounds in the environment. Environmental research may result in composite samples, such as water, precipitation, air, and sediment. They are classified separately from biology, geology, and paleontology collections because they are often mixtures of materials collected to study specific environments. For example, a water sample may be collected to study biota.

Some of the specimens and samples require extremely rigorous collecting, storage, and handling procedures to ensure specimen integrity for trace element or other analyses. For example, the National Institute of Standards and Technology, in conjunction with the National Oceanic and Atmospheric Administration and the National Marine Fisheries Service, has developed the National Marine Analytical Quality Assurance Program. Part of this program includes specimen banking (storage of specimens under very controlled, known conditions) to permit analysis of changes in marine environments over time.

17. *What kind of specimens and preparations will I find in environmental research collections?*

The variety of materials you may find in environmental research collections includes:

- biological tissues (in ultra-cold storage)
- soil samples
- water samples
- air samples
- air or water filters
- recording charts from analytical instruments – air, noise, water quality
- eggshell and mollusk shell samples
- other specimens or specimen parts collected according to special protocols

Chapter 2: Scope of Museum Collections, discusses environmental research samples in your scope of collection statement. For a discussion of how these specimens should be cataloged see *MH-II*, Appendix H: Natural History.

18. *What kinds of documentation are associated with a natural history collection?*

In some collections, the documentation is considered to be part of the specimen. Color images made when the specimen was collected are especially important. The National Park Service catalogs these collections as archival collections. The variety of materials used in documenting specimens include:

- original catalogs
- field notes
- locality maps (with handwritten notations)

- card files on various topics
- sampling/dissection records
- charts and graphs produced by analytical instruments
- computer tapes/disks
- original sketches/drawings/watercolors or other paintings
- plates or prints
- photographic records – slides or transparencies, prints, negatives, X-radiographs, prints and negatives of X-ray diffraction patterns and autoradiographs, motion picture film, videotapes, CD-ROMs
- sound recordings – reel-to-reel tapes, cassette tapes, phonograph records, compact disks

Other official records associated with natural history collections include:

- permit files and accession and catalog records (including catalog folders with copies of detached specimen labels)
- loan files
- condition records
- offprints of research articles based on the specimens
- exhibit catalogs featuring specimens
- books and periodicals

D. Collecting and Preparation Techniques.

1. *What are preparation techniques?*

Collectors use preparation techniques to prepare specimens for research and storage. These methods focus on the short-term preservation of the specimen. Preparation techniques achieve a particular purpose for research or public programming use of the specimen. Unfortunately, little research has been done to understand how interactions between the specimen and preservative chemicals or other preparation methods affect long-term preservation. Therefore, few preparation methods can be said to be either “right” or “wrong.” The effects of preparation and storage techniques are areas of active research. Keep abreast of current literature to be aware of changes in methods. Recommendations may change rapidly.

Literally hundreds of chemical formulas, materials, and techniques have been applied to specimen preparation over the past three centuries. Collectors still use many of these techniques. The methods vary according to:

- the kind of specimen – bird, mammal, fish, amphibian, reptile, plant, mineral, fossil

- the primary purpose for which the specimen is collected – research, education, exhibit

- the specific research purpose for which the specimen is collected – gross anatomy, histology, classical taxonomy, biochemical analysis, crystallography, trace element analysis

- the skill and preference of the collector or preparator

- project budget and staff resources

Talk to discipline-specific researchers to gain an understanding of the preparation techniques commonly used on the specimens in your collection. The information given below describes the most common preparation methods. This overview may assist you in requesting adequate data when you accession new collections. The methods are divided into sections on dry collections, freeze-dried specimens, fluid-preserved materials, specimen labels, and labeling techniques.

2. *What documentation should I keep on preparation techniques?*

You should acquire information on the collecting and preparation techniques used for each specimen. Get this information at the same time the park accepts the specimens for the museum collection. The 1988 article by Gerald R. Fitzgerald, "Documentation Guidelines for the Preparation and Conservation of Paleontological and Geological Specimens," and the 1989 article by Kimball Garrett, "Documentation Guidelines for the Preparation and Conservation of Biological Specimens," provide excellent surveys of the topics of importance. In addition to information on the condition of the specimens at the time of treatment, these guidelines recommend that you obtain documentation on:

- field collecting and shipping techniques – Was the specimen captured (trapping, netting, killing methods) or salvaged (roadkill)? If it is a fossil or mineral, what were the excavation, packing, and transport methods?

- initial treatments – cleaning, freezing, drying, pressing, fixation, coating or application of other preservatives, jacketing materials, and delayed shipments of frozen material

- initial laboratory treatments on arrival at a museum or other collecting institution

- post-collection treatments of specimens – fumigation, degreasing, fluid changes, cleaning, matrix removal, consolidation, coatings, filling gaps, pest-proofing, restoration, repair

- specimen analyses – X-radiography, dissection, molding and casting, sampling, or other procedures that are likely to have an impact on specimen condition

Record this information in ANCS+ in the Preparation/Treatment associated module.

When specimens deteriorate, there is no way to evaluate the impact of their preparation history on that deterioration unless there is documentation on preparation methods. Hundreds of references on preparation methods have been published. However, there are few records that link a specific treatment to a specific specimen. This void in the documentation of specimens limits their utility for research, exhibition, and educational programs.

A scientist must know how a specimen was treated to decide if it is appropriate for current research. For example, scientists may choose not to do biochemical analysis if a specimen has an unknown history. Also, be careful about using a specimen with an unknown history for open display or in hands-on educational programming. Many long-lived toxic chemicals have been used in specimen preparation and in subsequent treatments of specimens for various purposes.

3. *How do collectors prepare dry botanical specimens?*

Collectors use a variety of techniques to prepare botanical specimens. You may find a range of methods in your older collections. Appendix T: Care of Biological Specimens, describes current NPS standards for collecting and storage. Often, specimens are just collected and pressed. Collectors may kill botanical specimens with a fluid – alcohol or petroleum. These fluids also help to remove water from the specimen. Specimens may also be cut open, boiled or salted, or dried/preserved with alcohol or alcohol vapor prior to pressing. It was common in the past to treat nearly every specimen with chemicals to control insects and microorganisms. Today, collectors more often use heat treatments or freezing.

Specimens to be mounted on herbaria sheets are sometimes washed in the field. To dry and flatten the specimen the collector puts it under pressure between sheets of paper, sometimes with heat. Back at the museum, a preparator mounts pressed specimens on paper or, if the specimen is bulky, on board. If you mount herbarium specimens, buffered, acid-free paper or board should be used. Mounting methods include:

- using strips of cloth, polyester film, or paper attached with adhesive
- using strips made with heat set tissues (a pure cellulose lens tissue impregnated with a heat setting adhesive)
- using adhesive alone, either under the specimen, or as straps
- sewing the specimen to the paper or board with thread

Many materials for mounting herbarium specimens are listed in NPS *Tools of the Trade*.

Packets of paper or glassine are used to store some specimens. Samples that collectors may place in packets and attach to sheets include: microscopy samples, dissected parts, seeds, some fruits, delicate parts of some ferns, and some other easily damaged specimen parts. Microscope slides and photographs are often placed in packets on sheets. Collectors attach labels and packets of fragments with a variety of adhesives.

Collectors sometimes dry bryophytes (mosses, liverworts, hornworts) and fungi with gentle heat. They may cut up fungi to speed drying. In humid field conditions the collector may store fungi and bryophytes over a desiccant chemical (such as calcium chloride) after drying. Fungi are particularly susceptible to insects. They are usually treated with a fumigant or are frozen or heated prior to introduction into a collection. In contrast, bryophytes are not particularly attractive to insects. Pest control chemicals can damage bryophytes. Therefore, collectors keep these specimens as dry as possible and don't contaminate them with fumigants.

Collectors usually store fungi and bryophytes in packets. Fungi packets rarely are attached to sheets; bryophytes are usually attached to sheets. Bulky fungi may require storage in boxes. Fragile species may require small boxes or trays inside the packet.

Some large or bulky botanical specimens are housed in polyethylene bags after drying. Bags, containing various parts of the same specimen, are supported on a mat board the size of a standard herbarium sheet. The entire assemblage is then placed inside another polyethylene bag. Very large specimens may simply be housed in a polyethylene bag. Specimens stored in this fashion must be very dry to avoid fungal growth in the bags. Large palm fronds and conifer branches are candidates for this type of storage.

4. *What problems might I see with dry botanical specimens?*

There are a variety of problems you may see in dry botanical specimens:

- Fragments may be lost from fragile specimens.
- Damage may occur from poor handling techniques and storage.
- Adhesives used by collectors may become acidic, discolor, fail, or shrink, causing damage to the specimens or labels.
- Paper and glassine used for packets may be acidic or may become acidic over time.
- Mold growth may occur on acidic, deteriorating glassine, which tends to be hygroscopic.
- Mold growth may occur on improperly dried specimens.
- Insects may damage the specimens.
- Migration of pesticides may stain herbarium sheets.

Many specimens have been treated with chemicals that may be health hazards or cause damage to the specimen. (See *COG* leaflets 3/12-3/14 concerning problems caused by the use of a variety of fumigants.)

5. *How do collectors prepare dry entomological specimens?*

Collectors use a variety of techniques to prepare entomological specimens. You may find a range of methods in your older collections. Appendix T: Care of Biological Specimens describes NPS standards for curatorial care.

Collectors kill entomological specimens with a chemical vapor or by dropping them in alcohol. They pin small specimens immediately. Other specimens are stored in alcohol or triangular glassine or paper packets.

Sometimes collectors relax specimens in a high humidity chamber (with a chemical to control mold) before spreading and mounting them.

Normally, collectors pin specimens through the right side with stainless steel or coated metal pins. The exact pin placement is governed by the position of the segment at the base of the wings. Sometimes collectors will mount them by first adhering the specimen to a paper or plastic point. Poor quality paper, archival paper, and Mylar or acetate films have all been used as points. Thin, dried strips of fungus, *Polyporus*, have also been used.

Collectors use a variety of adhesives to attach specimens to points. The points are then mounted on pins. Labels are commonly pinned below the specimen using the same pin. Collectors will often dry pinned specimens with low heat in an oven. Specimens removed from fluid may be dried in a critical point dryer. The technique involves dehydrating the specimen in acetone, placing it in a chamber filled with acetone, pumping liquid carbon dioxide into the chamber to replace the acetone, then heating the chamber to the critical point at which the liquid carbon dioxide becomes a gas. With moderate additional heat, the specimen dries completely.

6. *What problems might I see with entomological specimens?*

There are a variety of problems you may see in dry entomological specimens. These include:

- Virtually all specimens are exposed to fumigants or other chemicals at some stage in shipping and/or preparation. Some of these materials remain toxic indefinitely. Today, entomologists most commonly use paradichlorobenzene. You may see crystals of paradichlorobenzene and napthalene on the specimens or in specimen containers. Because of health and safety concerns about toxicity, this and any other fumigant you use must be approved through your IPM coordinator. See Chapter 5: Biological Infestations.

- Pins with slippery surfaces can yield specimens that “spin,” or turn on the pin.

- Old specimen pins often contain copper or nickel in the alloys. These metals can react with fatty acids in the specimens to produce fibrous blue or green corrosion products.

- The collector may have used unstable papers, films, or adhesives when attaching insects to points.

- Unmounted specimens in paper or glassine packets are often vulnerable to insect pests because they are not yet enclosed in the tightly sealed, glass topped boxes (such as the Cornell-style drawers available through NPS *Tools of the Trade*) that are used to house most pinned insects.

- Damage may be caused by poor storage and handling practices. Sometimes broken body parts will be glued onto a label.

Refer to Appendix T: Care of Biological Collections, for information on preventive care of entomological collections.

7. *How do collectors prepare dry invertebrates?*

Some invertebrates are simply dried. Collectors may also immerse invertebrates in formaldehyde, alcohol, or other solutions. These techniques either kill the animal or work as fixatives. Calcareous materials (shells, corals, echinoderm spines) immersed in formaldehyde and improperly rinsed may be prone to "Byne's Disease." This is a mineral efflorescence that results from the reaction of organic acids, such as formic and acetic acids, with a calcium-based substrate. Byne's Disease usually gives a white powdery appearance to the surface of specimens.

Refer to Appendix T: Care of Biological Collections, for information on preventive care of invertebrate collections.

8. *How do collectors prepare dry vertebrate skins?*

Collectors routinely preserve birds and mammals as dry study skins. In contrast, dry skins of fish, reptiles, and amphibians rarely are preserved in research collections. To prepare study skins, collectors remove the skin from the specimen, treat it with absorbents, and fill it with fibrous materials. The filling is usually cotton batting (although a great many plant fibers and fine sawdust were used in the past). Modern collectors sometimes use polyester batting. Preparators use thin wooden supports inside bird specimens. In mammals, preparators use various types of wire to support the legs and tail. Labels are attached to the hind leg of the specimen with cotton or linen thread. In the past, specimens often were treated with chemicals during their processing. This is less common today, although collectors often rinse mammal skins in alcohol as part of the preparation process, and many collectors use sawdust, cornmeal, or other absorbent materials to facilitate drying. Study skins may be dried with heat. Today, birds sometimes are shipped in dry ice, stored in freezers, and prepared in museums. Collectors usually prepare mammals and birds in the field.

Collectors may dry large flat skins of vertebrates in the field, salt the skins, and later stabilize them using a variety of tanning processes. Sometimes collectors prepare the skins of small vertebrates as untanned flat skins. In this process, they remove the skin from the animal and then pin it to dry in a flat position. They may use absorbents in the skinning process and rinse small skins in alcohol prior to drying.

Taxidermy mounts and trophy heads can be extremely complex. A taxidermist may mount virtually any vertebrate. Taxidermists sometimes tan skins, but often they simply place a skin in a chemical solution to soften it. Once it is flexible enough, they manipulate it over a mannequin and let it dry in place. Mannequins may be bundles of fibrous materials, or a hard body constructed of plaster, fiberglass, or other easily formed materials. An internal armature of wood or metal supports the mannequin. Leg bones, or other skeletal material, and the skull may be used in the mounts. Other techniques used in mounting specimens include freeze-drying (see below).

Sometimes vertebrate shells or plates (scutes) and reptile and amphibian skins are dried and kept in collections. This is no longer a common practice and specimens prepared this way in the past were often treated with pest control chemicals during processing. Scutes are especially likely to have been treated with long-lived toxic materials. In some cases, the skins may have been tanned. Most often, they were prepared as untanned flat skins or were stuffed with any of a variety of fibrous materials.

9. *What problems might I see with traditional mounting techniques?*

There are a variety of problems you might see in specimens prepared using traditional mounting techniques:

- Arsenic and a number of other toxic compounds were used in the preparation and post-preparation treatment of taxidermy specimens. See *COG* 2/3, "Arsenic Health and Safety Update," for information on handling and use of these specimens. Commercial taxidermists may regard their materials and processes as proprietary and often are reluctant to provide detailed information. Tanned skins are rarely

  treated with pest control chemicals because the tanning processes render the skins fairly unattractive to insects and reasonably resistant to mold.

- Study skins of vertebrates with long tails and mammal specimens prepared with ears in upright positions are vulnerable to mechanical damage during storage and handling.

- Metal support wires used in specimens may corrode over time. Because the corrosion products have a greater volume than the original metal, the corrosion process often tears the skins. Metal armature in taxidermy mounts and wires in study skins may be copper or nickel alloys that will produce fibrous, blue or green corrosion products when they react with the fats in skins.

- The skins on taxidermy mounts are under great stress because the skins often shrink tightly to the form during drying. As a consequence, removing mounted specimens from their original stand changes the distribution of the stress, often causing the skins to tear or distort.

Refer to Appendix T: Care of Biological Collections, for information on preventive care of vertebrate collections.

10. *How do collectors prepare skeletal material?*

- Collectors may remove skulls and skeletons from specimens when fresh, after freezing, and occasionally from fluid-preserved specimens. They first remove much of the flesh from the bone. They then clean the specimens using a variety of techniques including:

- enzyme solutions

- maceration (with and without heat, detergents, ammonia, or bleaches)

- burial in sand, soil, or manure

- dermestid beetle colonies

After any of these treatments, further rinsing and some hand cleaning may be necessary. If cleaned by beetles, the specimens usually are fumigated, frozen, or rinsed in alcohol to kill the insects. Then the bones may be soaked in ammonia or chlorine bleach solutions to deodorize. The resulting specimens are then dried (with or without heat). Bones from large animals like bears may be degreased using organic solvents or alcohol. Sometimes large long bones are drilled and the marrow is removed to reduce the potential for migration of fats and oils out of the bone.

Fish skeletons may be removed from frozen specimens and cleaned with enzymes. Sometimes preparators stain the bones with an organic dye and store them in glycerin solutions.

11. *What problems may arise with skeletal material?*

Bone and teeth frequently deteriorate in vertebrate collections. Therefore, try to get documentation on exactly what processes preparators have used on bone. Bone is an organic/inorganic composite material. This means that the organic components are intimately mixed with the inorganic components and help to reinforce them and give them a certain flexibility. There are a variety of problems you might see in skeletal specimens.

- Prolonged maceration, enzyme solutions that have not been properly neutralized, and ammonia and chlorine bleach solutions that have a high pH degrade proteins, the primary organic reinforcement in bone and teeth, leaving the specimens brittle.
- Heat may also denature the protein.
- Acidic solutions attack the inorganic part of the composite, leaving bones soft and easily distorted.
- Poor storage and handling can damage bone causing cracking, abrasion and breakage. Low humidity in storage environments will cause cracking, especially to teeth.
- Numbers that have been written directly on the bone with indelible ink cannot be removed.

Refer to Appendix T: Care of Biological Collections, for information on care of skeletal material.

12. *How do collectors prepare freeze-dried specimens?*

Almost all types of biological specimens have been freeze-dried for exhibit purposes. After the specimens are frozen, the water is removed from them using vacuum sublimation. Specimens may be treated with a variety of chemicals as preparation for freeze-drying. After processing, preparators may use other materials to enhance specimen appearance. Large animals are difficult to freeze-dry, so these are often eviscerated before freezing. After freeze-drying, the specimens are stuffed with fibrous materials.

13. *What problems might I see with freeze-dried specimens?*

The loss of bound water makes freeze-dried specimens extremely fragile. For an excellent review of the problems of freeze-dried specimens see, "The Effects of Freezing and Freeze-drying on Natural History Specimens," by Florian (1990) listed in the Section G, Selected References. Because freeze-dried specimens are vulnerable to rehydration, especially at relative humidity above 40%, they can rot. It is important that you keep them in dry environments. Freeze-dried specimens are especially attractive to insect pests. Place these specimens in tightly sealed cabinets to prevent pests from getting into exhibit and storage cases.

Freeze-dried specimens are often used in NPS exhibits. These specimens are extremely vulnerable to insect attack and may be damaged or destroyed, requiring replacement. If you have freeze-dried specimens on display be sure to use good Integrated Pest Management (IPM) strategies to protect them. See Chapter 5: Biological Infestations, for information on developing an IPM plan.

Refer to Appendix T: Care of Biological Collections, for information on care of freeze-dried specimens.

14. *How do collectors prepare fluid-preserved specimens?*

A fluid-preserved specimen is "fixed," that is, treated with a chemical that causes some cross-linking of cell proteins. Then the specimen is stored in either the original fixative or in a chemical that preserves the fixed tissue. Collectors use a wide variety of chemicals for both processes. Sometimes specimens are not fixed prior to placing them in storage solutions.

Often, you will find small to moderately sized fluid-preserved specimens stored in glass bottles or jars. Large specimens are usually stored in tanks made of a variety of plastics or metals. Occasionally, plastic or metal liners are used inside a wooden frame or box. Collectors mount very tiny specimens on microscope slides or in small glass or plastic vials. Sometimes small containers are grouped inside larger glass containers.

In *botanical* collections perhaps the most common fixative is a solution called formal acetic alcohol (FAA). It is a mixture of formaldehyde (formalin), ethanol (ethyl alcohol), and glacial acetic acid in various proportions. A number of other fluid compositions have also been used. Instead of formalin fixatives, some preparators use alcohol as a preservative or a mixture of ethanol (with or without some methanol), water, and glycerin. There are a number of fixative/storage solutions, many of which contain glycerin.

In *entomology* ethanol is the most common fixative and preservative fluid in entomology. Sometimes other chemicals have been added to ethanol in an effort to preserve color or relax specimens.

Vertebrate specimens are usually fixed in buffered formalin and then preserved in alcohol. Numerous alkali neutralizers or actual buffers may be used in the formalin. Ethanol (70%) is the preferred storage fluid for mammals and birds. Fish, reptiles, and amphibians are stored in various concentrations of isopropanol (isopropyl alcohol) or ethanol. Numerous compounds are used for color preservation in vertebrate specimens. Preparators may have added these to any specimen.

15. *What problems may occur with fluid-preserved specimens?*

The container, closure, and gasket may react with the specimens or the fluid. Ask the donor what kinds of containers were used to house the specimens from the time they were collected. The storage solvent will evaporate over time and have to be replaced. Prior to fixation, collectors sometimes freeze specimens. This often leads to poor quality fixation and preservation.

Solvents used to store fluid-preserved specimens may gradually soak out lipids, proteins, and pigment over time, causing the solution to become discolored or cloudy. Labels printed on poor quality paper may deteriorate. The metal closure on flip-top jars may corrode.

Refer to Appendix T: Care of Biological Collections, *COG* 11/3, "Storage Concerns for Fluid-Preserved Collections," and 11/4, "Storage Containers and Labels for Fluid-Preserved Collections," for additional information on the care of fluid-preserved specimens.

E. Labels and Labeling

Inquire about the materials a collector used to label specimens. This will give you an indication of the preservation problems that may lie ahead. Labels contain important original information about the specimen and in some cases may be the primary documentation on the object. The information recorded on a label may include:

- species scientific name
- species common name
- collector's name
- collecting location
- habitat
- collection date
- field catalog number
- collecting institution
- park code
- catalog number
- accession number
- original fixative
- preservative

All NPS specimens should have NPS labels. See *MH-II*, Appendix H, for information on labels and labeling. Ordering information is available in NPS *Tools of the Trade*.

1. *What types of inks should I use on labels?*

Good inks for documentation are carbon printing inks, heat-fused carbon toner for printers and photocopiers, and carbon-based drafting film ink for technical pens. There are also some pigmented black inks in felt-tip pens that are acceptable for use on labels. Unfortunately, the ink often used on labels or on specimens is a dye that is acidic. It will fade when exposed to light and may fade as a result of exposure to oxygen in the air. Ballpoint pens and fugitive pencil (such as red pencils) will fade and therefore are not acceptable for writing on labels. See Williams and Hawks (1986) and Wood and Williams (1983) for information on inks and pens to use with both dry and fluid-preserved natural science collections. You can order ink and pens for labeling natural history collections through the NPS *Tools of the Trade.*

See more information on recommended inks, pens, and lettering styles and attaching strings and pins in *MH-II*, Appendix H. *COG* 11/4, "Storage Containers and Labels for Fluid-Preserved Collections," also gives information on inks and printers.

2. *What preservation problems will I have with metal labels and tags?*

Preservation problems arise from metal ear tags, bat and bird bands, and the small metal labels that collectors used to apply catalog numbers to some fluid-preserved specimens and skeletal specimens. All these specimens may be subjected to processing or storage in fluids, at which time the labels can begin to corrode.

- Corrosion products can stain specimens and, in some instances, may cause the labels to adhere to the specimens.
- Sharp corners on the labels can tear specimens.
- Metal labels on dry skeletal material scratch and abrade the bone.
- Specimen labels made of pure tin can degrade on frozen specimens.

Though separating the labels from the specimens and storing them is one approach; it is always best to keep labels with the specimens. For bone, you can keep the labels in small polyethylene bags in the container with the specimen, but not attached directly to the bone. In fluids, you can seal the metal ear tags and leg bands in air in small glass vials with polyethylene caps and place them in the container with the specimen. These methods allow the label to remain in the container with the specimen.

3. *What kinds of paper labels are used in collections?*

Paper labels may be made of almost any paper product, many of which are not permanent or durable. The paper may be single-ply or a laminate of two or more layers. Fluid specimen labels are sometimes made of Resistall paper, a cotton rag paper that has been treated with a melamine resin to make it fluid-resistant. Resistall papers often have a fairly low pH (4.5-5.2).

Labels reduced or reproduced by photocopy processes may be alkaline buffered, acid-free paper or may be any type of common photocopy paper. The paper used in printers to generate labels falls into the same categories.

4. *What kinds of paper labels has NPS used in the past?*

Since 1982 the Museum Management Program (MMP) has specified that paper labels be of 100% white rag or alpha cellulose content or be maximum permanence paper (with alkaline filler). The MMP makes these labels available through *Tools of the Trade*. Previously, Lewis, in *Manual for Museums* (1976), specified high quality, liquid-resistant paper. Burns, in *Field Manual for Museums* (1941), recommended white linen tags tied with linen thread for mammal specimens and high quality white paper for insects on pins. Older park collections will probably contain all these types of labels in their collections, as well as other labels that outside collectors used.

You must use NPS supplied labels when tagging specimens. Specify this requirement in collecting permits. When replacing old, non-standard labels be sure to keep the originals.

Refer to *MH-II*, Appendix H, for information on natural history specimen labels and their content.

F. Glossary

Arthropods – *a*ny of numerous invertebrate organisms of the phylum Arthropoda, which includes insects, crustaceans, arachnids, and myriapods

Articulated – when parts of a skeleton are joined together for display

Biology – the science of living organisms and life processes

Bolus (boluses) – prehistoric mammoth dung

Botany – the scientific study of plants

Brachiopods – any of various marine invertebrates of the phylum Brachiopoda, having bivalve shells and a pair of tentacled, arm-like structures on either side of the mouth

Bryophyte – a plant of the major botanical division Bryophyta; includes the true mosses, peat mosses, and liverworts

Chitin – a semitransparent horny substance that forms the principal component of crustacean shells, insect exoskeletons, and the cell walls of certain fungi

Consolidation – application of a liquid polymer (glue, plastic) that imparts strength to a fragile specimen

Crustaceans – any of the various predominantly aquatic members of the taxonomic group Crustacea, characteristically having a segmented body, a chitinous exoskeleton, and paired joined limbs; includes lobsters, crabs, shrimps, and barnacles

Duff – insect excrement and shed skins left as waste on specimens; frass

Echinoderms – any of a number of radially symmetrical marine invertebrates of the phylum Echinodermata, having a body often covered with spines; includes starfish, sea urchins, and sea cucumbers

Entomology – the scientific study of animals

Exoskeleton – an external protective or supporting structure of many invertebrates

Fixing – the use of a chemical, often formaldehyde, that reacts with tissue to limit deterioration

Frass – insect excrement and shed skins left as waste on specimens; duff

Herbarium – a collection of plants mounted and labeled for use in scientific study

Holotype – the single specimen used as the basis for the original published description of a taxonomic species

Infills – a gape or hole in a specimen that is filled with a foreign material for structural stability or aesthetic integration

Invertebrate – animal lacking a backbone or spinal column

Maceration – using a liquid to soften and remove flesh

Molding and casting – techniques used by preparators and others to make copies of specimens

Mollusks – any of various members of the phylum Mollusca, largely marine invertebrates; includes edible shellfish

Nomenclature – a system of terms used in a particular science or discipline, for example, an international system of standardized New Latin names used in biology for kinds and groups of animals and plants

Ontogeny – the history of the development of an individual organism

Peel – a specimen produced by applying a polymer to the surface of an object to reproduce surface texture that is then "peeled" off

Phylogeny – the ordering of species into taxa; evolutionary history of a species

Preparation – the process of readying natural science specimens for storage in a museum collection

Scat – excrement, fecal material

Scute – plates or shells from armadillos, turtles, or tortoises

Sublimation – the conversion of a solid directly into a vapor without passing through the liquid state

Systematics – the science of classifying all organisms, living and extinct, and of investigating relationships between them; the field of science concerned with taxonomy and phylogeny

Tanning – methods used to change the chemical structure of skin making it resistant to deterioration

Taxa – plural of taxon

Taxon – a group of organisms that makes up one of the categories in taxonomic classification, such as a phylum, order, family, genus, or species

Treatment – usually refers to a repair or restoration done by a conservator

Type – a specimen or sample used as the basis of description of a species

Vertebrate – animals with segmented bony or cartilagenous spinal columns

Zoology – the biological science of animals

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Taxon,
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Appendix R: Curatorial Care of Photographic Collections

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APPENDIX R: CURATORIAL CARE OF PHOTOGRAPHIC COLLECTIONS

A. Overview

1. *What information will I find in this appendix?*

This appendix discusses the composition and physical structure of photographic materials and outlines their long-term care and preservation.

2. *Why is preventive conservation important for these materials?*

All photographic materials are especially vulnerable to deterioration when exposed to:

- inadequate environmental conditions
- improper storage enclosures
- careless handling practices
- damaging exhibition procedures

For this reason, preventive care is absolutely critical to the long-term preservation of these irreplaceable images.

3. *How can I find the latest information on care of these types of materials?*

Watch the following sources for new information and techniques:

- NPS *Conserve O Gram* (*COG*) series
- e-mail NPS Museum Management Newsletter

See the NPS Museum Handbook, Part I (MH-I), Chapter 3, Museum Objects Preservation: Getting Started, for a discussion of preventive conservation and conservation treatment.

B. The Nature of Photographic Materials

Photographs are images formed by the action of radiation, usually light, upon a sensitized surface. While often thought of as a single technique, photography is many hundreds of related chemical processes known by a wide variety of process and trade names. Sources of assistance for descriptions of the various photographic processes are included in Section K.

1. *What is the component structure of photographic materials?*

The component structure of photographic materials includes a variety of:

- ***final image materials***, such as silver
- ***binders***, such as albumen, collodion, and gelatin
- ***supports***, such as paper, plastic film, metal, or glass (also called the *base*)

Negatives, prints, transparencies, and slides are all photographs.

The laminate structure of prints is often further complicated by the presence of:

- secondary supports
- additional colorants
- coatings
- adhesive layers

2. *Why should I identify photographic processes?*

Identifying the photographic process (final image material, binder, and base) will allow you to accurately assess the relative short- and long-term stability of a specific photographic object.

3. *What are the basic types of final image materials and how do they deteriorate?*

The image in every photograph is created by materials that absorb and scatter light. Final image materials may include:

- photolytic or filamentary silver
- metallic platinum
- pigments
- organic dyes

The final image material in most nineteenth-century photographic prints is a finely divided ***metallic silver***, identified as "printed-out" or "photolytic" silver. Photolytic, or metallic, silver particles are rounded in shape and scatter light, and, as a result, produce the red or brown image tones associated with nineteenth-century print materials in good condition. Photolytic silver particles are quite small and are extremely susceptible to image deterioration and rapid loss of highlight detail.

The final image material in most twentieth-century photographic prints is ***filamentary silver***, which consists of bundles of intertwined filaments, resembling steel wool, that are huge in comparison to photolytic silver particles. These larger particles are significantly less vulnerable to image deterioration. Their irregular structure absorbs light rather than scatters it. Therefore, filamentary silver images are characterized by a neutral black image color, unless toned with gold, sepia, selenium, or hand-colorant.

All silver images are prone to severe oxidation and, as a result, undergo characteristic changes. Photolytic silver images exhibit general fading throughout, a loss of highlight detail, and a shift in image color toward warmer (more red or yellow) tones. Filamentary silver images, on the other hand, exhibit a significant shift in color from neutral black to yellow brown as they deteriorate.

Mirroring, a dark, mirror-like, reflective tarnish stain caused by oxidation, is a common symptom of deterioration in silver images. It often appears as a bluish, metallic sheen visible in a photograph's dense image areas when examined in reflected or raking light. Silver images also can be adversely affected by improper processing during manufacture, resulting in a severely yellowed and faded final image material.

In platinum prints, the final image material is ***metallic platinum***. Since platinum is a noble metal, it's not susceptible to oxidation. Therefore, platinum images don't tarnish or fade. Platinum is, however, a catalyst for cellulose deterioration. Platinum prints may exhibit an embrittled and discolored primary paper support.

Pigments, such as lamp black, burnt and raw umber, burnt sienna, and Prussian blue, often have been used as final image materials for such printing processes as carbon, gum bichromate, and cyanotype. These pigments usually are dispersed in a binder, such as gelatin, gum arabic, or linseed oil, and tend to have good to excellent overall stability.

Finally, ***organic (synthetic) dyes***, as used in most contemporary negative and positive color processes, are considerably less stable, and will fade both in the dark and upon exposure to light. The destruction or decolorization of organic dyestuffs in color photographs is due to irreversible changes in their chemical structure. Upon exposure to light, high humidity, or high temperature conditions, organic dyes are readily converted to oxidized and often colorless dye fragments.

4. *What are the various types of binder layers?*

The binder in photographic material is the transparent layer in which the final image material is suspended and protected. Binders are important in determining optical properties, such as surface smoothness, gloss, density, and color, as well as the overall stability of specific print materials. The binders most commonly used throughout the history of photography include:

- ***albumen***, a globular protein from the white of hens' eggs
- ***collodion***, a form of cellulose nitrate
- ***gelatin***, a highly purified protein commercially produced primarily from animal hides and bones

Albumen (ca 1850-1900) actively deteriorates and yellows due to the inherent characteristics of the egg white protein and its chemistry. Albumen has a strong affinity for silver ions, and as a result, in processing these materials, colorless silver-albuminate complexes may be formed. Upon exposure to reactive sulfiding compounds, these colorless complexes may be converted to a yellow silver sulfide with a resulting increase in overall discoloration or staining leading to yellowing and loss of detail in non-image (highlight) areas. Albumen yellowing also occurs from prolonged exposure to light and high relative humidity conditions.

The albumen binder will expand and contract when exposed to fluctuating environmental conditions. Albumen prints, therefore, characteristically exhibit severely cracked and crazed binder layers. Albumen images almost always are mounted on a secondary support, since unsupported images will curl into tight rolls.

Collodion (ca 1851-1920) was used as a transparent binder in both glossy- and matte-surfaced photographic printing papers manufactured at the turn of the century as well as for ambrotypes, tintypes and the wet plate negative process that was introduced in 1851. Collodion is brittle, and is easily abraded and mechanically damaged when handled improperly.

Photographic ***gelatin*** (ca 1870-present) is a highly purified, homogeneous protein. While it is relatively stable and doesn't yellow severely like albumen, it is very reactive to changes in temperature and relative humidity conditions. When exposed to moisture, gelatin swells up to twenty times its volume, becoming soft and tacky. Finally, gelatin can serve as a nutrient for microbiological or fungal activity in conditions of high relative humidity and also is attractive to insects and vermin as a food source.

5. *What are examples of primary supports?*

The most common primary supports used throughout the history of photography include:

- paper
- glass
- flexible film
- sheet metal

In both historic and contemporary photographic print materials, the image-bearing layer usually consists of a coating on a ***paper-based*** support. When handled improperly, paper supports are susceptible to irreversible mechanical damage in the form of tears, creases, and losses.

In the early days of photography, these paper supports were manufactured from the highest quality rag fiber or chemically purified wood pulp. After 1881, machine-manufactured photographic papers were coated in the factory with a baryta layer, which consisted of the white pigment barium sulfate and gelatin. The baryta layer produced a highly reflective surface, allowing for greater contrast and brilliance in the final print. It also acted as a protective barrier between trace impurities in the primary support and the light-sensitive materials.

Plastic-coated, or resin-coated, photographic papers were introduced in the late 1960s. They were often subject to embrittlement, cracking, and/or localized fading of the photograph's silver image. Within recent years stabilizers have been introduced into these papers. As a result, current plastic-coated papers, when processed correctly, are considered to be as stable as fiber-based supports.

While ***glass*** was the favored image support material in the nineteenth century, these supports may deteriorate under unfavorable environmental conditions. The chemical composition of support glass is the single most important factor pertaining to the long-term preservation of collodion plates. Deterioration of the glass support can result in softening and flaking of the collodion binder and varnish layers as well as discoloration and fading of the silver image.

Nearly all existing still and motion picture ***films***, prior to the introduction of polyester film in 1955, were produced on a cellulose plastic support. Earlier films were made from cellulose nitrate, first marketed in 1889 and manufactured until 1951. See NPS *MH-I*, Appendix M, Care of Cellulose Nitrate Negatives. Later films were composed of a variety of cellulose acetate supports. All cellulose plastic bases are subject to hydrolysis upon exposure to adverse environmental conditions, particularly high relative humidity. The hydrolysis of cellulose nitrate film, for example, releases nitrous oxide, a strong oxidizing agent that aggressively attacks image silver and severely embrittles the plastic film base as well as all nearby materials. Cellulose nitrate film base also is highly flammable and will burn underwater, as it produces it's own oxygen during combustion. Valuable cellulose nitrate negatives must be reformatted and placed in cold storage.

In acetate films, acid hydrolysis won't accelerate silver image deterioration. However, the indirect consequences of hydrolysis may result in massive shrinkage and physical deformation, such as cockling, buckling, and channeling of the film base. Furthermore, acid-catalyzed hydrolysis will cause fire-retardant additives, historically incorporated into the film base during manufacture, to be released and deposited as liquid-filled bubbles in the gelatin binder.

Some of the earliest photographic processes used ***metal*** as the image's primary support. A daguerreotype photograph, for example, is a silver-plated sheet of copper with the whites or highlights of the image being a silver-mercury-gold amalgam and the darks pure silver metal. The daguerreotype plate is susceptible to deterioration resulting in the formation of corrosion films, primarily silver sulfide, on the support's surface. Tintypes were manufactured on japanned iron plates. The japanned surface was usually composed of a mixture of raw linseed oil, asphaltum, and lamp black pigment. A tintype's iron support may corrode or rust at the plate's unvarnished edges or anywhere the protective japanned surface has been scratched or otherwise damaged. Corrosion of the iron support may result in irreversible flaking and/or loss of a tintype's image-bearing (collodion) layer.

6. *Are there other structural concerns?*

Yes. When you analyze the component structure of photographic materials, you will also need to evaluate the presence or absence of a secondary support, hand colorants, final coatings (waxes, gelatin, and spirit varnishes such as shellac) and adhesive layers. Photographic prints often have been hand-colored with a variety of media, sometimes fugitive, including watercolors, pastels, and aniline dyes. These additional components can strongly influence the final appearance and stability of all photographic materials. Rubber cement adhesives, for example, can irreversibly stain and yellow binder layers.

C. Preparing a Preservation Strategy

A general understanding of the nature of photographic materials provides a basis for developing a preservation strategy for the collection.

1. *Why do I need a preservation strategy?*

A preservation strategy will help you care for and protect these diversified collections. In establishing a preservation plan, you need to understand and consider many issues pertaining to format and type, condition, housing, value, access, and use. In determining value, for example, you need to ensure that the collection materials support the park's approved Scope of Collection Statement and that these photographs are important for their artifactual, evidential, associational, administrative, or informational value. For example, heavily-used collections of lower value may be granted higher preservation priority when compared with little-used materials of higher value. See *COG* 19/10, Reformatting for Preservation and Access: Prioritizing Materials for Duplication.

Photographic collections should be assessed by a conservator for condition, processes, and format. The conservator should carefully examine all types of items in the collections, including albums, scrapbooks, and newer items such as microforms. Owing to quantity, it is often difficult, if not impossible, to examine all photographic objects in a collection; however, boxes and groups of items can be randomly sampled and assessed for storage, treatment, handling, and exhibition needs. In doing so, the conservator may make a checklist for tracking and quantifying general condition and deterioration problems associated with various photographic items. See Section H for a condition checklist.

2. *What are the basic elements of a preservation strategy?*

A preservation strategy tells you how to do the following:

- monitor, assess and control the environment
- establish handling procedures and a disaster plan
- rehouse photographic images
- reformat color materials and preserve originals in cold storage, where appropriate
- evaluate photographic materials for conservation treatment
- inspect negatives
- duplicate deteriorating materials
- inspect copy images

3. *How should I assess and control the environment?*

Survey storage facilities and exhibition spaces for evidence of the potentially damaging environmental conditions of relative humidity, temperature, light, and pests.

- Maintain the relative humidity (RH) levels for most photographic materials at 20% to 40%. You should strive for this range when storing all types of photos in one area. However, if you are storing only film-base materials, the preferred range is at 20% to 30% RH.

- Store most color and film-base collections at 4.4°C (40°F) or below. When you place collections in cold storage, they should remain in cold storage as much as possible. Therefore, make copy negatives and prints available for duplication and research use.

- Monitor and control the environmental conditions, especially relative humidity, in collections storage and exhibits to reduce the potential for microorganism growth. When RH reaches 65% and temperature rises above 75°F, the potential for microorganism growth increases.

- Use the photographs at the appropriate light levels. See Figure R.1.

Century	Type of Photograph	Appropriate Light Levels
19th	Most 19th century processes	<50 Lux or 5 footcandles
Late 19th (1880s)-20th	Photographs with Baryta Layers, such as Gelatin Printing-Out Paper, Collodion Printing-Out Paper, and Gelatin Developing-Out Paper	<100 Lux or 10 footcandles
20th	Modern color photographs	<50-100 Lux or 5-10 footcandles

Figure R.1. Appropriate Light Levels for Photographic Media

4. *Should I establish handling procedures and a disaster plan?*

Yes! First, establish handling and preservation procedures that are oriented toward stabilizing the condition of the entire collection.

Then, ensure that these procedures are followed so that the level of preservation is consistent throughout the collection.

Finally, establish a disaster plan to protect the museum collections in an emergency.

5. *Should I rehouse photographic prints and negatives?*

If the photographic prints are in acid-free or acid-neutral housings, you don't need to rehouse them, unless the housing is damaged. In all other situations, you need to rehouse photographic materials in acid-free archival sleeves and folders.

6. *How do I rehouse photographic prints and film negatives?*

If you need to rehouse ***photographic prints***:

- place each print in archival-quality plastic or paper enclosures to prevent damage from chemical deterioration and improper handling

- place the enclosure containing prints in a box or drawer

- place boxes or drawers on shelves or in cabinets

If you need to rehouse ***glass plate negatives*** and stabilize them:

- place negatives in four-fold archival paper enclosures
- place negatives upright on their long edge in padded boxes
- place boxes on shelves
- label boxes "Fragile Glass"

If you need to rehouse ***photographic albums and scrapbooks***:

- box them to protect them from dirt, dust, and gaseous pollutants
- interleave photograph albums with neutral pH tissue

Don't use buffered tissue or acid-free paper.

- don't use interleaving materials if they will cause stress on album bindings (such as significantly swelling a volume's width)

If you need to rehouse ***daguerreotypes, ambrotypes, and tintypes***:

- house them in acid-free folding boxes
- identify actively deteriorating cover glasses and replace them with contemporary high-grade alumina silicate glass
- have a trained conservator supervise the uncasing and resealing operations

If you need to rehouse ***film-based negatives***:

- place each negative in a sleeve
- place each sleeved negative in a box or drawer
- place each box or drawer on a shelf or in cabinet

7. *How should I preserve color materials?*

After housing, place color photographic materials in refrigeration or cold storage to slow irreversible deterioration. Cold storage promotes a longer life for the photographs being preserved. Even 20°F below room temperature provides many decades of additional life for photographic materials. Store collections of color negatives, transparencies, and prints, in archival housing within Ziplock bags in boxes, in a frost-free refrigerator with low-humidity refrigeration. You may place humidity indicator strips within the bag to help monitor environmental conditions.

If you must remove materials from the cold storage vault, for example if the power has been out for longer than 48 hours, allow the materials to acclimatize at room temperature for several hours before handling them.

Don't forget to monitor the frost-free refrigerator for temperature and humidity levels and to establish retrieval and access guidelines to severely limit the removal of materials.

8. *How do I evaluate photographic materials for conservation and further preservation?*

You should work with a conservator to learn how to identify photographic processes and formats and deterioration characteristics. Check photographic materials for:

- active flaking or powdering
- mold growth
- tape or adhesives present
- severely deteriorated supports

Ensure that photographic materials with these conditions receive conservation treatment.

9. *Who should inspect film-base negatives?*

You should work with a conservator to:

- inspect film-base negative collections and evaluate them for deterioration
- establish duplication programs
- develop handling guidelines
- establish archival storage procedures

10. *What about reformatting and duplicating deteriorating materials?*

You won't always be able to preserve all photographs in pristine condition. When faced with massive deteriorating photographic holdings, you will need to strike a balance between stabilization, treatment, and duplication.

Some processes, such as cellulose acetate and cellulose nitrate negatives may totally self-destruct over time in a normal storage environment. The self-destructive images are said to have inherent fault or inherent vice. The only way to preserve cellulose nitrate and cellulose acetate negatives may be permanent cold storage. In order to save the informational content of these negatives, it is necessary to duplicate these images using more stable materials. See *MH-I*, Appendix M, Care of Cellulose Nitrate Film, and *COGs* 19/10 through 19/13 on preservation reformatting.

Other photographic materials, while not as prone to self-destruction as cellulose acetate or cellulose nitrate, will deteriorate as a result of use, such as exhibition, regular handling, or frequent duplication. These heavily used materials will also benefit from duplication, as the duplicates may become the copies for use while the originals are preserved in cold storage.

Some scholarly researchers may still need to view the originals in order to study the image's process, format, or technique. In most cases, researchers are interested in the informational value of an image. Informational values may be captured in high-quality photographic copies.

If you need to rehouse and/or duplicate film-base collections, carefully consider the following options:

- ***Interpositives***. For maximum quality control during duplication, you should produce an interpositive (intermediate positive image on clear film). Make this interpositive from the original negative by contact printing the image onto a sheet of clear film, producing a positive transparency. Then, make a laterally correct (not reversed) copy negative from the interpositive. Retain the interpositive to serve as an archival master used for the creation of additional copy negatives. Use the copy negative as the duplication master to produce copy prints for staff and researchers. Keep the original negative in cold storage.

- ***Direct Reversal Film***. Another procedure requires the use of direct reversal film, to produce a direct but laterally reversed duplicate negative. The resolution of direct-duplicating film is good, although tone reproduction can be poor. Because of their fine-grained structure these films are prone to oxidation leading to silvering out and mirroring, hence image detail loss. These images must be accurately processed and toned during use and carefully inspected and tested after creation. Such requirements make the actual cost of direct duplicates equivalent to interpositive processes without providing the same quality of images. Request either polysulfide toning or gold toning which will extend the life of the negative. Be aware that gold toning can add 20-50% to the cost. In many cases, direct reversal or direct duplicate images, also known as direct positive images, don't produce publication quality negatives.

  Selenium toner was frequently recommended for use with all copy negatives, particularly direct duplicate negatives. However, the Image Permanence Institute (IPI) in Rochester, New York has found that selenium may not adequately protect a filamentary silver image in low density regions from oxidative attack. Don't request selenium toning of photographs. IPI is currently investigating the use of a polysulfide toner to which a small percentage of borax is added. For additional information, contact the Image Permanence Institute, Rochester Institute of Technology, 70 Lomb Memorial Drive, Rochester, NY 14623-5604, 716-475-5199.

- ***Copy prints and camera negatives or long-roll camera film***. Other duplication options to consider include producing of copy prints and camera negatives from the original negative or using a long-roll camera film for efficient and cost-effective duplication of large collections. As with direct reversal film, these processes won't necessarily produce publication or exhibition quality copies and some of the images' informational value may be lost.

When you are faced with massive deteriorating film holdings, consult a conservator. See *COG* 19/10, Reformatting for Preservation and Access: Prioritizing Materials for Duplication. You should carefully evaluate the available duplication options discussed above and consider the following factors:

- collection's size
- informational value
- evidential value
- associational value
- administrative value
- artifactual value
- condition
- projected use
- funding and staffing resources available

Collection value, usage, and risk or stability probably should determine which items you duplicate first. Don't dispose of original negatives once duplicated unless they are in an advanced state of deterioration.

Finally, you should establish two regular inspection programs:

- One should evaluate the technical and archival quality of the duplicate negatives. Compare the duplicate's optical, tonal, and physical characteristics with the originals. See *COG* 19/13, Preservation Reformatting: Inspection of Copy Photographs.
- The other should be used for all deteriorated film holdings. Select envelopes from every drawer at random and examine them for signs of deterioration as mentioned above. Note incipient deterioration so that you can monitor specific materials during the following inspections. Inspect collections with unregulated climates and generally poor conditions as many as four times per year.

11. *Who should inspect copy images?*

You should have all interpositives, negatives, prints, and slides, whether produced internally or by an outside photographic studio, inspected upon return.

All photographic copy work done for preservation purposes should be done to American National Standards Institute (ANSI) standards. Cite these standards in all contracts with photographers. Don't pay for duplication until after the copies pass inspection. Inspect the copy versus the original for: resolution, tonal range, completeness of image, and residual levels of chemicals. Materials that don't pass inspection criteria should be reshot at the photographic laboratory's expense. See Section K for a list of the appropriate standards.

Have someone experienced in reading negatives and in darkroom work, such as a photographer (other than the photographer who did the copy work), inspect all images. Inspection requires experience and a trained eye.

See *COG* 19/13, Preservation Reformatting: Inspection of Copy Photographs.

D. Preventive Conservation: Handling Photographic Collections

All photographic materials, color as well as black-and-white, may be irreversibly damaged by fingerprints, scratches, abrasions, and other forms of mechanical damage or mishandling. Here are some guidelines.

1. *How do I handle photographic prints?*

> ***Historic photographic prints may be irreversibly damaged if handled carelessly. The surfaces of these prints are delicate and, therefore, easily scratched, abraded, creased, cracked, or torn.***

General guidelines for ensuring object safety during any handling procedure are outlined in *MH-I*, Chapter 6, Handling, Packing, and Shipping Museum Objects. Some basic principles for the safe handling of historic and contemporary photographic print materials are listed below.

- Prepare a clean and uncluttered workspace for the safe handling of photographic collections. Instruct staff and researchers on the proper ways to handle photographs.

- Establish and enforce handling guidelines (for example, restricting food, drink, smoking, the use of pens) for all staff.

- Wear gloves when accessing collections that aren't protected by enclosures and when handling photographs that require temporary removal from paper or plastic sleeves. Research at the National Archives of Canada shows that immediate interactions will occur between salt in human perspiration and a photograph's final image material. These interactions result in irreversible oxidation of image silver to silver chloride followed by image staining or mirroring where the fingers touch the image. Staff and researchers who are required to wear cotton gloves will often approach a photographic collection with additional care and respect.

- Use temporary or permanent auxiliary supports (such as pH neutral board) during handling if necessary. In all instances, handle the auxiliary support and not the object itself.

- Exercise special caution when using plastic sleeves. Clear plastic sleeves are often too flexible to prevent structural damage. Slip a piece of archival bond (neutral pH) behind the image back before placing it in the sleeve. Transcribe any information from the back of the image in pencil to the back of the archival bond.

  Removing unmounted photographic prints from their polyester sleeves may prove difficult because of the static charge of the polyester film. Slit the plastic sleeve at a sealed edge and gently separate the cover sheet from the photograph by rolling it away from the object's surface.

- Control access to all collections. Using copy prints and/or xerographic copies will greatly reduce handling and subsequent damage. Restrict the photocopying of all original materials. In doing so, maintain and use a "master" set of xerographic copies for all subsequent photocopying. See *COG* 19/4, Archives: Preservation Through Photocopying, and 19/7, Archives: Reference Photocopying. Any collection that is regularly reproduced should have an effective system for creating master negatives so that originals need not be constantly photographed.

- Establish current inventories, finding aids, and container (such as box or folder) lists for all photographic collections to further reduce unnecessary handling.

2. *How do I handle daguerreotypes, ambrotypes, and tintypes: cased and uncased formats?*

You should consider the daguerreotype, ambrotype or tintype and its original housing as a total artifact deserving protection as a whole. Don't disturb these housings unless absolutely necessary. If for any reason you remove an original housing, carefully label and retain them.

If you remove an original housing, use a small suction cup to carefully lift the "photographic package" out of the miniature case interior. This maintains proper configuration and orientation of the fabric liner that serves as a "compression seal" within the case and further protects the photographic image from oxidation. Don't use a suction cup if the brass mat and tape assembly are damaged or not present.

Do not disassemble the photographic package without the supervision of a trained conservator.

Restrict the handling of all original material to only those researchers who are working on images as evidence of connoisseurship issues or those who can't obtain sufficient information from the copy. All other researchers should use copy prints. Secure totally unprotected daguerreotypes and ambrotypes immediately. See Section G. Separate them from the collection to ensure protection against casual handling. Use a Form 10-645, Archives and Manuscript Collections, Separation Sheet to maintain the link between the object and its original location within the collection. See NPS *Museum Handbook*, Part II, Appendix D, Museum Archives and Manuscript Collections for guidance on this form. The surfaces of primary images may be damaged by careless handling because they are very fragile.

Caution both researchers and staff not to open a case completely (180 degrees) when viewing an image as this may cause severe stress on the hinge. Don't use the metallic clasps as they tend to abrade the surrounding leather or paper on the case. If the case is warped, locking the case may break the spine.

Remove loose surface dirt from the case's interior and exterior surfaces with a soft brush. Don't use other cleaning methods because the unprotected surfaces of both daguerreotypes and ambrotypes are extremely sensitive and must be handled with utmost care. Only a trained conservator should clean these materials following a careful assessment of need.

3. *How do I handle glass plate negatives and*

Collodion and gelatin glass plate negatives and transparencies are very susceptible to damage. Their weight, bulk, and inherent fragility often pose *transparencies?*

the potential for serious handling problems. When handling glass plate collections, follow these guidelines carefully:

- Never underestimate the weight of glass. When working with these materials, be sure to have a firm grip on all enclosures in which glass plates are housed.

- Always handle glass on a padded and smooth work surface. You can construct this type of surface by padding a rigid piece of eight-ply board with successive layers of unbleached linen followed by sheets of lens tissues attached to the reverse of the work surface with pressure sensitive tape. As the surface becomes dirty, the sheets of lens tissue can be easily removed.

- Never handle the emulsion surface of a glass plate negative or transparency directly. Wear unpowdered latex gloves, since cotton gloves may be awkward and are inappropriate for the handling of glass artifacts.

- Before removing glass plate negatives or transparencies from their original (and often opaque) storage enclosures, always examine them carefully to determine the negatives' condition. In some cases, binder layers may be actively flaking and/or partially adhered to their enclosures. Glass supports may be broken or cracked. Safe removal may require that the original enclosures be slit at two edges with a microspatula and the plate carefully removed without scratching the glass or emulsion.

- Duplicate these fragile materials whenever possible. Use the copies for duplication services and reference purposes in order to avoid unnecessary handling of the original materials.

4. *How do I handle film-base black-and-white negatives and transparencies?*

Carefully restrict access to all film negative or transparency collections. The chemical by-products of deteriorating film could be dangerous to staff and visitors, resulting in skin and eye irritation, headache, nausea, and respiratory difficulty

You can mitigate these effects by taking the following precautions:

- Improve room ventilation and air quality by changing the position of supply air registers and the overall level of air movement

- Use fans to maintain air movement while working with these collections

- Wear protective gloves at all times when handling film collection material

- Wear an appropriately rated respirator when handling large quantities of these materials. Respirators are not considered protective if facial hair interferes, because a proper fit cannot be assured. The respirators must be fitted to each employee. See NPS-50, *Guideline for Loss*

Control Management, Release No. 2, Chapter 32, Respiratory Protection Program, for detailed guidance.

- Limit exposure time by staff and visitors

See *MH-I*, Chapter 11, Curatorial Health and Safety, for additional guidance.

5. *How do I handle slide collections?*

- Handle slide collections carefully to protect them from physical damage, fingerprints, and dirt.

- Don't leave slides in illuminated viewers or on light tables for longer than is absolutely necessary. (Kodachrome slides are particularly sensitive to light fading.) Also, don't leave slides uncovered on desks and table tops, as this exposure to ambient light may induce irregular fading and image deterioration.

- Keep the projection time for original slides to a minimum and use expendable duplicates whenever possible.

- Don't use high-intensity xenon arc projectors or other projectors that have been modified to increase their light intensity. It is usually light, and not heat, that causes fading when a slide is projected. (Some slides, however, may be more susceptible to heat-related damage, such as those with silver images including Polaroid Polachrome instant color slides and all types of black-and-white transparencies.)

E. Preventive Conservation: Storing Photographic Collections in the Proper Environment

Environmental stability is essential to the longevity of all photographic collections. Where different types of photographic collections are stored in one space, you will need to set up many microenvironments in boxes or cabinets. Find the mean average humidity of what all materials in the room may need and use silica gel, humidifiers, or dehumidifiers as necessary to adjust the relative humidity. Specific materials need specific preventive conservation measures.

1. *How do I store photographic prints?*

Store photographic print materials at a **constant** relative humidity (RH) between 30% and 50%, in dark storage (boxed). Avoid RH fluctuations of more than 5%. Exposure to high relative humidity levels dramatically accelerates the rate of deterioration and can result in the oxidation of silver image materials, binder layer staining, mold, and even permanent changes in size and shape. Excessively dry conditions, on the other hand, may cause cracking, crazing, and embrittlement.

Store most photographic prints at 20°C (68°F) or below. Store contemporary color print materials at 4.4°C (40°F) or below.

The fading of color images is primarily controlled by the storage temperature and to a lesser degree by relative humidity. In all cases, carefully monitor temperature and relative humidity levels as described in *MH-I*, Chapter 4, Museum Collections Environment. See Figure R.2 for relative humidity and temperature requirements for various media.

Also, you will need to monitor and control (through air filtration) the levels of particulates and gaseous pollutants such as nitrogen dioxide, sulfur dioxide, hydrogen sulfide, and ozone.

Type of Photograph	Storage Temperature	Storage RH (Relative Humidity)
Most photographic prints, black and white negatives, direct positives, and transparencies	<68°F (20°C)	30-50% RH
Ambrotypes, daguerreotypes, and tintypes (Cased and Uncased)	65-68°F (18-20°C) ±2°	40-50% RH
Glass plate negatives and positives	68°F (4.4°C) ±2°	35% RH±3%
Black-and-white silver gelatin film based negatives cellulose nitrate and acetate	As low as possible	20-30% RH
Color photographic prints, negatives, slides, and positive transparencies	35-50°F (2-10°C)	20-30% RH

Figure R.2. Relative Humidity and Temperature Requirements for Photographic Media

2. *How do I store daguerreotypes, ambrotypes, and tintypes: cased and uncased formats?*

Daguerreotypes, ambrotypes, and tintypes are composed of a wide variety of materials. Store them at a RH of 40%-50% and temperature of 18°-20°C (65°-68°F).

Brass mats and preservers and iron supports of tintypes corrode at high relative humidity levels. Also, the glass used in glazing materials or actual supports for these photographic images is often chemically unstable. Don't store them in relative humidity conditions above 50% RH. On the other hand, leather, paper, and wood may become embrittled and cracked if stored in very dry conditions, contributing to structural deformations of the case. Maintain the relative humidity for these materials above 40%.

3. *How do I store glass plate negatives?*

Historic glass plate negatives are complex, laminate objects that require specific and controlled storage environments. The safe relative humidity range for the storage of glass plate negatives at room temperature conditions is 35% ± 3%. Avoid temperature and relative humidity fluctuations.

If the relative humidity is too low (below 30%), you may see severe flaking of the image-bearing layer from its glass support. If RH is too high (greater than 40%), you may see glass corrosion, silver image deterioration, microbiological attack, and even physical damage to the binder layer and varnish coatings.

4. *How do I store film-base*

One of the most pressing problems facing large photographic holdings is *black-and-white negatives?*

the active and rapid deterioration of their film-base negative collections. Many unique images exist only as negatives. You will need to give the preservation of their informational content the highest priority.

Store these materials at 20%-30% RH and at temperatures as low as possible.

A very significant increase in film life is possible when storage humidity is lowered below 50%. Lowering the RH from 50% to 20%, for example, can improve expected film life four-fold.

Some other storage considerations for film-base negatives:

- Use a cold storage vault or commercially-available frost-free refrigerator or freezer to retard deterioration and prevent irreversible loss. Select these units carefully and monitor them routinely for temperature and relative humidity levels. See Section F.10.

- Restrict access to the materials housed within these units to staff who have been instructed in the procedures for collection retrieval of refrigerated or frozen items.

- Pack the negatives carefully in boxes. House negatives in Ziplock brand bags with humidity indicator strips.

- Use copies to access the original negatives in cold storage for copying or reference. If you must remove the originals for any reason (such as if you have a power outage of greater than 48 hours) allow them to acclimatize at room temperature for several hours before allowing access and use.

- Store deteriorated film-base collections in a well-ventilated location.

- Segregate nitrate films from other collections, preferably in their own freezer.

5. *How do I store color photographic collections?*

Color materials, including color negatives, slides, positive transparencies, and prints, are considerably more complex in construction than contemporary black-and-white materials. The storage environment is important.

Store these materials at 20-30% RH with a maximum temperature of 2°-10°C (35°-50°F). Store them for long-term at the lower rate, and be sure to avoid cycling. With color print, negative, transparency, and slide collections, storage *temperature is the most significant factor* in determining the rate of image fading and staining. Each -12°C (10°F) reduction in temperature will approximately double the life expectancy of color materials, as long as they aren't removed regularly from cold storage. High RH levels (greater than 65% RH) will promote the growth of fungus on emulsions, resulting in irreversible damage.

Color photographs are typically composed of at least three separate dye layers, consisting of cyan, magenta, and yellow organic dyes. The specific deterioration of these color photographic processes is often characterized by an overall loss of density; shifts in color balance caused by the unequal fading of the cyan, magenta, and yellow dyes; changes in contrast; loss of detail; and overall yellowish staining.

In addition, color photographic prints may crack and delaminate due to exposure to light or to widely fluctuating relative humidity.

> ***Color image deterioration is the result of inherent instability of organic dyes. Consult Henry Wilhelm's and Carol Brower's book, The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures for more specific information on identifying and categorizing these unique deterioration characteristics.***

6. *What characteristics do I need to know about color photographic collections?*

- ***Dye fading that occurs in dark storage.*** Like light fading, dark fading stability is also specific to the type of color film or print materials. The rate of dark fading is primarily a function of temperature and typically results in a final shift in color balance, as the cyan, magenta, and yellow dyes fade at differing rates.

  Some color processes, such as Ilfochrome and Kodak Dye Transfer, are very stable in the dark. Kodachrome slide film is more stable in dark storage than Ektachrome slide film. Ektachrome, however, is more stable than Kodachrome if they are routinely projected.

- ***Dark storage yellow stain formation.*** This type of deterioration typically occurs with some color (chromogenic processes, including Kodachrome and Ektachrome) materials and often is a more serious problem than dye fading. For example, many Kodacolor prints dating from 1942-1953 now exhibit severe yellow stain formation especially prominent in their margins. This discoloration is caused by the unstable magenta dye-forming color couplers that remained in these prints following processing.

- ***Choice of processing method.*** The method of processing (stabilized or water wash) will often directly influence final image stability and the rate of stain formation. The image stability of instant color photographic processes (a stabilized process), for example, is very poor. Objectionable levels of yellowish stain may be observed in these stabilized, non-water washed materials after only a few months of dark storage.

- ***Processing shortcomings.*** Decreased dye stability and/or increased stain levels may result if color materials are processed using improperly replenished or contaminated chemicals or if the photograph isn't washed adequately so that residual processing chemicals remain. See Section G for a list of ANSI standards.

- ***Image fading, staining, or physical deterioration.*** These factors may be worsened by post-processing treatments. The application of lacquers, retouching materials, and high-pressure mounting techniques may adversely affect a photograph's final image stability.

F. Preventive Conservation: Housing Photographic Collections

1. *How do I house photographic prints and negatives?*

Consider funding and staffing, environmental conditions, and the use of the collection when deciding which type and style of enclosure to use. Individually folder, sleeve, or interleave mounted and unmounted photographs within acid-free boxes or stainless steel file drawers. Suitable photographic enclosure materials may be composed of chemically stable plastic or unbuffered, neutral pH paper materials. See *COG* 14/2, Storage Enclosures for Photographic Prints and Negatives.

Use the following guideline when selecting and ordering supplies, and require that the vendor meet its specifications: ANSI Standard IT9.2 1991, *Photographic Processed Films, Plates and Papers - Filing Enclosures and Storage Containers* (see Section K).

See the NPS Tools of the Trade (TOT), A Listing of Materials and Equipment for Managing Museum Collections, for sources of housing materials as well as other curatorial supplies discussed in this appendix.

2. *What about paper photographic storage enclosures?*

Paper storage materials must have passed an accelerated aging test known as the Photographic Activity Test (PAT). (Check with the vendor.) The PAT determines whether there will be harmful chemical or physical interactions between a photograph and its paper enclosure over its storage lifetime. (The PAT is described completely in ANSI IT9.16-1993.)

Photographic storage enclosures made of paper should have a high alpha cellulose content, a non-degraded form of cellulose frequently found in high-rag-content paper most desirable for paper to be permanent. Paper enclosures should contain no lignin, ground wood, or alum-rosin sizing. Printing ink shouldn't bleed or transfer, nor affect the image of the photograph.

The enclosure materials should be pH neutral at 7-7.5, and the paper *must be unbuffered* (not have an alkaline reserve). Current research, however, indicates that using buffered enclosures to house salted paper, albumen, gelatin, platinum, and collodion processes isn't detrimental provided humidity levels are maintained. It isn't necessary therefore to replace present buffered enclosures with unbuffered materials; however, purchase unbuffered paper enclosures when choosing new supplies.

Contemporary color processes, most particularly dye transfer and cyanotypes, require the use of unbuffered papers and enclosures.

There are a number of advantages and disadvantages in using paper enclosures for photographic storage. They are easy to write on and are generally less expensive than plastic materials. They are opaque, thereby protecting photographs from light. Unfortunately, this requires the users to remove each photograph from its individual paper enclosure prior to examination, which increases the possibility of damage.

All enclosures should be standardized and made to fit easily in acid-free boxes. Identify the photographic image in pencil on the outside of each folder before inserting the print.

Paper enclosures are available in several forms including envelopes, seamless enclosures, and folders. Try to use the four-fold seamless storage enclosure; it has no adhesive seam to attract moisture and contribute to image deterioration. You can easily remove the image from the enclosure without danger of abrasion. You can, however, support fragile materials on two-ply ragboard (of neutral pH bond) by placing the ragboard behind the image within the envelope to provide better support.

You can also place prints in individual acid-free folders, even placing several photographs in one folder. In this situation, interleave each photograph with a neutral pH, unbuffered sheet of paper which has been cut to the size of the folder. Don't place more than 15 items in a single folder.

Various types of unbuffered paper envelopes are available from conservation supply companies. Use envelopes with a narrow side seam, sealed with a non-hygroscopic and non-reactive adhesive, rather than a thick central seam. During storage, be sure the emulsion or binder side of the photograph faces away from the seam. Use envelopes with a top flap, as the flap prevents dust from entering the envelope. Each envelope should only hold one photograph; when this isn't possible, interleave them.

Don't use glassine or kraft paper envelopes for photographic storage.

You can mat mounted and unmounted photographs with 100% acid-free neutral pH ragboard window and back mats. See *COG* 13/1, Window Mats for Paper Objects. Fragile, damaged or severely warped mounted photographs as well as all photographs exhibiting a flaking binder layer may require sink mat and mount housing for additional protection. A sink mat is a museum mat for paper objects that has a recessed section in the bottom sheet that protects the paper object from contact with the overmat or cover sheet. Use sink mats for photographs that have been hand-colored with friable media such as charcoal, pastel, conte crayon, and similar media that can easily be smeared, as well as for photographic prints that have damaged surfaces.

Never dry mount onto secondary supports or laminate previously unmounted photographic prints.

Matted photographs may be hinged into their back mats with long-fibered Japanese tissue hinges attached with wheat starch paste, or mounted with good quality paper photo corners. Don't use polyester photocorners, particularly on fragile images, because they can cause abrasion. Don't use hard plastic corners or flanges because they may not be chemically neutral and some have sharp edges that may scratch, abrade, or emboss a photograph.

Paper photo corners, which should be as large as possible, are the most convenient and safe means of attachment when used properly. You can fabricate these in-house from acid-free dense paper or purchase them from a conservation supply company. See *COG* 14/1, Making Mounting Corners for Photographs and Paper Objects. Any photograph with edges covered by the window mat may be mounted this way if it is strong enough to withstand its own weight resting on its lower corners while on display. The corners should be loose around the outer edges, to allow the photograph to expand with changes in relative humidity.

Reinforce the corners with a strip of archival quality linen tape or with pressure-sensitive tape adhered to the back mount. (The recommended pressure-sensitive tape for archival purposes is 3M 415 double-sided, polyester transparent tape coated with an acrylic adhesive.)

For storage, insert a sheet of unbuffered, lightweight neutral pH paper or polyester film between the photograph and the window mat to guard against abrasion. Examine carefully previously matted materials to determine their construction and materials stability.

3. *What about plastic photographic enclosures?*

Use plastic enclosures because they have the advantage of allowing an image to be viewed without removing it from the enclosure. This technique *greatly* reduces the possibility of handling damage and is ideal for large, high-access collections that haven't been copied.

If you use plastic enclosures, give special concern to humidity control. Photographic emulsions may stick, or "ferrotype," to the slick surface of these materials.

Use plastic materials ONLY if you can maintain relative humidity below 70%.

Suitable plastic enclosure materials include uncoated polyester and polypropylene. Don't use the following materials for housing photographic prints, negatives, transparencies or slides: chlorinated plastic such as polyvinyl chloride (PVC) or polyethylene sheeting, highly plasticized sheeting or coatings, or cellulose triacetate film.

Because of the build-up of static electricity, don't use plastic materials, especially polyester film, for housing photographs that have a flaking or friable binder layer or applied color.

Don't use plastic housing materials for images on glass, either negative or positive, as they are very prone to image flaking.

Also, one side of some polyester film photographic storage sleeves is slightly matted to avoid ferrotyping. The matting is done with silica dioxide or through roughening of one surface. Don't use these "matted" or "frosted" films for photographic storage.

You can choose from a wide variety of plastic enclosure designs available from conservation supply companies. Here are a few examples:

- ***Plastic sleeve.*** The sleeve is a plastic enclosure that opens along two or three sides. One particular polyester sleeve design you may want to use opens along both long sides with a flap. The flap allows inserting and removing of the photographs without potentially dangerous sliding. "L" sleeves, sealed along a long and short edge, also allow for easy and safe access to a photographic print.

  You can cut neutral pH, unbuffered mat boards (.01"-.02" thickness) to standard sizes and then insert them into the plastic sleeve, behind the photograph. The clear plastic sleeve allows the photograph to be viewed without being removed, and therefore protects the photograph from scratches, dirt and fingerprints. The neutral pH, unbuffered board neutralizes acids, provides fragile photographs with additional support, and allows the print to be identified without labeling directly on the image.

  Take care when handling sleeved photographs, since they may slip or fall out of the open sides of the enclosures.

- ***Polyester folder.*** This enclosure is made by welding two sheets of polyester film together along one edge. These folders are most successful when used inside neutral pH, unbuffered paper envelopes. The polyester folder protects the photograph from handling whenever you remove it from the envelope.

- ***Polyester sheet with multiple pockets.*** You can use this system for housing small mounted and unmounted photographic prints within a larger-sized standard folder. It consists of two polyester film sheets that have been welded together to form standard-sized clear polyester film pockets or pouches. To maintain the original order of a collection, all images should be of the same size if this system is being used. Therefore, it may not be practical for a varied size collection.

- ***Unbuffered acid-free folder with polyester film overlay.*** This paper folder has the addition of a sheet of clear polyester film attached to its inside, along the right margin. It can be made in-house or purchased from archival vendors. This storage enclosure is particularly effective for housing unmounted and fragile albumen photographs that often have a strong tendency to curl.

- ***Polyester/ragboard enclosure.*** These "handling folders" are available commercially in standard sizes. They consist of a sheet of polyester film adhered at two edges in an "L" shape, adhered to a fractionally larger sheet of four-ply buffered acid-free ragboard. The photographic print is slipped under the polyester sheet and housed flat. This enclosure provides unmounted and fragile photographic prints with additional protection. However, mounted photographs are more likely to slip and slide within it, so this design isn't appropriate for all photographic formats.

4. *How do I house panoramic (oversized) prints?*

Panoramic prints, usually longer than "normal" photographic prints, are often found in a tightly rolled and vulnerable configuration. While you can flatten a loosely rolled print by placing it between two pieces of clean, dry, blotting paper under weights, many tightly rolled prints will crack and tear irreversibly if forced open without the proper humidification and flattening procedures. Consult a trained photographic conservator if in doubt.

You can house flattened panoramic prints in polyester film sleeves with a fold-lock closure at the long edge. You can purchase pre-welded lengths of rolled polyester in a variety of widths that can be cut to size as required. You can also insert a four-ply ragboard support into the sleeve for increased protection. Be sure to transfer any identification information from the back of the print to the back of the board *before* housing the print in the sleeve.

You also may house panoramic prints flat in heavyweight paper folders. In some instances, it may be necessary to house these large format materials rolled onto neutral pH unbuffered tubes. Take care that the diameter of the tube is sufficiently large (4" or greater) to ensure adequate protection of the photograph. Once rolled with the binder side inward, cover the tube with polyester film, attached with a Velcro button closure.

5. *How do I containerize sleeved prints?*

Once they are housed in individual storage enclosures, you can place photographic prints in acid-free file folders and special acid-free storage boxes that are free of lignin, ground wood, and alum-rosin sizing. Paper and board stock used to construct these storage boxes may be buffered (have an alkaline reserve). Use flat storage, in shallow acid-free boxes or flat file drawers, for fragile photographs and those that are adhered to brittle mounts. Be sure that all folders or enclosures exactly fit the inner dimensions of the storage box, so that they will stack neatly and not shift dangerously.

If they are in generally good condition, you can store 10" x 12" or smaller photographs upright in boxes or acid-free hanging file folders. Boxes and file cabinets must not be overcrowded, but also must not be so loosely filled that all support is lost. Equip vertical file drawers with rigid support of metal or acid-free mat board every 6"-8".

Fire resistive (insulated) filing cabinets are not recommended because they don't use space efficiently. They also are bulky for storage areas, and very expensive. A better storage method is to house photographs upright in boxes on steel shelving units.

6. *What storage techniques do I use to rehouse photographic materials?*

No single storage system is ideal for all photographic materials. Base your storage decisions upon format, type, condition, use, and value of the photographs. Those materials that are most heavily used should probably be rehoused first, followed by original photographic prints of high value and/or in fragile condition. A strategy for setting priorities is described in *COG* 19/10, Reformatting for Preservation and Access: Prioritizing Materials for Duplication. In order to reduce damage caused by handling, house those photographs most often used and requested in plastic enclosures. In all cases, use standard-sized storage enclosures only.

Photographic objects are particularly susceptible to the potentially reactive and volatile by-products released by some of the materials used in the manufacture of storage cabinets. Use only galvanized or stainless steel cabinets or steel cabinets coated with a baked-on-enamel finish or non-reactive powder coatings. These powder coatings are made by electrostatically applying powdered epoxy resin that is fused to the enamel finish with heat. No solvents or plasticizers are used in the process.

Remove paper clips and staples from all photographs before storing them. Rusty paper clips or staples or other metal attachments may permanently stain, fade, emboss, and/or tear photographic prints. See *COG* 19/5, Removing Original Fasteners from Archival Documents.

During rehousing, examine all photographic items to assess the need for further preservation treatment. Learn to identify those deterioration problems that require immediate conservation treatment, such as photographic materials exhibiting actively flaking binder layers, the presence of pressure-sensitive and rubber-cement adhesives, and severely deteriorated and embrittled primary and secondary supports.

The presence of active mold growth is another critical problem that you should address immediately. You can prevent continued bio-deterioration by removing spores via aspiration, and then controlling the environment stringently.

7. *How do I house daguerreotypes, ambrotypes, and tintypes: cased and uncased formats?*

These objects are frequently found housed in their original decorative folding cases that were often constructed of wood covered with embossed leather or paper. The photographic images are protected by a lacquered brass mat and a cover glass, usually bound together with paper tape and further covered with a decorative brass foil or preserver.

Each miniature-cased object should have individual housing protection in the form of a wrapper or container that conforms to its three- dimensional format. You can house cased photographs in individual, custom made, four-flap boxes of heavyweight acid-free folder stock. Boxes are also available from a variety of conservation suppliers in stock sizes.

Write the catalog number and other identifying information in pencil on the outside of the box. If possible, use acrylic adhesive on 3M mounting tape to adhere a 35mm contact print of the image to the outside of the storage box to help minimize handling of these fragile artifacts. Store the arranged cases flat, by size, in acid-free boxes or padded drawers. Vertical storage may be necessary for larger collections where space is a problem.

- ***Loose daguerreotype plates***. These materials are extremely vulnerable, so give them the highest priority for protective housing. This may consist of a sink mat (see Section G), alumina silicate cover glass, and a pressure-sensitive tape seal. The sink mat may be fabricated from an acid-free unbuffered ragboard or die cut from 60 point polypropylene sheeting. To ensure adequate protection, use ragboard that has passed the PAT. When purchasing ragboard, check vendor's specifications. Filmoplast P-90 and Permacel J-Lar 4000 pressure-sensitive tapes have been successfully used for binding daguerreotypes. These chemically stable tapes are both manufactured using an acrylic adhesive. J-Lar provides a better barrier to moisture. The specific composition of these tapes may change in time. Therefore, rehoused daguerreotype plates must be carefully monitored to ensure that their deterioration isn't progressive.

Identify actively deteriorating cover glasses and replace them, as time permits, with contemporary glass. Ask a conservator to supervise all uncasing and resealing operations.

- ***Loose ambrotypes***. House loose ambrotypes in four-flap neutral pH paper enclosures or envelopes. Protect the glass support from breakage by including a four-ply neutral pH ragboard sheet. House broken or cracked ambrotype supports in a sink mat, or sandwich them between two sheets of ragboard to await further treatment. Note that the ambrotype's surface is easily abraded and scratched, although the surface isn't as delicate as the daguerreotype's surface.

- ***Loose tintypes***. House loose tintypes in good-quality paper or plastic, such as polyester and polypropylene film, enclosures. Four-ply ragboard inserted behind the tintype will provide its flexible support with additional protection. House sleeved tintypes vertically in acid-free boxes (never in plastic enclosures).

For tintypes that exhibit a flaking collodion binder layer, use four-flap paper enclosures only.

8. *How do I house glass plate negatives and positives (lantern slides)?*

Use a four-flap neutral pH paper enclosure for storing glass plate negatives and lantern slides in good condition. These enclosures should meet ANSI IT9.2 specifications (see Section K).

Storing each plate in its own enclosure prevents rubbing and abrasion on the plate. When using the four-flap enclosure, place the glass plate image in the center with each flap carefully folded over the emulsion side. This avoids the necessity of sliding the image in and out of the enclosure. Write any pertinent information in graphite on the outside of the seamless enclosure before the image is inserted. Some commercially made paper sleeves aren't suitable for glass plate storage, as photographic emulsions can be irreversibly damaged through the action of sliding the plate in and out of an envelope.

Never use plastic sleeves, envelopes, or folders with glass plates. Don't place glass plates in cold storage.

Caution: Only excessively dirty materials and/or those designated for duplication require cleaning. You should only attempt this cleaning after determining the emulsion side of the glass plate, usually the less glossy side. (If a question remains, consult a conservator.) During rehousing, carefully clean the non-emulsion or base side of the glass plate with a soft brush followed by a cloth slightly dampened with distilled water. Don't allow moisture to come in contact with the emulsion side of the glass plate.

House all glass plates according to size after making careful notes on their original order. Store glass plate negatives and lantern slides that are in good condition and smaller than 10" x 16", vertically (upright) on their long edge within the sleeves. Store them in metal file drawers or in acid-free, flip-top, reinforced boxes that contain no lignin, ground wood, or alum rosin sizing.

In each case, cut pieces of four-ply neutral pH ragboard to the size of the enclosures and place them as rigid dividers between every five to ten individually enclosed plates. These dividers will help support the weight of the plates and will also ensure that these fragile glass plates remain in an upright position as the collection is accessed by staff. Insert additional dividers or wedges to fill up extra space in a box or drawer.

Don't use traditional wooden grooved boxes for glass plate storage.

Cracked or broken glass plates should be duplicated to eliminate the need for further handling. Support them on their emulsion side with a clean, clear single-weight piece of high alumina silicate glass or non-textured Plexiglas of the same dimension. Protect the supported plate on both sides with four-ply neutral pH ragboard also cut to the size of the damaged negative. Then seal the sandwich at all edges with Filmoplast P-90 pressure-sensitive tape, and note the subject matter and condition on the ragboard support.

House glass plate negatives that exhibit active flaking or deteriorated binder layers and/or broken glass supports in custom-made neutral pH sink mat housings. Build these mats out of acid-free, single-walled corrugated board, laminated together with 3M 415 double-sided pressure-sensitive tape. Use neutral pH ragboard shims, attached to the back mat with 3M 415 tape to separate glass fragments to prevent abrasion along broken interfaces. Construct each sink mat with a hinged lid and be sure its height is sufficient so that its lid doesn't come in contact with the negative's surface. Standardize the outer dimensions of all sink mats.

In most cases mending isn't required and protective housing as described above should be sufficient. If mending is deemed necessary, ask a conservator to do it.

Finally, mark all folders and boxes containing glass clearly with the word "GLASS." Don't house boxes of glass plate negatives on upper or bottom shelves where they may be difficult to reach or lift.

9. *How do I house black-and-white negatives?*

Use three layers of protection when storing black-and-white negatives.

- Place each negative in a sleeve
- Place each sleeve in a box or drawer
- Place each box or drawer on a shelf or in a cabinet

House nitrate and acetate film-base materials in chemically stable buffered paper enclosures that meet ANSI IT9.2 specifications (see Section K).

House sheet film negatives in four flap seamless enclosures or envelopes with a side, rather than central, seam. If envelopes are used, insert the negatives so that their emulsion surfaces face away from the seam.

> ***Don't use plastic materials including Mylar polyester for the storage of nitrate or deteriorated acetate negatives.***

10. *Why do I place color photographic collections in cold storage?*

Cold storage is the only way to preserve color photographs in their original form for long periods of time. Therefore, with valuable color collections, be sure to use humidity-controlled cold storage for originals and copies for reference and duplication purposes.

Cold stored masters should be the originals, regardless of process. Duplication and viewing copies should be available so that the original images don't need to be removed from cold storage. Each generation of copies loses some image detail and has some color shift. Avoid introducing a copy as the master, because subsequent copies are apt to be too distorted.

While all color photographic materials will benefit from cold storage, according to Henry Wilhelm there are specific color photographic processes for which cold storage is particularly imperative. These include pre-1984 Ektacolor, Fujicolor, Agfacolor, and Konica Color prints; all pre-1991 Kodak Ektachrome prints; color negative films, especially Ektacolor, Vericolor II, Kodacolor-X, and Kodacolor II; and color transparency films such as Process E-1, E-2, E-3, and E-4 Ektachrome films, ANSCO and GAF films.

The majority of color slides are one-of-a-kind transparencies produced by the reversal processing of chromogenic (Kodachrome and Ektachrome) film. No negative remains. The most important factors you need to consider in determining the useful life of color slides is their inherent dye stability and resistance to stain formation during aging. Improper processing of color materials can also adversely affect image stability.

The stability of color transparency film varies considerably. Kodachrome film, for example, is clearly the most stable transparency film in dark storage, yet it has the worst projector fading stability of any slide film currently available. E-6 Ektachrome film, in comparison, will develop high levels of yellow stain during dark storage but is more stable than Kodachrome when projected.

11. *How do I determine what is appropriate cold storage?*

You can create cold storage either by using a frost-free refrigerator or by constructing a cold storage facility. The latter option is significantly more costly and only appropriate for large collections of materials for which the use of refrigerator units isn't feasible.

12. *What do I need to know about storage in a frost-free refrigerator?*

Refrigerated storage is vital for the long-term preservation of pre-1984 Ektacolor, Fujicolor, Agfacolor, and Konica Color prints; all pre-1991 Kodak Ektachrome prints; color negative films including Ektacolor, Vericolor II, Kodacolor-X, and Kodacolor II; and color transparency films such as Process E-1, E-2, E-3, and E-4 Ektachrome films, ANSCO and GAF films.

A frost-free refrigerator will effectively slow the fading rates and greatly extend the life of color photographic materials. See *TOT* for specific makes and manufacturers. Operate these refrigerators in a well-ventilated room, but not in the museum storage room. They give off a considerable amount of heat. In the event of a power failure lasting longer than 48 hours, unplug the unit and leave the door open until the power is restored.

- ***Environmental Monitoring and Control***. Maintain refrigerators properly. Monitor temperature and humidity levels at all times, ideally through the use of a datalogger drilled and attached to the refrigerator for external monitoring. Use conditioned silica canisters to help maintain the relative humidity. Place a separate thermometer in the refrigerator compartment where temperatures should be adjusted to 1.7°-4.4°C (35°-40°F).

- ***Fullness.*** Don't pack the refrigerator too tightly as constant air circulation is essential. You can use the vegetable and fruit storage drawers, but never place photographic collections directly on the bottom of the refrigerator compartment. Don't block the vent for forced cold air, and don't keep food and drink in the refrigerator.

- ***Housing*****.** Package all color films and prints in envelopes and boxes and place them in polyethylene bags, such as heavy duty freezer Ziplock bags, or wrap them in polyethylene with all seams carefully sealed with freezer tape. Slide collections, packaged in paper or plastic boxes or slide pages, should also be sealed with polyethylene. This eliminates the need for pre-conditioning and prevents moisture condensation on the collection materials when the refrigerator door is opened or when they are removed and warmed to room temperature. Place moisture indicators inside the bags to help monitor environmental conditions.

  If it is unavoidable, then carefully seal all photographs in vapor proof enclosures such as heat-sealable, aluminum foil envelopes. In doing so, precondition these materials at a low (30%-40%) relative humidity. These kinds of storage systems come with a constant risk of improper seals and punctured enclosures, so they tend to reduce, and in some cases realistically eliminate, access to the collection.

- ***Preconditioning.*** Pre-condition valuable photographs by storing them for several days at a low relative humidity for maximum safety. Keep objects in the surrounding environment several hours while they reach equilibrium with the surrounding air. Then seal them in vapor-proof envelopes and place them in the refrigerator.

- ***Retrieval Guidelines.*** Develop proper collection retrieval guidelines in consultation with a conservator. Warm-up times will vary and are dependent upon the amount of materials being removed. Don't routinely retrieve collections from cold storage. Instead, use access and duplication copies for research access and copying.

  Allow a collection to warm up for 24 hours if you must retrieve it. During this time the collections should remain wrapped in polyethylene bags to prevent moisture condensation. Air should be allowed to circulate freely around the collections as they gradually warm to room temperature.

- ***Refrigerator Selection.*** If at all possible, don't use a freezer, or an older manual defrost or newer cycle defrost (energy saver) refrigerator. The unit should have separate refrigerator and freezer compartments. Both compartments must be guaranteed to be frost-free.

  – Cooling coils in the unit should be located only in the side of the freezer section. No part of the refrigerator or freezer that condenses moisture or forms ice crystals should be visible in the unit.

  – Air should be forced over the cooling coils and into the freezer section by an internal fan.

  – All cooling in the refrigerator section should come from cold air blown in from the freezer section by an internal fan.

13. *What do I need to know about storage in a cold storage vault?*

Because the design and construction of a cold storage vault for photographic materials requires specialized knowledge, you will need to select an experienced contractor and consult with curators, archivists, and conservators familiar with cold storage systems.

- ***Environment.*** For optimum protection, experts may recommend vault temperatures of -18°C (0°F) and relative humidity levels of 30%. These levels are difficult and expensive to maintain and aren't ideal in situations where collections are regularly accessed. For these reasons, many cold storage vaults in the United States are currently operating at 4.4°C (40°F) and 40% RH. Whatever the temperature, humidity cycling must be avoided in all cases.

  Equip your vault with redundant and independent environmental systems in the event of equipment failure. Install air filtration systems to remove acetic acid and oxidizing gases. Outside the storage, install automatic dry-desiccant dehumidifiers with high efficiency particulate air (HEPA) filters. All cold storage vaults should have automatic shutdown systems that will activate when deviations from pre-set limits of temperature and relative humidity occur.

- ***Housing***. Storage in a low temperature vault requires that the photographic materials be placed in acid-free boxes, portfolio cases, motion picture cans, and other enclosures safe for the long-term storage of photographs. Vapor-proof packaging isn't required.

- ***Retrieval.*** You also need to be aware that regular and constant retrieval of materials from cold vaults will directly affect their projected life expectancy. Heavily accessed materials may not benefit as significantly from storage in low temperature vaults—below -9.5°C (15°F). Therefore, be sure to make use and duplication copies of rare or fragile materials ***before*** placing the items in cold storage, so that the originals can fully benefit from cold storage and be preserved for a maximum lifetime.

Place packages removed from the vault in polyethylene bags and allow them to warm up gradually. Small packages, such as a single matted color print, should have very short warm-up times and should be available for use almost immediately upon removal from cold storage.

14. *When can I remove original photographic materials from cold storage?*

Don't remove originals from cold storage except in three cases:

- power outages of longer than 48 hours
- visits by photographic researchers who are studying details of process, format, and image manipulation
- the need to replace a damaged, deteriorated, or lost copy negative

15. *How do I house color slide collections?*

Color slides not in cold storage, such as those that may be heavily used, should be enclosed in individual polypropylene or triacetate sleeves, unless kept in permanent or inactive storage. These sleeves should fit tightly around each slide so that the slides won't fall out. These sleeves aren't necessary for glass-mounted slides because glass mounts offer protection from fingerprints and scratches. Glass mounts don't reduce the rate of fading associated with dark or light storage.

You can also house slide collections in polypropylene slide pages, available in several gauges. (These pages may be used in conjunction with individual acetate sleeves.) The heavier gauge (5.0) is recommended for its superior handling characteristics. Rigid, open frame polypropylene Saf-T-Stor slide pages supplied by Franklin Distributors Corporation are also recommended. Avoid polyvinyl chloride (PVC) pages as well as low density polyethylene. Polyethylene's physical strength is inadequate and the presence of anti-block and slip agents that have been incorporated during manufacture may promote ferrotyping of the slide surfaces.

You can house large slide collections in acid-free boxes fitted with movable interior dividers or in baked-on enamel or powder-coated cabinets, but be sure that non-glass mounted slides are carefully protected from handling.

G. Preventive Conservation: Exhibiting Photographic Collections

1. *How do I exhibit photographic prints?*

The recommended environmental conditions for the exhibition of photographic print materials are identical to those for storage: 30%-50% RH and 20°C (68°F). Never exhibit photographic prints for more than four months per year.

> ***Never place original photographic print materials on permanent display. Consider exhibiting facsimiles or copy prints where the use of original prints isn't essential.***

Restrict illumination, either artificial or natural, for display of most nineteenth century photographic print materials to 50 lux (5 footcandles). This standard applies to all photographic materials which have exposed paper fibers, such as salted paper, platinum, and cyanotype; photomechanical processes, such as collotype and photogravure; and albumen photographs. Fifty lux (5 footcandles) also is recommended for photographic prints that have applied color such as hand tinting and/or tinted binder/baryta layers. Prints with untinted baryta layers, most silver gelatin and collodion-chloride processes, may tolerate up to 100 lux (10 footcandles) exposure.

Never expose photographic materials to direct sunlight or ultraviolet radiation. If possible, use tungsten (incandescent) or fiber optic illumination instead. Incorporate filters and diffusers with all case lighting.

It's also a good practice to monitor the condition of photographic prints at frequent intervals while they are on display. Photochemical damage is usually most apparent as a difference in appearance between exposed print areas and those protected by the window mat. You can find procedures for monitoring print materials in Section K.

All framed photographs you select for exhibition should be paper hinged or photocornered into 100% neutral pH ragboard mats and glazed with ultraviolet filtering acrylic sheeting (Plexiglas). *Only* latex paints should be used to prepare walls and exhibition spaces, since the peroxides emitted during the curing of oil-base paints will accelerate silver image deterioration.

Finally, have a conservator stabilize any photographs that exhibit serious deterioration problems before exhibiting them. See *MH-I*, Chapter 8, Conservation Treatment, for guidance on conservation treatment.

2. *How do I exhibit daguerreotypes, ambrotypes, and tintypes: cased and uncased formats?*

A cased object consists of the photographic image, decorative brass mat, and cover glass. These components are usually sealed with paper tape and flexible brass preserver. The photographic images themselves aren't particularly light sensitive (for example, a daguerreotype plate won't fade upon exposure to light). However, the dyed decorative fabrics, paper, and leather integral to case construction, as well as some of the pigments used in hand coloring, are very susceptible to fading. Natural resin varnish layers on tintype and ambrotype surfaces may yellow upon exposure to light.

Exhibit cased objects within closed display cases at low light levels (50 lux or 5 footcandles) for limited periods of time.

You also should maintain stable temperature and relative humidity levels within these cases. A sudden rise in temperature may cause an ambrotype's black lacquer backing to irreversibly crack and craze or a daguerreotype's gilded surface to exfoliate.

3. *How do I exhibit color photographic collections?*

All color prints, with the exception of Ultrastable Permanent Color, will fade when exposed to light during exhibition. Different types fade differently with some lasting significantly longer than others. Never subject valuable or non-replaceable color prints to prolonged (more than one week) display. Use copies instead.

For most color print materials the spectral distribution of the illumination source, for example, incandescent versus fluorescent, has relatively little effect on their fading rates. In fact, it is the intensity of illumination that is important.

Keep illumination levels low: 50 to 100 lux (5 to 10 footcandles) is frequently recommended for the exhibition of color photographic material. Also, be sure to monitor prints with a reflection densitometer prior to and following exhibition, in order to have a qualitative record of a print's original condition and the complex changes that may take place following exhibition. Consult a photograph conservator for procedural guidelines to ensure that prints aren't damaged during the monitoring process and that the results are valid.

Color images deteriorate due to inherent instability of organic dyes. Wilhelm (previously cited) identifies and categorizes these unique deterioration characteristics. The characteristics pertaining to exhibited collections are as follows:

- Fading caused by exposure to light and ultraviolet radiation during display or projection. The rate of light fading is a function of the intensity of illumination and the duration of exposure. The rate of fading is also specific to each type of color film and print material. Most Kodak Ektacolor RC prints made between 1968-1977 and displayed for extended periods of time, for example, now exhibit severe image fading and color balance shift.

  The light fading characteristics of modern materials vary considerably. Most modern chromogenic color print materials have an ultraviolet-absorbing coating and, therefore, UV radiation isn't considered to be a major contributing factor to the light degradation of these materials. Most of the fading that occurs with these papers is caused by exposure to visible light. Ilford, Ilfochrome and Kodak Dye Transfer prints don't have UV-absorbing coating. These materials will be quickly and irreversibly damaged by exposure to ultraviolet radiation. Ektachrome slide film is more stable than Kodachrome when the processes experience regular exposure to light.

  In general, you should carefully restrict the exhibition of original color photographic prints and, where acceptable, substitute facsimile copy prints for long-term display.

- Light-induced yellow stain formation. For most modern color materials light-induced staining is a relatively minor problem when compared with the irreversible fading of cyan, magenta, and yellow dye layers.

H. Preventive Conservation: Inspecting Photographic Collections

1. *What is the Condition Checklist for Visual Images?*

The Condition Checklist for Visual Images provides a simple way for conservators or park curators who are familiar with visual images and their conditions to record the overall condition of an image, group of images, or collection, as well as the control numbers, location within a specific collection, physical process, format, and techniques, and specific deterioration conditions.

2. *How do I use this checklist?*

The form can be used to record this information for: a single image (for example, negative 5, of folder 9, of box 3, of collection X); a group of images (for example, negatives 43-97, of boxes 1-2, of collection X); an entire collection (for example, negatives 1-2000, of boxes 1-20, of collection X). When using the form for more than one image, check all categories that apply for that group of materials. You may need more specific data for planning purposes, such as the estimation of the amount of treatment work needed or rehousing needs. In such cases, use specific numbers to indicate the quantities of images that exhibit a specific trait (for example, brittleness 10 indicates that 10 images exhibit brittleness in the materials being evaluated).

3. *Where do I find the checklist?*

See Figures R.3a and R.3b for the checklist. An unpunched full size checklist accompanies this appendix. Keep the full size checklist as a master and make copies for your use.

I. Conservation Treatment Issues for Deteriorated Photographic Materials

1. *What does this section cover?*

This section describes appropriate treatments for different kinds of deteriorated photographic print materials in order to give you a sense of what will need to be done. In some cases, no treatment may be appropriate. In all cases, have a conservator treat these materials.

2. *Why use a conservator?*

In devising a valid treatment proposal, a conservator will evaluate the physical condition and chemical composition of all components that may be incorporated into these photographic materials, including the secondary support and its method of attachment, as well as the presence of hand coloring, retouching, and/or additional varnish layers. Historic and contemporary photographic materials are composed of a wide variety of organic and inorganic compounds, synthesized into a complex, multi-layered structure. The conservator will:

- consider potential reactions and interactions of these materials to proposed conservation treatment procedures.

- evaluate the photograph's historic and aesthetic integrity as well as the short- and long-term risks and merits of a particular treatment procedure

- identify the purpose (exhibition versus storage) and scope (single item versus large group) of a particular treatment in order to determine the nature and extent of possible reconstruction or restoration

- propose a viable treatment procedure to the curator that is based on all of these critical factors

3. *What are the ethical considerations?*

An accurate discussion of current conservation treatment practice should include an acknowledgement and understanding of the ethical principles and standard guidelines that conservators follow. All conservators are bound by a Code of Ethics. See *MH-I*, Chapter 8, Conservation Treatment, and Appendix D, Code of Ethics, for a detailed discussion of conservation treatment and the Conservator's Code of Ethics. These codes address the critical issues of treatment practice, such as:

- In the treatment of photographic materials, all actions must be governed by respect for the integrity of the photograph including its physical, historical, aesthetic, and cultural significance. The conservator must adhere to the highest and most exacting standards.

- The conservator must restore deteriorating materials according to an understanding with the owner, custodian and, in some cases, the photographer, if living. Conservation treatment must not modify or conceal the true nature of the object. It must be detectable, although it need not be conspicuous, and must be fully documented. A conservator must use appropriate materials and techniques that will have the least adverse effects and that can be removed most easily and completely. Conservation treatment procedures must not impede future examination or treatment possibilities.

US Department of the Interior
National Park Service

Condition Checklist For Visual Images

Control Numbers:

Accession number(s) ______________________

Catalog number(s) ______________________

Item number(s) ______________________

Negative number(s) ______________________

Collection Name: ______________________

Location(s) of the Item(s) in the Collection:

Box number(s) ______________________

Folder number(s) ______________________

Item sequence number ______________________

Other number ______________________

Photographer(s): ______________________

Dates: ______________________

Physical Description:

Process(es) ______________________

Format(s) ______________________

Size(s) ______________________

☐ Color ☐ Monochrome

☐ Negative Transparency ☐ Print(s)

☐ Positive Transparency ☐ Drymounted

☐ Matted ☐ Framed ☐ Cased ☐ In Album

☐ Autographed

General Condition Analysis:

☐ Excellent ☐ Good ☐ Fair ☐ Poor

Specific Condition Analysis:

(Check all that apply and indicate approximate quantities or percentages when dealing with large quantities)

a. Primary Support/Secondary Support:

☐ Brittleness ______________________

☐ High acidity ______________________

☐ Lignin content ______________________

☐ Cockling/buckling ______________________

☐ Curling ______________________

☐ Folds/creases ______________________

☐ Wrinkles ______________________

☐ Warp ______________________

☐ Tears ______________________

☐ Losses ______________________

☐ Holes ______________________

☐ Tack holes/punctures ______________________

☐ Adhesives ______________________

☐ Tapes ______________________

☐ Discoloration ______________________

☐ Waterstains ______________________

☐ Matburn ______________________

☐ Foxing ______________________

☐ Mold ______________________

☐ Insect/vermin accretions ______________________

☐ Dirt/grime ______________________

Figure R.3a. Condition Checklist for Visual Images (Sample)

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National Park Service

Condition Checklist For Visual Images

b. Image Layer/Media:

☐ Fading ______
☐ Color shift ______
☐ Discoloration ______
☐ Water stains ______
☐ Oleaginous stain ______
☐ Silver sulfiding or tarnishing ______
☐ Loss of highlight detail ______
☐ Loss of dense detail ______
☐ Loss of surface gloss ______
☐ Emulsion flaking ______
☐ Applied color flaking ______
☐ Bleeding/feathering of applied color ______
☐ Surface cracking/crazing ______
☐ Surface abrasion ______
☐ Embrittlement ______
☐ Media stuck to another object ______
☐ Emulsion softening ______
☐ Emulsion powdering ______
☐ Cockling/buckling ______
☐ Channeling ______
☐ Dimpling ______
☐ Emulsion bubbling or flow ______
☐ Binder migration ______
☐ Trim ______
☐ Cut ______
☐ Tears ______
☐ Losses ______
☐ Holes ______
☐ Adhesives ______
☐ Cloth tapes ______
☐ Plastic tapes ______
☐ Dirt/grime ______
☐ Dust ______
☐ Smoke damage ______
☐ Fingerprints ______
☐ Insect grazing ______
☐ Mouse chew ______
☐ Insect or vermin accretions ______
☐ Mold ______
☐ Foxing ______
☐ Other (Describe) ______

Additional Comments:

Figure R.3b. Condition Checklist for Visual Images (Sample)

4. *What treatments will the conservator use?*

While many of the conservation treatments discussed apply to both nineteenth- and twentieth-century photographs, they do *not* apply to contemporary color materials. The complexity of modern color materials eliminates most treatment options.

> ***It is important that these treatments be carried out by a conservator who specializes in photographic materials. Improperly done, these treatments will cause irreversible and catastrophic damage.***

Practical, reversible, and predictable conservation treatment procedures for deteriorated photographic print materials are continually being developed and refined. However, many questions remain unanswered. Many objects are left untreated as informed conservators advocate restricted handling and stringent environmental control for the preservation of particularly fragile materials for which treatment isn't, at this time, an option.

- ***Removal of Microorganisms***

  The organic constituents of photographic materials are vulnerable to microbiological attack associated with upper extremes of temperature and relative humidity. The most effective treatment in all but the most severe cases is modification of the environment and removal of the mold growth from the affected item by using a vacuum aspirator or tweezers.

  Mold removal may yield a fragile and disfigured surface, requiring careful consolidation and inpainting by a conservator. Primarily because of their potential toxicity and chemical reactivity, the use of fungicides or fumigants in the treatment of mold-damaged photographic materials has been curtailed radically. See *COG* 3/4, Mold and Mildew: Prevention of Microorganism Growth in Museum Collections, for guidance on monitoring and controlling the environment to prevent microorganism growth in collections.

- ***Consolidation of Flaking Binder Layers***

  In some cases, photographic images will exhibit moderate to severe flaking of their binder layer, thus requiring immediate consolidation by a conservator. (Consolidation is the application of an adhesive to improve cohesion between a deteriorated binder layer and its substrate.)

  Consolidation techniques also may incorporate the use of aqueous or non-aqueous solutions, the choice of which is typically dependent on the physical and chemical compatibility of the consolidant and its selected solvent with the deteriorated binder layer. The use of solvent-soluble adhesives such as acrylic resins, for example, may not be appropriate for the consolidation of a deteriorated collodion binder layer. Likewise, the high pH of acrylic dispersions, often ranging from 8.0 to 9.0, may prove problematic for use with proteinaceous binders. The conservator will also need to evaluate any additional properties, such as long- and short-term reversibility, flexibility, adhesive strength, chemical reactivity, and the possibility for irreversible visual alteration.

- ***Reduction of Surface Dirt***

  Photographic images exhibiting embedded dirt and grime may be carefully surface cleaned after a conservator has thoroughly evaluated the possibility for physical or chemical damage, as well as permanent alteration in surface reflectance or gloss. Conservators employ a variety of materials and techniques in an attempt to reduce dirt and grime layers effectively from photographic surfaces. These include soft brushes, non-sulphur-containing crumbled vinyl erasers, distilled water and organic solvent solutions applied with cotton swabs and/or balls.

  Severe structural damage to a binder layer may prevent dirt removal. This is often true of deteriorated albumen photographs, in which the egg white binder is severely cracked and crazed. The conservator must be extremely careful when cleaning photographs in which the final image material is embedded in the paper support, such as salted paper or platinum prints, as these images are abraded easily.

  On film-based negatives and transparencies and slides, park staff may use compressed air available in aerosol cans (for example, Dust-Off, Omit) to reduce surface dirt. This procedure should be performed under the guidance of a conservator and only on film in good condition with no evidence of physical damage. Some aerosol-canned products contain oily gray substances. Test first by spraying on a white blotter.

  Photographic materials that have accumulated a lot of surface dirt and dust may require immediate attention by a conservator, who will safely remove superficial loosely attached dirt with a dry, soft brush.

- ***Removal of Tapes and Adhesives***

  In order to safely remove paper hinges, residual adhesives, and pressure-sensitive tapes from a photograph's surface, a conservator may use direct or indirect moisture vapor, methyl cellulose poultices, aqueous solutions, organic solvents, and many other accepted paper conservation techniques.

- ***Removal of Poor-Quality Secondary Supports***

  The vast majority of historic photographic prints were mounted during manufacture, with mounts usually consisting of a poor-quality lignin-core board sandwiched between two thin, high-quality papers. Lignin decomposition products may react with proteinaceous materials such as albumen or gelatin, producing a highly colored compound and/or emitting oxidants such as peroxides and causing silver and dye image materials to fade and discolor. In addition, these secondary supports are often acidic and embrittled, posing serious structural danger to the photographs themselves. If this is the case, use extreme care in handling these fragile materials, and consider conservation treatment.

If undertaking treatments of this type, the conservator will consider the historic and aesthetic integrity of the photograph's secondary support. Through careful visual and microscopic examination, the conservator will evaluate the possible deleterious effects associated with the mounted photograph's adhesive and secondary support material, as well as the sensitivity of the photograph's component structure to possible physical or chemical damage during treatment.

Typical backing removal techniques involve mechanical removal, the local application of moisture vapor or steam, and/or immersion in aqueous or organic solutions. Treatment choice will be dictated by the photograph's structural and chemical condition. Inadequately hardened gelatin prints, for example, may swell dangerously when exposed to moisture. Exposure to moisture via surface cleaning, humidification or immersion will likely cause albumen binder layers to crack and craze, with a resultant loss of surface gloss. Many albumen and silver gelatin photographic prints, therefore, may require absolutely dry techniques, such as the use of metal or Teflon spatulas, for the safe removal of their deteriorated secondary supports.

- ***Humidification and Flattening***

  Humidification and flattening of rolled, cockled or warped photographic prints are critical operations that, if done incorrectly, may induce dimensional instability, irreversible damage to a binder layer, and/or irreversible staining in the photograph's primary support. However, a conservator can develop treatment strategies for the humidification and flattening of curled photographic prints and, in some cases, park staff can be trained to carry out these procedures as well.

- ***Chemical Treatment***

  An issue of considerable importance and active debate in the photograph conservation field today is the use of chemical treatment. The dire consequences of ill-advised treatments can't be ignored. For this reason, most practicing conservators agree that many chemical treatments, such as the bleach and redevelopment of faded silver images, particularly on fine art photographs, require more research before use.

- ***Structural Repair***

  Photographic prints exhibiting creases, tears, losses, and other structural damages may be mended by a conservator utilizing accepted paper conservation techniques. In most cases, the conservator can mend tears successfully by using the appropriate weight Japanese paper combined with wheat starch, gelatin, or methyl cellulose adhesive.

- ***Remounting of Photographic Prints***

  Photographic prints that have been removed from their mounts during treatment may require lining or remounting in an attempt to stabilize, consolidate, strengthen, and facilitate handling for exhibition and/or storage.

In selecting the appropriate mounting technique, the conservator will consider a variety of factors pertaining to the photograph's condition and appearance prior to and following mounting. The conservator must take into account the potential for cracking or crazing of an albumen binder layer, for example due to the expansion and contraction of a wet secondary support. This may occur in many currently practiced remounting techniques.

Methods used by conservators to remount photographic prints include:

– line unmounted photographs directly onto Japanese papers or rag papers and boards using methyl cellulose or wheat starch adhesives

– line a humidified photograph with Japanese paper and wheat starch paste onto a sheet of unbuffered two- or four-ply ragboard that has been counterlined on the reverse to minimize warpage

– adhere the unmounted photograph onto a smooth-surfaced rag paper with wheat starch or methyl cellulose adhesive

  The polyester fabric or "Dacron," which is then pasted onto sanded Plexiglas, acts to hold the photograph's secondary support under tension and is removed following drying.

The latter technique may be particularly suitable for the mounting of larger collections or holdings of photographic prints, as the cost of materials and time requirements can be minimized.

Each of these mounting techniques has distinct advantages and disadvantages. Discuss the ramifications associated with each of these options with your conservator.

• ***Compensation of Losses***

Following remounting, a conservator may inpaint abrasions, scratches, tear edges, and other disfiguring damage in a photograph's surface by using a variety of media, including watercolors, ground pigments in acrylic resins, and pastel pencils. In all instances, the conservator will first evaluate the long-term aging characteristics of the selected media and their "compatibility" with the damaged photograph in terms of chemical reactivity, solubility parameters, and surface qualities. The extent of compensation should also be discussed and agreed upon in collaboration with the curator or collection manager.

J. The Recovery of Water-Damaged Photographic Materials

See *MH-I*, Chapter 10, Museum Collections: Emergency Planning for guidance on emergency planning, and to Chapter 8, Conservation Treatment, for general rules on appropriate response to emergency situations involving museum objects.

1. *How should I recover water-damaged materials?*

If at all possible, water-soaked photographic materials should be air-dried, laid flat on a clean surface or hung on a line with clips that won't leave indentations (not binder clips). If you can't air-dry these materials, due to lack of personnel, facilities, and/or time, freeze them and then thaw and air-dry them later. Don't freeze glass plates or lantern slides.

Vacuum freeze-drying is the next preferable alternative. In this system place the photographs in a vacuum chamber either wet or frozen. The vacuum is pulled, a source of heat introduced, and the photographs, which dry at temperatures below 0°C (32°F), remain frozen until dried. Vacuum freeze-drying may result in a significant loss of gloss and/or a strong tendency to curl. The tendency to curl may be overcome by careful humidification following freeze-drying. In all cases, *avoid vacuum thermal-drying* whereby photographic materials are dried at temperatures above 0°C (32°F). As a result, photographic binder layers will have a strong tendency to block or stick together irreversibly. Don't vacuum freeze dry glass plates or lantern slides.

If photographs have been immersed in dirty water, a disaster recovery team should carefully wash them in changes of cold, preferably distilled, water prior to air-drying or freezing. Carefully monitor the condition of the photographs to ensure that binder layers or original ink annotation on mounts aren't being damaged. Some color processes may require bathing in a stabilizer prior to air-drying. Consult a conservator.

2. *What should I salvage first?*

In general, black-and-white photographic prints appear to be more resistant to water damage than contemporary color materials. Photographic film-base negatives are more resistant to deterioration than print materials. Depending upon the collection priority, you may want to salvage color materials first.

Mold grows after 48 hours above 65% RH and 21°C (70°F). Emulsions soften and stick if not separated during the drying process. During salvage, rescue the following first: silver gelatin processes (prints, negatives, and transparencies), glass plates, lantern slides, ambrotypes, daguerreotypes, color materials and acetate and nitrate film base. Albumen processes, collodion prints, salted paper prints, cyanotypes, and platinum prints can be done last.

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American National Standards Institute. (See following list of standards)
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ANSI IT9.2-1991 (Enclosures and Containers)
ANSI IT9.6-1991 (Safety Film Stability)
ANSI IT9.11-1991 (Safety Film Storage)
ANSI/NAPM IT9.11-1993 (Storage of Photographic Film)

ANSI/NAPM IT9.16-1993 (Photographic Activity Test)
ANSI IT9.20-1994 (Storage of Photographic Prints)
ANSI/NAPM IT9.18-1994 (Storage of Photographic Plates)
ANSI PH1.51-1990 (Photo & Micrographic Film Dimensions)
ANSI/ASC OG4.8-1985 (Residual Thiosulfate)

These items are available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, 212-642-4900; or from the Association for Information and Image Management, 1100 Wayne Avenue, Suite 1100, Silver Spring, MD 20910, 301-587-8202.

FULL SIZE CONDITION CHECKLIST

- **This full size Condition Checklist for Visual Images is for your use.**
- **Save as a master set.**
- **Copy as needed.**

US Department of the Interior
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Condition Checklist For Visual Images

Control Numbers:

Accession number(s) ______________________

Catalog number(s) ______________________

Item number(s) ______________________

Negative number(s) ______________________

Collection Name: ______________________

Location(s) of the Item(s) in the Collection:

Box number(s) ______________________

Folder number(s) ______________________

Item sequence number ______________________

Other number ______________________

Photographer(s): ______________________

Dates: ______________________

Physical Description:

Process(es) ______________________

Format(s) ______________________

Size(s) ______________________

- ☐ Color
- ☐ Negative Transparency
- ☐ Positive Transparency
- ☐ Matted ☐ Framed ☐ Cased
- ☐ Autographed
- ☐ Monochrome
- ☐ Print(s)
- ☐ Drymounted
- ☐ In Album
- ☐ Other ______________________

General Condition Analysis:

☐ Excellent ☐ Good ☐ Fair ☐ Poor

Specific Condition Analysis: (Check all that apply and indicate approximate quantities or percentages when dealing with large quantities)

a. Primary Support/Secondary Support:

- ☐ Brittleness ______________________
- ☐ High acidity ______________________
- ☐ Lignin content ______________________
- ☐ Cockling/buckling ______________________
- ☐ Tack holes/punctures ______________________
- ☐ Adhesives ______________________
- ☐ Tapes ______________________
- ☐ Discoloration ______________________

US Department of the Interior
National Park Service

Condition Checklist For Visual Images

- ☐ Curling ____
- ☐ Folds/creases ____
- ☐ Wrinkles ____
- ☐ Warp ____
- ☐ Tears ____
- ☐ Losses ____
- ☐ Holes ____
- ☐ Waterstains ____
- ☐ Matburn ____
- ☐ Foxing ____
- ☐ Mold ____
- ☐ Insect/vermin accretions ____
- ☐ Dirt/grime ____
- ☐ Fingerprints ____

b. Image Layer/Media:

- ☐ Fading ____
- ☐ Color shift ____
- ☐ Discoloration ____
- ☐ Water stains ____
- ☐ Oleaginous stain ____
- ☐ Silver sulfiding or tarnishing ____
- ☐ Loss of highlight detail ____
- ☐ Loss of dense detail ____
- ☐ Loss of surface gloss ____
- ☐ Emulsion flaking ____
- ☐ Applied color flaking ____
- ☐ Bleeding/feathering of applied color ____
- ☐ Surface cracking/crazing ____
- ☐ Surface abrasion ____
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- ☐ Emulsion powdering ____
- ☐ Cockling/buckling ____
- ☐ Channeling ____
- ☐ Dimpling ____
- ☐ Emulsion bubbling or flow ____
- ☐ Binder migration ____
- ☐ Trim ____
- ☐ Cut ____
- ☐ Tears ____
- ☐ Losses ____
- ☐ Holes ____
- ☐ Adhesives ____
- ☐ Cloth tapes ____
- ☐ Plastic tapes ____
- ☐ Dirt/grime ____
- ☐ Dust ____
- ☐ Smoke damage ____
- ☐ Fingerprints ____
- ☐ Insect grazing ____
- ☐ Mouse chew ____
- ☐ Insect or vermin accretions ____
- ☐ Mold ____
- ☐ Foxing ____
- ☐ Other (Describe) ____

Additional Comments:

Appendix S: Curatorial Care of Objects Made From Leather and Skin Products

Page

List of Figures

List of Figures (continued)

APPENDIX S: CURATORIAL CARE OF OBJECTS MADE FROM LEATHER AND SKIN PRODUCTS

A. Overview

1. *What information will I find in this appendix?*

You will find the National Park Service's present understanding of objects made of leather and skin products. You also will learn about preventive care for these objects including:

- agents of deterioration posing the greatest threat to these objects
- measures for preventing or minimizing the impact of these agents
- techniques for handling, marking, and cleaning these objects
- methods and techniques for improving storage and exhibit conditions
- methods for monitoring the condition of these objects

2. *Why is it important for me to practice preventive conservation with these objects?*

Advancements in the treatment of leather and skin products have not kept pace with the progress made in conserving other kinds of museum objects. The conservation field only can offer limited solutions to the problems facing objects made of leather and skin. Conservators and the scientific community have begun to focus more specifically on developing new treatment strategies for the preservation of leather and skin. While new information is provided as it becomes available, you need to practice sound preventive conservation now because:

- preventive measures stabilize objects and leave opportunity for appropriate future interventive treatments
- conservators can only offer limited treatment solutions

Conservators discourage traditional interventive treatments, such as the application of saddle soaps and dressings. *Avoid interventive conservation treatment of leather and skin objects whenever possible.*

See NPS Museum Handbook, Part I (MH-I), Chapter 3, Museum Objects Preservation: Getting Started, for a discussion of preventive conservation and conservation treatment.

3. *How can I find the latest information on care of these types of materials?*

Refer to the following sources for new information and techniques:

- NPS *Conserve O Gram* series
- e-mail NPS Museum Management Newsletter

B. The Nature of Leather and Skin Products

The skins and hides from vertebrates constitute the class of natural materials called skin products. Leather is one type of skin product that is produced by a particular tanning process. Processed and unprocessed animal skins have supplied the basic fabric for making utilitarian and decorative objects since prehistoric times. You will often find these materials in art, history, ethnology, and science collections.

1. *What is the structure of skin?*

Animal skin is a fibrous layer of living tissue that protects an organism from the elements. Figure S.1 illustrates its structure.

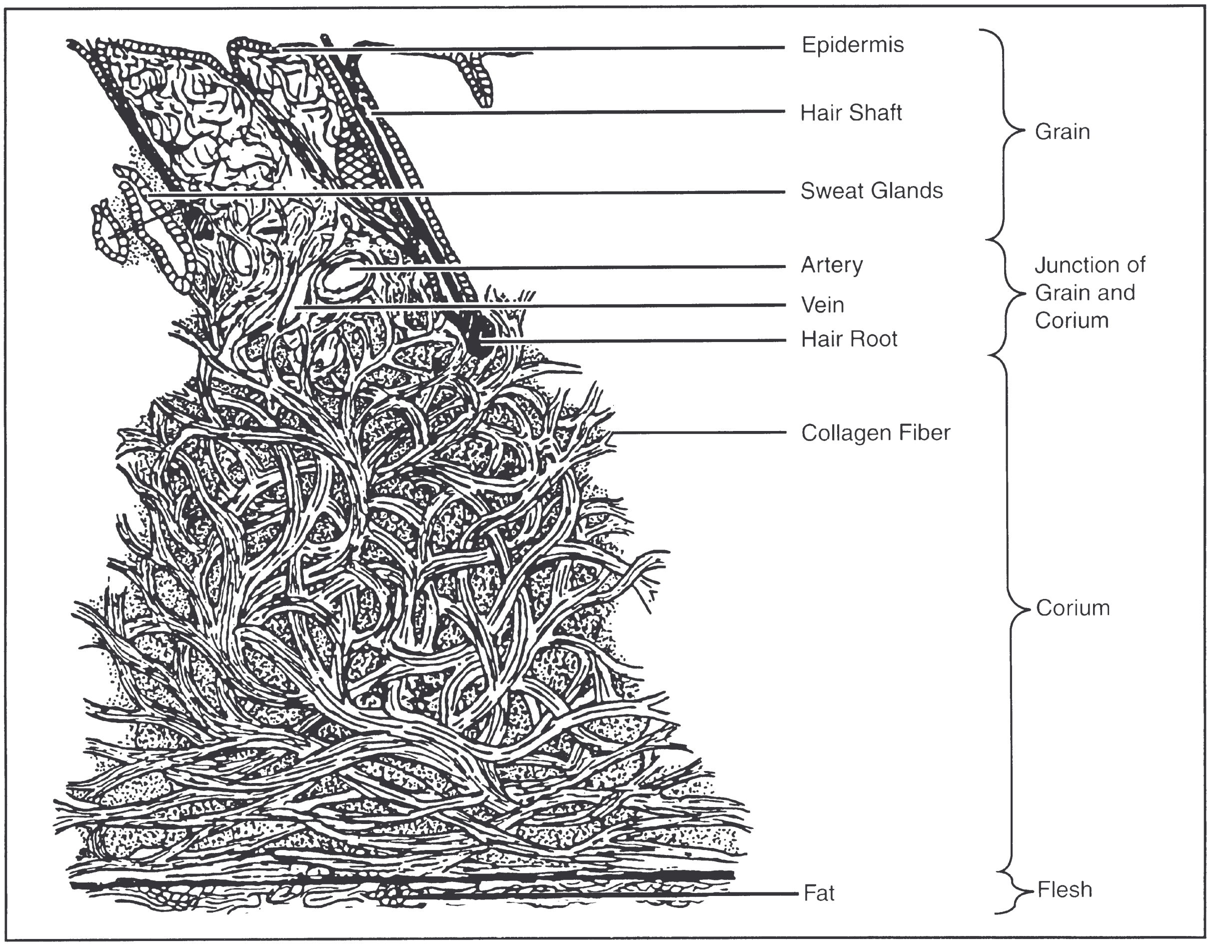


Figure S.1. The Structure of Skin

Once removed, an unadulterated skin is a proteinaceous sheet containing hair, sweat glands, fat and blood vessels, as well as its basic constituent of collagen fibers. These protein fibers are composed of coil-like molecules built of tiny fibrous strands that are twisted together, then aligned side by side overlapping one another, much like cotton fibers are arranged in a textile yarn. (To prevent separation of the cotton fibers the yarn is twisted during manufacture to produce a strong and usable thread.)

2. *How is animal skin processed?*

Animal skin can be tanned and untanned. Examples of untanned skin include rawhide, parchment, and vellum. Stable skin is processed by chemically binding fibers together, commonly referred to as tanning. The amount and type of bonding that occurs within a skin establishes its "degree of tannage." The term "leather" refers technically only to the fully tanned skin products. Figure S.2 describes degrees and types of tannage of most skin and leather objects in park collections.

Un-tanned	Semi-tanned	Native-tanned	Fully-tanned
rawhide parchment vellum	oil tannage alum tannage	smoke tannage brain tannage oil tannage	vegetable tannage mineral tannage combination tannage

Figure S.2. Degrees and Types of Tannage

People have preserved or "tanned" skin products in many ways to render them strong, insoluble, and more resistant to temperature and moisture. Nearly all of the methods of skin processing techniques used by skin and leather workers throughout the ages achieve some degree of tannage. Many of these procedures rely on mechanical properties more heavily than chemical tanning, such as the softening that results from introducing oils.

Unfortunately, determining an object's original manufacture requires considerable study. While laboratory treatments vary for different types of skins and leathers, *preventive conservation procedures are similar for most of these materials*. Your familiarity with the general skin processing categories can be very useful since these methods are responsible for many of the object's functional characteristics. See Figure S.3 for physical characteristics of these products.

3. *How do I recognize different species?*

The skin or hide of each animal species is recognizable by its physical characteristics. The principle variations among animal types are the size, density, and distribution of the animal's hair, which gives rise to a distinctive grain pattern.

The relative thickness of hide and skin products is traditionally measured in "ounces." Each ounce represents 1/64 of an inch. The black solid lines in Figure S.4. represent the thickness of leather being measured.

CHARACTERISTICS OF LEATHER AND SKIN PRODUCTS

	RAWHIDE	OIL TANNAGE	ALUM TANNAGE	SMOKE TANNAGE	BRAIN TANNAGE	VEGETABLE TANNAGE	MINERAL TANNAGE
TANNING MATERIAL	No Tannage Applied	Cod Liver Oil and Other Oils	Alum or Aluminum Sulphates or Chlorides	Aldehydes from Wood Smoke	Animal Brains	Extracts of Wood Chips, Bark, Leaves, Roots, Fruit	Chromium Sulphates or Chlorides
COLOR AFTER TANNAGE	White to Yellow	Dull Yellow	White	Yellow to Yellow/ Brown	White to Yellow	Yellow/Orange to Light Brown	Bluish White to Pale Green
EFFECT OF WATER	Stiffens, Dissolves, Turns Transparent	Water Absorbed, Tan Stable	Stiffens, Water Removes Tan	Water Resistant	Stiffens, Water Absorbed	Water Absorbed, Water Removes Tan Slowly	Water Absorbed, Tan Stable
TYPICAL USES	Saddle Trees, Drumheads, Scabbards	Gloves, Wettable Leathers	Gloves, Pelts and Furs, Book Bindings	Native American Clothing, Lodges	Native American "Buckskin" Clothing and Objects	Shoe Soles, Saddles, Book Bindings	Clothing Shoe Uppers

Figure S.3. Characteristics of Leather and Skin Products

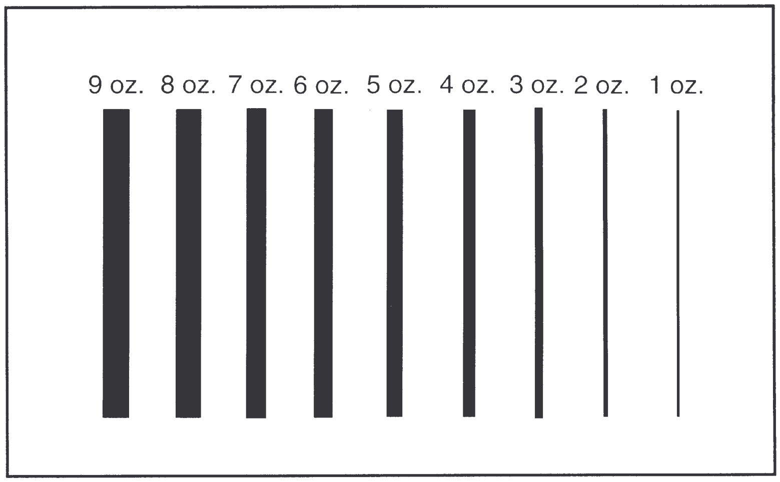


Figure S.4. Thickness of Skins and Hides

The characteristics and uses of common animal skins and hides are listed below.

Cow Hide

- Grain/hair pattern: pebbly, pronounced with large, equidistant hair spacing
- Thickness: 2 to 20 ounces
- Processing note: often split into several pieces
- Special feature: very durable, excellent for tooling and carving
- Uses: shoe soles, belting, trunks, clothing

Calf Skin

- Grain/hair pattern: same as cowhide only smaller
- Thickness: 1.5 to 4 ounces
- Special feature: greater uniformity and fineness than cowhide
- Uses: upholstery, shoe uppers, clothing, bookbindings

Bison Hide

- Grain/hair pattern: similar but less uniform than cattle
- Thickness: 5 to 20 ounces
- Special feature: loose-knit fibers on flesh side; very large hide size; stiff hump between shoulders
- Uses: 19th century boots, sleigh blankets, Native American shields, robes, clothing, tipis

Horse Hide

- Grain/hair pattern: resembles cow hide but less dense
- Thickness: 3 to 7 ounces
- Special feature: strength, texture and thickness are inferior to cow hide; compact fibers, especially in butt region
- Uses: whips, aprons, base for enameled leathers, trunks

Deer Skin

- Grain/hair pattern: large follicles form definite single rows; closely spaced fine hairs are similar to goat skin
- Thickness: 2 to 9 ounces
- Processing note: hairs are sometimes left on
- Special feature: loose structure (like sheep) results in a very stretchy leather
- Uses: parchment, gloves, clothing; Native American clothing, moccasins, containers

Sheep Skin

- Grain/hair pattern: linear groupings of large and small groups
- Thickness: 1.5 to 3 ounces
- Special feature: weaker, less durable skin (loose interweave of fibers); loosened texture (fibers run parallel to skin surface)
- Uses: suede leathers, bookbindings, jackets, gloves, chamois

Goat Skin

- Grain/hair pattern: groupings of three coarser hair follicles with closely spaced fine hair follicles
- Thickness: 2 to 3 ounces
- Special feature: close-knit collagen fibers; more durable and stronger than sheep skin
- Uses: linings, billfolds, shoe uppers

Pig Skin

- Grain/hair pattern: very coarse hairs are sparsely distributed in groups of three
- Thickness: 3 to 4 ounces

- Special feature: high fat cell content produces tough but spongy leather; very rough surface; limited water resistance

- Uses: shoes, bags, gloves, pants

Exotic Leathers

Reptile

- Special feature: surface patterns distinguish reptile type: crocodile, alligator, snake, or lizard

- Special feature: light, thin, grainless leathers often are made from bellies

Fish

- Special feature: structure is different from mammals but scales are comparable to hair on mammals

Seal

- Special feature: proportionally stronger than other leather materials; fur is left on for coats, fur is removed from base for enameled leather

C. Agents of Deterioration

The ways that skin products deteriorate can be identified and categorized. The interdependency of these mechanisms cannot be overstated. For example, temperature changes directly affect a skin or hide's moisture content, the rate at which chemical deterioration proceeds, and the object's susceptibility to biological infestation.

1. *What is the threat of biological infestation?*

A great variety of biological organisms are attracted to skin and hide products making these materials subject to quick and irreversible damage or total destruction. For example, insects are frequently attracted to the oils present in skin products as well as surface soils. Also, poorly cleaned materials are particularly attractive as a nutrient material for insects and microorganisms, as are all items made from rawhide.

Most insects prefer skin products made from fur and unborn animal skins. The most frequent infestations involve dermestid beetles and clothes moths, but other beetles and moths also attack skin and fur on occasion, as do silverfish and cockroaches.

> ***Insect development usually relies on higher levels of humidity and temperature.***

Since skin products are acidic in nature, microbic deterioration of skin products is generally limited to molds and occasionally bacteria. This deterioration is primarily due to environmental factors such as high humidity (above 65% RH) and a wide temperature range (in most cases 10°-40°C [50°-104°F]). These organisms produce organic acids and enzymes that bleach and stain the skin. Fungal growths are often characterized by a white, gray, or green fuzzy appearance. These growths occur most commonly on objects made from rawhide and on those skin products that have become heavily soiled.

2. *How do I prevent pest problems?*

Here are some measures to prevent or minimize biological infestation:

- Monitor all areas of the museum continually and systematically to identify insect and microbial problems at an early stage. Use insect monitoring traps and routinely inspect objects for frass, nesting materials and damage. See *MH-I*, Chapter 5, Biological Infestations, for guidance on developing a museum Integrated Pest Management (IPM) Program.

- Identify dead or living pests that you suspect of attacking skin objects.

- Develop a pest control program that includes a designated staff coordinator, with guidelines for preventive and emergency measures. Its focus should be pest control through good housekeeping and modifying the environment.

- Minimize microbiological attack of skin products by keeping relative humidity below 65% and by keeping areas clean.

- Never apply insecticides and fungicides directly to hide artifacts because they can damage the objects, complicate long term preservation, and contaminate the material for future handling and study.

- Gaseous fumigation methods available for skin and hide materials are few and require coordination by a conservator. In addition, contact the park, center, or your IPM coordinator prior to pesticide use. Technology is constantly changing and the coordinator will have access to the latest and most appropriate solutions. Your IPM coordinator must authorize and approve all pesticide use before application.

Non-toxic means of extermination such as freezing are preferable. See NPS Conserve O Gram 3/6, An Insect Pest Control Procedure: The Freezing Process, for guidance on the technique of freezing for controlling pest infestations.

3. *What about the loss of hair and fur?*

The loss of hair and fur from skins and hides not only devalues an object, but also can destroy its potential usefulness. The causes of hair or fur loss are complex and usually depend on the form and structure of the animal, the hide's original processing techniques, and the environmental conditions to which it has been subjected.

There are numerous types of hair loss:

- Epidermal slippage: hair is lost as the epidermal layer separates from the dermal layer.

- Deterioration of the individual hair follicles: hair roots become loose and hair falls out.

- Hair shaft breakage: mechanical damage weakens the hair and it breaks at its base.

- Biological attack: insects feed on the hair itself or epidermal layer, resulting in the hair being severed.

You can't do much about hair loss that is due to insufficient fixing during processing, but you can control many of the other causes, such as high temperatures, low relative humidity, photochemical degradation, and insect damage.

4. *How can I stop hair and fur loss?*

To limit the loss of hair and fur:

- Minimize the exposure of fur or hair products to lighting; illuminate only to the minimum level necessary to see the object. Recommended levels are 50 lux (5 footcandles) or less.

- Minimize handling.

- Stabilize the relative humidity and temperature to which hides with hair and fur are exposed. Don't expose them to rapid changes of either temperature or humidity and protect them from desiccation.

- Routinely inspect hair and fur products for insect damage. Remove loose or broken hair by brushing and vacuuming, and store materials in insect-proof containers such as metal museum storage cabinets with door gaskets.

5. *What is the threat of thermal reaction?*

Skin and leather products are thermosensitive. Skin tissue has a heating threshold, or point of thermal contraction, which is referred to as its shrinkage temperature. For newly processed skins and hides, this point is frequently between 60°-75°C (140°-167°F). However, the shrinkage temperature of degraded hides of aged objects can be considerably lower.

Heating dries out, embrittles, and deforms skin and leather objects. Changes in temperature also can destabilize relative humidity levels. Exhibit lighting, direct sunlight, and proximity to heating registers and radiators can easily damage leather and skin objects, which also become more sensitive to heat as they age.

Elevated temperatures cause eventual damage not only by speeding up the chemical deterioration processes, but by causing unstable fats and oils to come to the surface where they often deposit as unsightly spews. Spews (also spelled spues) are surface deposits of solidified fats and oils that exude from the interior of the leather/skin material. They appear as a white crystalline deposit or as a whitish bloom. Desiccation can also result from over-heating.

6. *How can I minimize the threat of thermal reactions?*

Try these preventive measures to minimize thermal reaction:

- Safeguard skins from exposure to warm, moist air. The acceptable minimum and maximum temperature levels are from just above freezing to 20°C (70°F).

- Reduce the damaging effect of heat cycling by placing objects away from external building walls, exterior doors and windows, exposed pipes, heating and air conditioning vents, direct sunlight, exhibit lighting sources, and locations such as hot attic spaces.

7. *What about water and moisture damage?*

While skin materials have a great affinity for water, inappropriate levels of atmospheric moisture or direct wetting usually cause serious damage. The direct wetting of skin products initiates deterioration because these materials have only a limited degree of water resistance. Rawhide, parchment and vellum are most prone to damage. Aged objects made of full-tanned leather are also highly susceptible to stiffening and darkening from wetting.

All animal materials readily absorb moisture from the air. Excessive moisture (levels above 65% RH) causes swelling of the skin's fibers and encourages biological infestation. Excessive dehydration (humidity levels below 22% RH) forces the skin to give up moisture permanently, which results in shrinkage and deformity.

Dehydration reduces the skin's ability to take up and hold moisture, thus weakening it and dramatically decreasing its flexibility. Repeated exposure to moist and dry cycles will, eventually, physically stress the hide's fibers enough to induce mechanical damage and increase its susceptibility to chemical deterioration. The hide's soluble components are frequently displaced, leached, or deposited on the surface resulting in the alteration of physical characteristics.

When skin material is subjected to either excessive moisture or high humidity in conjunction with heat and acid conditions, its chemical structure is attacked, causing shrinkage and embrittlement. If allowed to continue, the skin will lose its structure and become gelatinous. The boiling of skin to produce gelatin or hide glue is an example of this process.

8. *What are the measures for limiting water and moisture damage?*

To minimize water and moisture damage:

- Keep hide materials dry by protecting them from wetting and exposure to relative humidity levels above 65%. House objects in water-resistant containers, such as storage cabinets and exhibit cases. Whenever possible, include moisture absorbing materials to buffer enclosed spaces against extreme fluctuation of RH. These materials may include commercially-available buffers such as cotton or linen cloth, acid-free paper products, or silica gel. See *MH-I*, Appendix I, Curatorial Care of Archeological Objects, for a discussion of the use of silica gel.

- Control the relative humidity to conform to the recommended levels suitable for the collection's circumstances. Stabilize humidity fluctuation to the recommended range of 40-60% RH. Normally, you will regulate humidity through the central air-handling system, but you also can use localized and portable sources of humidification/ dehumidification to protect objects from unnecessary damage.

- If you discover mold on objects made of leather or skin, consult a conservator regarding vacuum cleaning and disinfectant procedures.

9. *What is the threat of prolonged exposure to oxygen?*

For organically-based materials like skin products, prolonged exposure to oxygen is one of the more serious and avoidable chemical factors that causes deterioration and is responsible for altering both the skin's chemical structure and many of its tanning compounds.

Its long-term effects include the hardening of skin and hide material, embrittlement, cracking and crazing of the skin surface and overall yellowing or darkening as well as a number of serious internal structural changes. Oxidative degradation is caused by high temperatures and humidities and exposure to light radiation.

10. *How can I minimize these oxidation reactions?*

By taking the following preventive measures:

- While it is impractical to keep most of these materials from being exposed to oxygen, if an object is extremely rare, consult with a conservator about storage and display in a hermetically sealed container filled with inert gas (such as nitrogen or helium).

- Don't expose hide materials to excessive humidity or heat. Use air conditioning, storage design and exhibit design to eliminate the detrimental effects of these environmental stimulants of oxidation.

- Reduce the level of visible light to the minimum required and eliminate exposure to ultraviolet light.

11. *What about pollutants?*

The threatening forms of pollutants to skin products are particulate and gaseous pollutants. Particulates are solids that are suspended in air and range in composition from inorganic to organic. Because skin has such a porous and absorbent surface, these solid foreign materials easily work their way into the fibrous network of skin products causing soiling, staining, and eventual stiffness.

Little data is available regarding the effect of gaseous pollutants on skin but it is probable that oxidant, acidic and sulphating gases play some role in the deterioration process. Native-tanned and semi-tanned materials seem relatively more resistant than do commercial, vegetable-tanned leathers. It is likely that pollutants promote oxidation, hydrolysis and overall discoloration.

12. *How can I minimize the effects of pollutants?*

To minimize their effects:

- Modify the building's central air conditioning and filtering system. Various filters can trap different size particles, and effectively remove gaseous contaminates.

- Exhibit and store your objects in tightly sealed enclosures constructed of the highest quality inert materials. Install specialized pollutant absorbers with individual storage cabinets.

13. *What harm can light cause?*

Light is an important factor in the process that degrades skin products. Its damage is cumulative and irreversible.

Certain wavelengths break down polymeric bonds and are detrimental to all skin materials. The ultraviolet range of light is one of the most dangerous wavelengths for skin products; however, visible light also causes structural damage and color change.

Light can act as a catalyst when oxygen, water vapor and various pollutants in the atmosphere combine to increase the rate of deterioration. The rate of degradation is generally related to the intensity and length of light exposure. Fading of smoked and pigmented hides is a particular problem where prolonged light exposure is involved.

14. *How can I minimize the effects of light?*

Take these preventive measures:

- Minimize the exposure of skin materials to visible light; illuminate only to the minimum level necessary to see the object. Recommended maximum levels are 150 lux (15 footcandles) for most materials and 50 lux (5 footcandles) for painted skins and hides with fur.

- Eliminate ultraviolet (UV) radiation through the use of UV absorbing filters installed between the light source and the artifact or on the light source itself. Select lighting systems with low proportions of UV radiation. The maximum acceptable proportion of UV radiation is 75 microwatts per lumen.

- Maintain stored objects in darkness. Ensure that unfiltered light does not reach stored skin and hide materials.

- Monitor and adjust lighting fixture locations and light bulb wattage individually. Use timers and dimmers for controlling light in exhibits.

See MH-I, Chapter 4, The Museum Environment, for general guidance on temperature, relative humidity, light, and pollution.

D. Preventive Conservation: Guidelines for Leather and Skin Object Care, Handling, and Storage

The most successful method of preserving leather and skin products is a good preventive conservation program. This program needs to include systematic collection care, handling and storage practices, and regular inspection and condition evaluation. This approach replaces the traditional practices and remedies of the past that have been found to be detrimental to museum objects.

For longer life of skin and leather objects follow these general guidelines:

- Identify the general category of the skin product correctly.

- Understand the product's basic characteristics, as well as its deterioration features.

- Upgrade the general environment that includes controlling climatic conditions, minimizing light exposure, providing physical support, and protecting from mishandling, soil accumulation, and pest infestation.

Inspect, evaluate, monitor, and document an object's condition, periodically; record the urgency for conservation treatment.

- Provide specialist care for those objects requiring complex or considerable conservation treatment.

And follow these specific guidelines:

1. *How do I provide a stable and appropriate humidity?*

Use enclosures such as exhibit cases or storage cabinets to stabilize humidity and reduce handling, soil accumulation, and attack from microorganisms and insects.

Set relative humidity to an acceptable range: less than 5% RH change within a 24-hour period and an annual change of no more than ±8% fluctuation from the set point.

Humidity parameters are frequently 40%-60% RH; however, the specific set points will vary according to:

- climatic considerations
- an object's state of deterioration
- your facility's air handling capability
- requirements of any composite and associated materials present
- the relative humidity with which the object has reached equilibrium

2. *How do I monitor the condition of objects?*

Inspect objects for deterioration regularly. If you do not regularly evaluate and document their state of degradation, deterioration of leather and skin objects can go undetected and unchecked. Evaluate the condition of objects thoroughly when they are acquired. Then, inspect the objects periodically to identify progressive damage, such as lengthening of tears, increases in surface or pigment loss, and evidence of biological attack. Finally, use a conservator to assist in periodic surveying of significant objects in order to establish conservation treatment needs. See *MH-I*, Chapter 3, Museum Objects Preservation: Getting/Started, for guidance on Collection Condition Surveys.

3. *How do I clean objects?*

The degree to which each soiled object can be cleaned is a function of the nature of the soil and the sensitivity of the object. Clean an object only as necessary to remove airborne soil accumulation.

Don't directly apply chemical reagents such as cleaners, dressings, waxes, and coatings: they are not beneficial and will complicate future conservation treatment.

You can't remove some surface soils by simple cleaning methods, and other soils are not removable at all. Highly deteriorated objects cannot be cleaned by routine procedures so degraded surfaces should be noted and protected so that cleaning will be avoided.

When decorative elements on an object are extensive and very delicate, refer cleaning to a professional conservator. Surfaces that have specialized finishes also may require exemption from cleaning. Figure S.5 describes cleaning techniques that can be considered for objects in good condition.

4. *How do I handle skin and hide materials?*

Much of the damage caused to leather and skin products is due to improper handling. Therefore, you need to train staff in proper handling techniques. See *MH-I*, Chapter 6, Handling, Packing, and Shipping Museum Objects, for general handling rules.

In addition to the general rules there are a few essential rules for the safe handling of these objects:

- Be prepared before handling these objects by having a clean area ready to receive the object. Arrange for assistance from others when necessary.
- Consider the weight of the entire object before lifting; aged and deteriorated fibers cannot tolerate much physical stress. Avoid suspending, creasing, and folding items.
- Move leather and skin artifacts on a tray support, in a drawer, or in a box; if direct handling is necessary, use both hands and support the object from underneath, not from original handles and straps.
- Accommodate the special handling requirements of appendages and decorative elements such as beadwork and dangles.
- Handle skin and hide materials only while wearing clean, cotton gloves; if hand contact is required, wash hands just before handling.

See MH-I, Appendix I, Curatorial Care of Archeological Objects, for a discussion of support trays for objects.

5. *What about catalog labeling?*

Marking and labeling leather and skin artifacts for cataloging purposes can present a number of preservation problems:

- The porous, absorbent nature of all skin products can cause labeling inks, paints and varnishes to be absorbed into the skin tissue causing irreversible staining and stiffening.
- The adhesives associated with commercial labeling tapes have poor long-term stability.
- Pressure sensitive tapes and embossed plastic tapes tend to fall off in time, and their adhesives are generally not removable from the skin.
- Any type of metal tag (including aluminum) or metal ringed tag can cause corrosion. Aluminum in contact with skin and hide materials causes dark spots on the surface of the object.

Cleaning Techniques	Tools	Caution
VACUUMING - This is the safest cleaning method, if carefully executed.	Use fine plastic screening and a vacuum cleaner with adjustable suction or a rheostat and a small standard nozzle attachment.	Screening between the leather and the nozzle protects the leather, but movement of the screen can also cause abrasion. Flaking surfaces and loose parts may be accidentally removed.
DUSTING - This is the most frequently used technique. It can be combined with vacuuming.	Use camel hair brushes.	Dust acts as an abrasive; each time a material is brushed, surface material may be removed. Brushing also increases the danger of knocking off delicate pieces.
FORCED AIR - Compressed air cleaning must be done outside the collection area or dust will simply be redistributed.	Use a compressor, air hose, and broad compressed air nozzle.	Loose or fragile pieces can be blown off if too great a pressure is used; 40 pounds/square inch is maximum.
ARTIST'S ERASER - This method can occasionally remove stubborn surface deposits from the grain side of firm, intact leathers and skins.	Use artist's block or powder eraser. (Testing has shown "Magic Rub" block and "Scum X" powder to be the least damaging.)	This technique is not useful on deteriorated surfaces or where skin or decorative layers may be susceptible to flaking. Remnants of the eraser may become deposited in textured surfaces and require vacuuming.

Figure S.5. Cleaning Techniques for Leather and Skin Objects in Good Condition

You can determine the specific labeling technique you will need by considering the individual object. Maintain consistency throughout the collection and use the least damaging method. Consider both indirect and direct labeling.

- Indirect labeling allows you to avoid irreversibly damaging the hide material with ink. The two recommended methods of indirect labeling are tie-on tags and fabric labels.

  – Make tie-on tags from high quality, acid-free paper products or inert plastic materials. Corners should not be sharp. Attach tags in a manner that does not cause undue stress, such as to an orifice, strap or handle. Use soft cotton string or a non-abrasive plastic loop for attachment.

  – If you can't label an object with a tie-on tag, use a fabric label, such as those made from cotton twill tape or non-woven spun-bonded polyester; these can be sewn to soft skin products using a beading needle and single strand, white cotton thread. You can usually attach these labels without passing completely through the skin, and you can limit stitches to the upper edge of the label. Attach at a seam or inconspicuous area of the skin or hide material, or loop to a permanent strap.

- Direct labeling on skin products can be recommended only for firm leathers and rawhide. You can apply a barrier coating or ground of clear Acryloid B-72 resin to a small, inconspicuous area (approximately 1 cm x 3 cm in size). When dry, apply the catalog number directly. The ink should have different solubility than that of the ground resin, so it may be changed if necessary.

See NPS Conserve O Gram 1/4, Use of Acryloid B-72 Lacquer for Labeling Museum Objects and the Museum Handbook, Part II, Chapter 3, Cataloging. In addition to normal health precautions, exercise additional caution when using solvents around leather and skin products because excessive amounts can cause deterioration.

Label the object neatly in the most inconspicuous place possible. Your labels should be small yet clearly readable from a distance of one foot. Use a high quality and iron-free ink, such as India ink.

6. *How do I provide adequate physical support for objects?*

Most organic materials lose their structural integrity as they age. Collapsed, creased, or folded materials will develop local weaknesses and damage if not protected by custom mounts and supports.

Use high quality, non-reactive materials:

- rigid acrylic sheeting
- acid-free matboard and unbuffered paper tissues
- washed and undyed cotton and linen fabrics
- polyester batting
- polyethylene foam products

Attached components can cause deterioration when in contact with other materials (such as metal parts). Separate components by a barrier of polyethylene sheeting or layers of acid-free tissue.

7. *How do I store objects properly?*

Store skin and leather objects in a space that is dedicated to the storage of museum collections, where climate control and security can be adequately controlled. Although storage requirements vary somewhat for individual leather and skin materials, basic conservation principles recommend that you provide a spacious and secure storage area, appropriate cabinets and containers, an area that is as free as possible from environmental threats, and individual storage supports. See MH-I, Chapter 7, Museum Collections Storage, for guidance on storage of museum collections.

The storage needs of tanned and untanned materials can be discussed at two levels. The first level addresses the overall collections storage facility with its system of shelving, cabinets, drawers, and trays. The second level focuses on individualized object supports. The following discussion provides more guidance based on these basic principles.

- ***Provide Appropriate Cabinets and Containers***
  - Protect objects made of skin products within cabinets or on shelving with dust covers. Items should not be piled, folded, squashed or leaned. Use cabinets and storage furniture made of metal with a baked enamel finish. Don't use wooden cabinets and shelving, because wood products emit damaging vapors.
  - Use storage trays and containers to house and support individual

objects as well as to reduce stress and damage during handling. Any material that directly contacts the specimen, such as boxes, tubes and tissue papers, must be of acid-free unbuffered paper. Limit your use of plastics to pure polyethylene, acrylic and polyester products.

- Vacuum and dust your storage areas regularly. Dust is acidic, abrasive and damaging to these materials. Routine and systematic housekeeping also lessens the chance of insect problems that can harm leather and skin objects.

• ***Provide Individual Storage Supports***

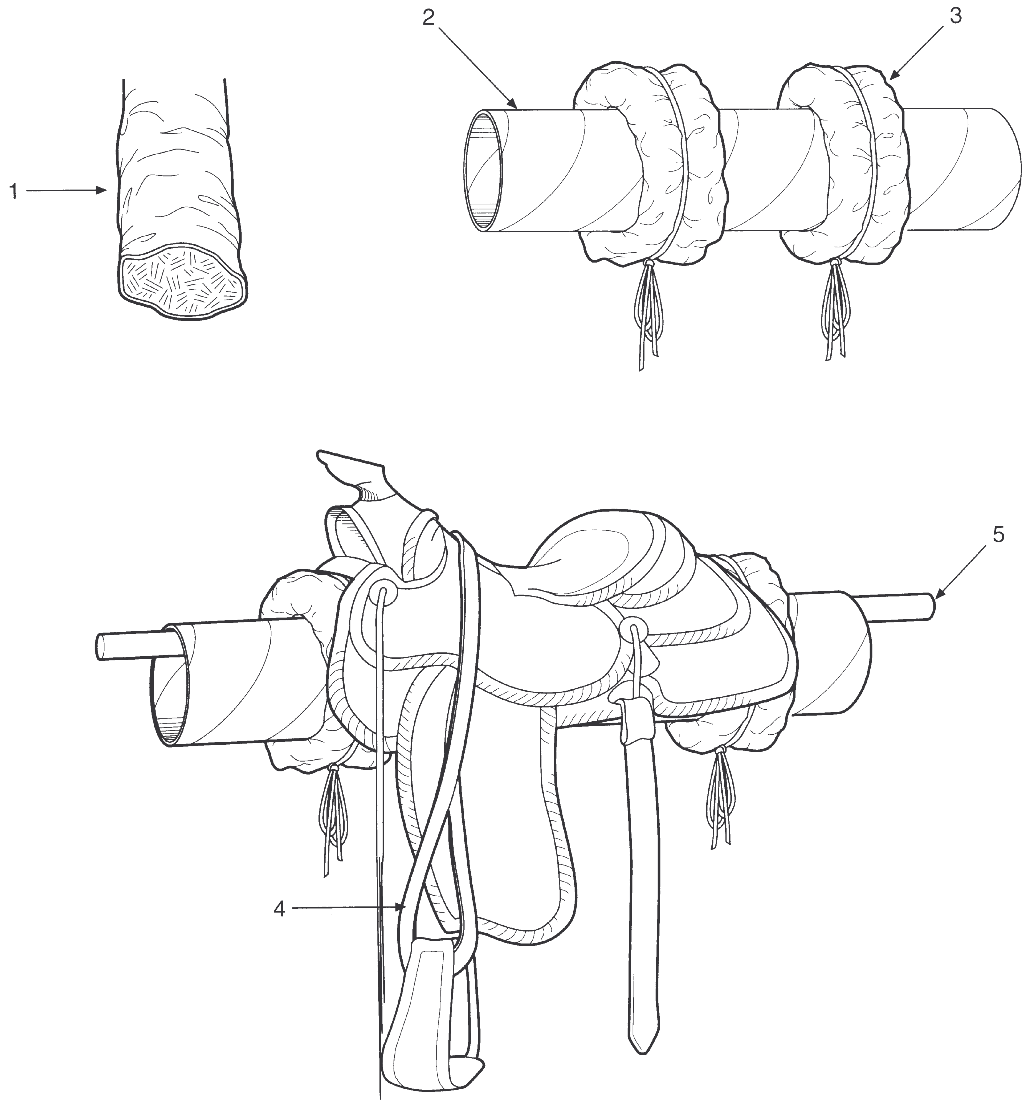
- You will need custom supports for many leather and skin artifacts just as you do for other sensitive organic materials. As skin products age, they become more susceptible to damage resulting from the lack of physical support. Many three-dimensional objects and most large objects (such as saddles) have additional requirements for either internal or external reinforcement.

> ***Individual supports shouldn't constrict or interfere with the expansion and contraction of the skin materials, restrict the gain and release of moisture as the hide responds to environmental changes, be permanently attached to be object, or provide harborage for damaging insect pests.***

- Use supports to provide specific reinforcement to all vulnerable areas that are prone to damage under the object's own weight or because of the limitations of the storage container. Disfigurement and folding of skin materials frequently leads to permanent deformity, the straining of fibers and eventual cracking.

- The design and materials (see page 16, item 6) you will use in your supports depends on the shape, weight and needs of the individual object. For instance, you can roll flat hides and robes around large diameter (minimum of 6" diameter) tubes. Store garments flat and stuffed with a light weight support to eliminate creasing. Place saddles on a rigid saddle tree or dummy support if fenders are likely to become deformed. See Figure S.6 for an illustration of how to construct a saddle mount.

- Hide objects can deteriorate because of poorly selected and inappropriate support materials. Harmful materials are those that emit damaging vapors and organic compounds.



1. Fabricate a muslin sleeve filled with acrylic polyester batting to a diameter of 4 or 5 inches. The padding should not be overly tight or loose to permit firm support.

2. Use a heavy cardboard tube 6” in diameter.

3. Tie the rings of the filled muslin sleeves around the cardboard tubes with twill tape in the location of the saddle bow (front) and hind bow (back) for full support. The acrylic polyester padding will compress to fill the interior dimensions of the saddle so that the saddle will not rock or slip when placed on the mount. The weight of the saddle should keep it in place, although the saddle can be tied to the padded tube with wide twill tape in the area of the cinch belt as an added precaution.

4. Loop a sling made of wide twill tape or a strip of muslin around the saddle to support the stirrups.

5. Use a metal pipe, length of slotted angle, or 2” X 4” wooden board to support the mount.

Figure S.6. Constructing a Saddlemount

E. Summary: Leather and Skin Product Deterioration and Preventive Care

The previous two sections discussed deterioration, the causes of deterioration, and ways to limit deterioration through preventive conservation efforts. Figure S.7 summarizes some of this information.

CONDITION	PROBABLE CAUSE	PREVENTIVE ACTION
Deformation (contraction, cockling, cupping, shrinkage)	Physical alteration during use, storage or exhibition	Support in unconfined space
	Desiccation	Raise & stabilize ambient RH
	Alternate wetting or drying	Use container to protect against humidity extremes
	Excessive heating	Lower ambient temperature
	Photochemical reaction	Filter UV radiation, lower visible light
Embrittlement (rigid, inflexible, brittle)	Disuse, absence of flexing	None available
	Desiccation	Raise and stabilize ambient RH
	Soil impregnation	Use container, filter air
	Deterioration, loss of fat	Filter UV radiation, lower visible light
	Detanning	Use container
	Photochemical reaction	Filter UV radiation, lower visible light
Low cohesive strength (weakened, powdering, separating, fibrous)	Poor manufacture	None available
	Mechanical abuse	Use container, eliminate handling
	Chemical air pollution	Use container, filter air
	High acidity	Use container, filter air, stabilize ambient RH
	Oxidation	None available
	Loss of fat or water content	Stabilize ambient RH
	Photochemical reaction	Filter UV radiation, lower visible light
Physical Damage (abrasion, tearing, splitting, holes, missing parts, disjoined section)	Historic usage	Support, limit handling
	Inherent stress	Support, limit handling
	Dimensional movement	Stabilize ambient RH
	Handling	Use container, limit handling
	Stitching failure	Use container, limit handling
	Adhesive failure	Use container, limit handling
	Biological attack	Inspect, initiate control program
Soil or stain accumulation (oiliness, water staining)	Use during historical period	Document, identify using remaining characteristics
	Improper handling	Instruct staff in proper handling, limit handling
	Unprotected storage or display	Use container, filter air
	Unstable fat spew formation	Stabilize ambient temperature
Discoloration (fading, darkening, lightening)	Soiling or staining	Use container, filter air
	Excessive fat content	None available
	Acid deterioration	Use container, filter air
	Photochemical reaction	Filter UV radiation, lower visible light
Loss of grain layer or exterior surface	Morphological feature of skin	Use container, limit handling
	Poor manufacture	Use container, limit handling
	Mechanical abuse	Limit handling
	Uneven consolidation	None available
Loss of fur or hair (slippage, breakage)	Morphological feature of hair	Use container, limit handling
	Poor manufacture	Use container, limit handling
	Desiccation	Stabilize RH
	Insect attack	Initiate periodic inspection and control program

Figure S.7. Leather and Skin Product Deterioration and Preventive Care

F. Conservation Treatment Issues

Curators, collectors, and conservators alike have been guilty of relying on old treatments to preserve skin materials, and far too frequently they accepted the promotions of commercial products designed for contemporary leathers. This history of haphazard treatment and unsystematic evaluation of skin products has resulted in considerable damage and loss. Common criticisms of past treatments of skin and leather products are that preservation attempts have not differentiated among the distinct categories of skin materials and have relied too heavily on the application of "preservatives."

The traditional remedies and reagents once routinely used in museum collections are now being carefully scrutinized by museum conservators. With the aid of scientific investigation and the assessment of the results of past treatment, several important new directions are being taken. The findings on past treatments have not been encouraging.

The routine application of preservatives (such as saddle soaps and leather dressings) is discouraged.

1. *What are the perils of saddle soap?*

There are many problems associated with the use of "saddle soap" on historic and artistic objects made from animal skin products. With the best of intentions, this commercial product has been inappropriately applied to just about every form of skin material in the past.

"Saddle soap" was not developed as a cleaner, but as a 19th century leather conditioner. Its basic components of neatsfoot oil and cod or sperm oil were emulsified with soap in water to produce an emulsion fat-liquor introduced during early tanning. As a conditioner, saddle soap is considered obsolete by tanners today.

Its application has caused considerable permanent damage to skin and leather objects since its components cannot be easily rinsed out and adequately removed (as manufacturer instructions often suggest). Saddle soap effectively softens and emulsifies surface oil and dirt, however it usually distributes them deeper into the material. The mixture's high moisture content presents a hazard to aged skin materials that should not be wetted, as well as light colored vegetable and/or alum tanned leathers.

Commercial formulations of saddle soap differ in their ingredients, some containing abrasives and even colorants. Saddle soap quality fluctuates greatly among manufacturers.

Perhaps most importantly, conservators now suspect that the surface cracking on many older skin and leather objects may well be due to past "saddle soap" application. Avoid it.

2. *What are the drawbacks of leather dressings?*

The care of skin and leather goods has traditionally involved the routine use of leather dressings, solutions of fats and oils that lubricate skin products to increase flexibility. Modern research has shown, however, that the haphazard use of dressings has been the cause of considerable deterioration within museum collections.

These solutions should never be applied to Native-tanned materials or objects comprised of untanned or semi-tanned skin products. Avoid the use of leather dressings on museum objects.

Numerous drawbacks are associated with dressing of skin products. For example, dressings frequently:

- darken lighter colored leathers
- encourage biological attack
- form fatty spews at the surface
- oxidize over time and stiffen the material
- wick into surrounding materials
- soften original finishes and decoration
- cause dust to accumulate
- impede future conservation treatment
- contaminate the material for future analysis

3. *What about neutralization of acids?*

The chemical decay and disintegration of leather resulting from exposure to acids is a well-known problem and its solution for older leathers remains unresolved. Vegetable-tanned leathers produced since the mid- 19th century frequently exhibit a condition of internal fiber degradation known as "red rot." The color of the leather actually reddens as the deterioration progresses. In its advanced state, affected leather will disintegrate into a powdery form.

This condition is most always associated with sulfuric acid, introduced either during the tanning process or from atmospheric contact with the contaminant sulphur dioxide. (Leather readily absorbs acid from the air.) Sulphur dioxide, when absorbed, becomes sulphur trioxide, which unites with water to form sulfuric acid, resulting in a devastating effect on collagen fibers. Certain vegetable tannages (the ones categorized as condensed tannins) have been identified as being much more susceptible to this mechanism of deterioration.

Modern leathers are fortified against acid formation by incorporating buffering salts that repress acid formation and action. Some of the museum preservation literature during the last decade recommended that older leathers be treated with similar buffering salts, such as potassium lactate and potassium citrate, to protect them from acid attack.

The problem that museum curators face is that there is no easy and safe method for long-term neutralization of acids that are present in historic leather objects. There are three drawbacks associated with the treatment of leather with standard buffering salt solutions:

- The salts must be introduced in an aqueous solution yet water can be very damaging to historic leather causing stiffening, color change and disruption of applied finishes.

- Salt solutions are meant only for vegetable-tanned leather and will de-tan and damage mineral-tanned materials; the applicator must, therefore, be able to distinguish between them, which is not an easy task.

- The addition of buffering salts will do nothing for leathers that have already begun to deteriorate from acid exposure.

The conservation field is looking at other methods of deacidifying leathers; vapor phase reagents and non-aqueous chemicals are being investigated. The importance of this conservation issue is clear to those involved, and acceptable procedures should be available to museum staffs in the near future.

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Appendix T: Curatorial Care of Biological Collections

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APPENDIX T: CURATORIAL CARE OF BIOLOGICAL COLLECTIONS

SECTION I: THE NATURE OF BIOLOGICAL COLLECTIONS

A. Overview

1. *What information will I find in this appendix?*

This appendix discusses the nature of biological collections and outlines strategies for their long-term care and preservation.

Most biological collections are either dry collections or wet collections. They also may include collections preserved at low temperatures or microscopy collections. This appendix discusses all four types of biological collections. It also includes the four basic stages of preservation: stabilization, processing, storage, and maintenance.

2. *What are biological collections?*

Biological collections are typically:

- preserved plant or animal specimens
- specimen documentation, such as labels and notations (**Note:** associated project data, reports, notes, etc. should be accessioned into the park's archives and cross-referenced to the related specimens)

Normally biological materials are maintained as separate collections based on:

- the types of specimens
- the type of preservation
- differences related to management, care, and use

Plants would be a part of a plant collection, but depending on the size and diversity of the collection, it might be appropriate to differentiate types of plants, and include a vascular plant collection and a non-vascular plant collection.

B. Introduction to Biological Collections

1. *What types of specimens are included in biological collections?*

Common biological collections include non-vascular and vascular plants, and animals, both vertebrate and invertebrate. See Table T.1 for a listing of common biological collections and their phylogenetic relationships to one another.

Plants		Animals	
Non-vascular Plants	**Vascular Plants**	**Invertebrates**	**Vertebrates**
• Aquatic - algae • Terrestrial - fungi - lichens - mosses	• Gymnosperms - conifers • Angiosperms - flowering plants	• Porifera - sponges • Cnidaria - jellyfishes - corals, sea fans, anemones • Ctenophora - comb jellies • "Vermes" - various phyla of worms and leeches • Arthropoda - crustaceans - spiders and mites - horseshoe-crabs - insects - centipedes and millipedes • Mollusca - snails, slugs, abalones - clams - squid, octopuses, nautiluses • Echinodermata - sand/sea stars - brittle stars - sea urchins - sea cucumbers - sea daisies - sea lilies and feather stars	• Fish • Amphibians and Reptiles • Birds • Mammals

Table T.1. Common biological collections and their phylogenetic relationships to one another

Table T.1 lists the most common types of biological collections. Your collection may include more specialized collections such as parasites, butterflies, or beetles. Table T.1 does not include specimens from other kingdoms of living things, such as bacteria and amoebas. Nor does it cover all known phyla of plants and animals. Other objects or specimen parts also may be included in various specialty collections (see Table T.2.).

Note: Most specimen parts and related archives have little relevance unless they are linked to a voucher specimen with sufficient characteristics to permit identification using the techniques of classical taxonomy.

	Macroscopic material	Microscopic material, including SEM stubs)	Replicas (casts, molds, and models)	Specimen documentation (in addition to accession, catalog, and loan records)
Plants	Wood samples, tree rings, large seeds or fruits, exsiccati (usually collections of specimens in bound volumes), economic botany samples such as cultivars	Pollen, very small seeds, dissected parts	Models in wax, glass, synthetic polymers etc.; molds	Primary labels and annotation labels Place all project documentation in the park archives: field records; notes and manuscripts; permits; original art work; images (photographic, digital, video, film.
Invertebrates	Larvae, dissected organs or other tissues, freeze-dried specimens, eggs, pupae	Dissected organs or other tissues; some whole organisms (larvae, shell ultrastructures)	Models in wax, glass, synthetic polymers; molds; some larvae	Specimen labels Place all project documentation in the park archives.
Fish	Taxidermy preparations, gut contents, eggs, larvae, fin clips, freeze-dried specimens, cleared and stained specimens, frozen tissues	Scales, otoliths	Casts or models in plaster, synthetic polymers, etc.; molds	Field identification tags and specimen labels. Place all project documentation in the park archives.
Amphibians & Reptiles	Nests, eggs, taxidermy preparations, cleared and stained specimens, skeletons, dry or tanned skins, gut contents, larvae, frozen tissues, freeze-dried specimens	Internal and external parasites	Casts or models in plaster, synthetic polymers, etc.; molds	Field identification tags and specimen labels Place all project documentation in the park archives.
Birds	Scats, eggs, nests, spread wings, taxidermy preparations, skeletons, complete or partial dioramas, samples of feathers, feet and bills, some large parasites, gut contents, embryos, frozen tissues, freeze-dried specimens, naturally mummified specimens	Internal and external parasites	Casts or models of whole specimens or tracks in plaster, synthetic polymers, etc.; molds	Specimen labels and leg bands Place all project documentation in the park archives.

Table T.2. Specimen parts and other materials included with voucher specimens in a collection.

Mammals	Scats, eggs, nests, taxidermy preparations, skeletons, complete or partial dioramas, naturally mummified specimens,	Internal and external parasites, hair samples, baculi, phalli, karyotypes	Casts or models of whole specimens or tracks in plaster, synthetic polymers, etc.; molds	Field identification tags, specimen labels, and ear tags Place all project

	tanned skins, horns and antlers, gut contents, dissected organs, embryos, frozen tissues, freeze-dried specimens or specimen parts, sectioned teeth, some dissected baculi; some large parasites			documentation in the park archives.

Table T.2. Specimen parts and other materials included with voucher specimens in a collection (continued)

Biological collections may be grouped within broad taxonomic categories according to the nature of preservation. Biological specimens normally are preserved by drying, preservative fluids (either as macroscopic or microscopic preparations), or storage at low temperatures.

2. *What is the value of biological collections?*

Biological collections are valuable (in order of rank) as:

- types (specimens referred to in the first published account of a new taxonomic group)
- rare, endangered or extinct species
- vouchers for specific research studies or specimens of special historical value
- specimens rarely found in any collections or those that are rare in the particular collection in question
- specimens that fully document the existence of a species at a given place and time (most properly collected and maintained biological specimens will fit this category)
- specimens collected specifically for destructive sampling or for interpretive programs

Some specimens fall into more than one of these categories.

The most common uses of biological collections are to resolve issues related to taxonomic identification and provide physical evidence of the presence of a particular taxon at a specific place and point in time.

3. *What is the basis for collecting appropriate specimens?*

Before you can understand if a particular specimen is appropriate in a collection, you first must understand its value. You also need to know how the specimen might be handled and used. Cultural value, usually for historical or scientific purposes, is the basis for responsibly selecting material for biological collections.

Note: Many historical specimens were not necessarily collected to answer a specific research question, as specimens collected for scientific purposes today are. However, if historic specimen collections do include adequate documentation, (detailing the existence of a taxon at a place and point in time), they are scientific collections too.

Collecting based on emotional values can result in collection biases and inappropriate commitments for the collection. Examples of collecting for emotional value may include:

- the acquisition of particularly attractive or unusual specimens
- some salvage operations

Collecting for use often assumes eventual destruction or transfer of the specimen in question. For responsible resource management, you must evaluate:

- the level of initial preparation that a specimen needs for placement in the collection
- the amount of long-term management and care required for such specimens once placed in the collection

For instance, a taxidermy mount of a commonly occurring animal, which lacks collecting, preparation, and provenience data, has little purpose other than exhibition or teaching. It may not be appropriate to allocate resources for long-term management and care of such a specimen.

4. *How are biological collections used?*

Collection use is dependent on many factors, such as the specimens or parts available, expertise available, preservation methods, and preservation quality. The use of most collections falls into specific categories, which vary according to the number of specimens involved. For instance, a single specimen can be used for:

- a voucher of research
- a synoptic reference sample
- documentation of the occurrence of a species at a given place and time
- interpretation

As the number of specimens of a given species increases, the types of use expand substantially. Besides the uses noted above, the collection can document:

- variations
  - among individuals
  - among age groups
  - between sexes
- seasonal variation
- geographical variation

- geographical distribution
- ecological relationships and associations

> ***Remember: The basic reason for maintaining biological collections is to promote their use in both science and education.***

5. *Does preservation method affect use?*

Yes, the method of specimen preservation has an impact on collection use.

Dry preservation is useful for visual examination of characteristics, particularly where a degree of color and some delicate parts are important.

Fluid preservation may sacrifice color, but is useful for preserving internal organs that might be exposed by dissection.

Because there is no single preservation method that will accommodate all possible uses of a specimen, a collection often includes specimens preserved by different methods.

Many of the modern research uses for biological collections involve very specialized preservation methods and materials. These include:

- histology
- parasitology
- chemical or biochemical analyses
- molecular genetics
- analyses of environmental pollutants

These uses require appropriate research personnel, facilities, and equipment. Many institutions with collections lack the expertise to carry out or even to properly evaluate requests for these kinds of fairly sophisticated research. Such institutions also can rarely provide appropriate care for the materials generated by the research.

6. *How should I manage biological collections?*

Manage collections to ensure that they are available for use. When you decide to preserve a specimen, you should:

- utilize appropriate processing methods. Such methods must comply with standard practices appropriate to the type of biological materials. This will ensure the quality and integrity of:
  - the specimen
  - associated information
- organize the specimens (with hundreds, perhaps thousands, of others) in an established order

- this facilitates retrieval of specimens

- use storage equipment and supplies that best serve the goals of preservation and access

Your management responsibilities also include:

- updating the organization of the collection
- directing collection growth as scientific research changes

7. What is involved with the proper care of biological collections?

To provide proper care, document and use the best:

- preservation methods
- preservation materials
- collection environments
- handling practices
- storage designs
- emergency salvage and response procedures
- condition reporting
- collection treatments

When you practice proper collections management and care, your collections will be accessible, useful, and stable. Remember to incorporate management and care concerns in the development of all recommended policies and procedures.

8. What are the agents of deterioration that affect biological collections?

Biological materials are designed to decompose. They can be damaged by any of the following processes:

- Mechanical
- Biological
- Chemical

Remember: Damage from one process can sometimes cause another.
The specific agents of deterioration that affect biological collections are:

- visible and ultraviolet (UV) light
- inappropriate temperature
- inappropriate relative humidity levels and fluctuations (especially at extreme levels)
- contaminants or pollutants

- pests
- fire
- water
- physical forces
- criminal activity
- neglect

All of these agents may act on biological specimens. The risk of one agent over another may vary considerably, depending on the type of preservation or collection.

9. What should I know about preventive conservation of biological collections?

Biological collections have research potential. New and innovative technological approaches to research are common. Avoid any action that might compromise the research integrity of the specimens. For this reason, your response to threats of mechanical, biological, or chemical damage should **emphasize stabilization before interventive treatments**.

10. *How should I handle biological specimens?*

Some specimens may have special handling requirements. Discuss these issues with the researcher who collected and/or prepared the specimens. Contact your regional/SO curator or the Senior Curator of Natural History if you have any questions.

In general, handle specimens as you would other museum objects:

- Handle specimens as infrequently as possible.
- Handle each specimen as though it's irreplaceable and the most specimen valuable in the collection.
- Never smoke, eat, or drink while handling specimens.
- Don't wear anything that may damage the specimen. To avoid scratching and snagging surfaces, be careful of breast pocket contents, jewelry, watches, and belt buckles.
- Use only a pencil when examining specimens.
- Save all information that is associated with the specimen, such as tags and labels.
- Know the condition of a specimen before moving it.
- Lift and/or move the specimen by supporting its strongest structural component. Do not lift it by protruding parts, small bones, wings, or attachments. These areas are weak. They also can be easily separated from the rest of the specimen (and lost!).
- Use a utility cart with padded shelves and raised sides to transport specimens from one room, area, or building to another. See *Tools of the Trade* for additional information.

- Handle only one specimen at a time and use both hands. Use one hand for support and the other hand for balance.

- If you transport a specimen via a specimen tray, be sure that it cannot shift or fall out. Use cavity packing (see Appendix I, Figure I.6., page I:11) to keep specimens from shifting.

- If you need to temporarily place a specimen in an unstable position for examination, be sure to support it. Exercise extreme caution in these situations. Return the specimen to a stable base or surface as soon as possible.

- Never hurry when handling specimens. Move slowly.

Figure T.1. Use extra care when transporting specimens with delicate parts, such as this pinned butterfly specimen. Photograph courtesy of the Bohart Museum of Entomology, University of California, Davis.

If part of a specimen is broken, reattach it as soon as possible to prevent it from becoming separated or lost. At a minimum, place the broken part in a labeled polyethylene bag or acid-free (not buffered) envelope to ensure that it doesn't become lost. Consult with your regional/SO curator, the Senior Curator of Natural History, or a natural history conservator for advice.

11. *Are there any other handling issues that I should be aware of?*

Researchers will need to handle specimens in order to study them. But don't assume that everyone who requests collections access (including scientists) is aware of all the proper handling procedures.

Be sure that you:

- know how to appropriately handle all of the specimens in your collection.
- thoroughly brief all collections users on proper specimen handling techniques. A good way to do this is to provide all researchers with a copy of your park's "Collections Handling Guidelines."
- require all collections users to sign a statement agreeing to abide by these and any other applicable rules, as a condition of access.

For additional information, refer to Chapter 6: Handling, Packing, and Shipping. You also may find the following example standard operating procedures to be useful:

- Figure 6.14, "Example of Written Handling Rules for NPS Collections" on page 6:30
- Figure G.6., "Sample Visitor Log" on page G:32
- Figure G.7., "Conditions for Access to Museum Collections" on page G:33

12. *Are there any health and safety concerns related to biological collections?*

The collection, preparation, and handling of biological specimens can pose various risks to human health and safety. One of the most familiar concerns is the historic use of toxic chemicals, such as arsenic, for preservation and pest control. These collections may involve other risks as well.

Collecting living organisms can be dangerous because of:

- the organisms' natural defense systems, such as:
  - marine organisms that sting (jellyfish, stingrays, sea urchins, octopuses, and others)
  - venom in snakes
- non-target species in the same habitat.

Even after collection, be sure to handle all organisms with care. Natural toxins in the plant or animal and diseases can be transferred to humans from an animal or its parasites. Health hazards include:

Bacterial Diseases

- Anthrax (hoofed animals)
- Bucellosis (cattle, goats, hares, pigs)
- Erysipelas (pigs, marine mammals, possibly birds)
- Leptospirosis (rodents, hares, hedgehogs, possibly others)
- Plague (rodents)

- Pseudotuberculosis (birds, some rodents and possibly other small animals)

- Psittacosis/ornithosis (birds)

- Rickettsial diseases such as Rocky Mountain spotted fever, rickettsialpox, recrudescent typhus, murine typhus, Q fever, and momcytic erlichiosis (small mammals, carnivores, deer)

- Salmonellosis (primarily rodents, reptiles, some birds)

- Tetanus (most animals)

- Tick-borne spirochetal diseases such as Lyme disease, and other relapsing fevers (rodents)

- Tuberculosis, avian (birds)

- Tuberculosis, mammalian (relatively uncommon in wild animals)

- Tularemia (burrowing rodents, ground squirrels, rabbits and hares)

Fungal Diseases

- Aspergillosis (birds, occasionally mammals)

- Histoplasmosis (colonial birds or mammals where excrement accumulates)

- Ringworm (mammals, occasionally birds)

Viral Diseases

- Hantavirus (rodents)

- Rabies (coyotes, foxes, raccoons, skunks, some bats)

- West Nile virus (birds)

> ***Often, only someone with expertise in a particular species may recognize an animal's symptoms indicating a potential human health hazard. Eliminating the hazards can be complicated. Each one is resistant to different factors. For example, freezing specimens prior to preparation will not destroy some bacteria and viruses, such as some rickettsial diseases and rabies. Freeze-drying will preserve many pathogens for prolonged periods.***

Taking material from the wild into collections also can involve hazardous materials used to tranquilize, kill, clean, or otherwise prepare specimens. These hazards vary with the type of specimen and preservation method (dry, wet, low temperature, microscopy).

Provide safe conditions; ensure that:

- human health and safety is paramount; superseding all other concerns

- all health and safety risks are taken seriously and eliminated to the degree possible

- unnecessary risks are avoided

- warnings about health and safety risks are provided verbally and in writing to staff and collection users

- compliance with governmental health and safety regulations is standard practice, including:

  - monitoring for hazards

  - using engineering controls to mitigate hazards

  - worker training, including training in the use of personal protective equipment where engineering controls are not feasible

- collection personnel work in pairs when safety is a concern (for example, handling heavy equipment or toxic chemicals)

- staff properly dispose of all parts discarded during the preservation process (such as internal organs of vertebrates preserved as dried skins)

For additional information related to curatorial health and safety, see Chapter 11. You can also obtain information concerning methods to mitigate biohazards without compromising the utility of specimens from:

- The Centers for Disease Control and Prevention (CDC)
  (800) 311-3435
  www.cdc.gov

- The American Society of Mammalogists
  www.mammalsociety.org

SECTION II: PRESERVATION OF BIOLOGICAL COLLECTIONS IN GENERAL

A. Overview

For purposes of organization and discussion, preservation is subdivided into the following stages:

- **Stabilization:** preservation activities associated with halting active deterioration and minimizing the risk of loss, damage, or disorder as it relates to the specimen and its associated information

- **Processing:** preservation activities beyond stabilization that are related to making the specimen available for use

- **Storage:** preservation activities associated with housing of the specimens for the sake of access, organization, and protection

- **Maintenance:** preservation activities associated with corrective actions in response to a real or perceived problem

  By definition, both emergency management and pest management are "maintenance" activities.

Note: Most specimens you receive will already be stabilized. They probably will have undergone some degree of processing too. Park biologists or outside researchers working under contract usually carry out this work. These scientists are familiar with the standard protocols for specimen stabilization and processing in their fields. Curatorial staff should be involved only in some aspects of processing, and in the storage and maintenance of the collections.

> ***Make sure you have documentation as to what processes were used by the researcher.***

B. Stabilization of Biological Specimens

1. *What is stabilization?*

Stabilization includes:

- halting active deterioration of a specimen
- minimizing the risk of loss, damage, or disorder of the specimen and its associated information

2. *What issues should I consider prior to stabilization?*

Carefully evaluate all incoming material:

- Does the quality of the specimen(s) and associated information comply with standards for the collection?
- Does the acquisition of the specimen(s) comply with the park's Scope of Collection Statement and:
  - serve institutional mission and goals?
  - contribute to the utility of the collection?
  - pose any health and safety risks?
  - pose any legal, ethical, or social problems?
  - require special resources for collection or salvage, preparation, or long-term care?

3. *What issues should I consider once we decide to initiate stabilization of specimens?*

- What is the condition of the specimen? Keep in mind that it may be:
  - alive
  - recently dead

- in some state of decomposition (as a result of necropsy, freezing, or delay between collection and initial stabilization)

- What parts of the specimen are to be preserved?

- What kind of stabilization (dry, wet, low temperature) is appropriate?

- Does stabilization require additional materials for support of the specimen and/or specialized equipment for the process?

- What professional standards (for example, positioning) apply to the stabilization technique?

- What special methods (for example, exposing diagnostic features) must be applied to insure maximum use of the specimen?

- Does completion of the stabilization of choice make the specimen available for use? Will subsequent processing treatments be required? For example, a vascular plant specimen may be stable after pressing to remove moisture. However, it won't be useful until it has been mounted.

4. *What information should I document during stabilization of biological specimens?*

Because so much information is lost when a specimen is removed from its natural setting and collected, the collector documents:

- ecological information

- field conditions

- observations about the specimen and its habitat

- accurate locality data

Such documentation usually includes:

- field notes

- field tags applied to the specimen

- photographs

- digital images

- original artwork

- sound or video recordings.

Remember: At a minimum, researchers working in NPS areas are required to provide the park with:

- an Investigator's Annual Report for each year of the permit

- copies of field notes, data, reports, publications and/or other materials resulting from the studies

Be sure that these data are included in the collection and are cross-referenced with the specimen/s, including all catalog information in ANCS+.

Note information about the individual specimen. Often this involves recognizing the species and assigning a field or preparation number (especially in the case of tissues and/or parasites removed from the specimen). This allows the specimen to be cross-referenced to other related information. Some disciplines may not assign these numbers because all of the pertinent information is maintained with the dry specimen (this is sometimes the case in botany).

The collector also should have provided provenience information. This is especially important for ensuring specimen value and use within the collection. Such data include:

- the species
- the field or preparation number
- the methods used for stabilization from the time of collecting until received at the park
- where the specimen was collected
- when the specimen was
  - collected (including the method, as well as any drug and/or chemical used during the collection of animal specimens)
  - prepared
- who collected the specimen
- who stabilized the specimen

Hopefully, the collector also included:

- any special handling procedures
- information related to parasites or tissues collected from the specimen

You also need to be sure to document the natural conditions and features of the specimen, particularly those that may be changed by stabilization. Examples include color, markings, weight, dimensions, sex, reproductive condition, age, and physical condition.

Any documentation about specimen history, such as condition of the specimen, environmental conditions, and stabilization methods and materials, may prove useful in determining the integrity of the specimen for various uses.

5. *Are there any other issues related to stabilization that*

Yes. Be sure to bear in mind that:

I should consider?

- Various stabilization methods are used but can vary significantly between disciplines. Refer to the specific stabilization methods in subsequent sections for more information.
- The intended use of the specimen can significantly influence how it will be preserved.
- Stabilization should be the first step in preservation. Take care to ensure that stabilization practices comply with disciplinary standards.

6. *What protection concerns and practices are involved with stabilization of biological specimens?*

During stabilization, you should:

- ensure the relationship of the specimens and their data
- protect the specimens from all agents of deterioration

The agents of deterioration that most often damage specimens during stabilization depend greatly on the nature of stabilization. Refer to the specific stabilization methods in subsequent sections for more information.

7. *What health and safety concerns should I be aware of during stabilization?*

Specimens may contain animal-borne pathogens and/or toxic chemicals that are part of the plants or animals themselves. If chemicals are used as part of the stabilization process there may be additional risks. These hazards depend upon the specific chemicals. Protect yourself with good personal hygiene. Use appropriate engineering controls (such as biohazards hoods and chemical vapor hoods), and properly chosen gloves. If engineering controls are unavailable (as is often the case during field stabilization), you may need to use additional personal protective equipment.

C. Processing of Biological Specimens

1. *What is processing?*

Processing involves those activities beyond stabilization that are related to making the specimen available for use. These activities depend on standard practices established by individual disciplines. Processing typically includes a sequence of steps that includes:

- preparation
- accessioning
- cataloging
- labeling
- loans or other collection access

2. *What are the NPS requirements for processing of project-generated specimens?*

Specimens that you acquire should already have been accessioned, cataloged, and labeled. <u>This is required of researchers (NPS and non-NPS) who have NPS collection permits</u>.

Director's Order #24: NPS Museum Collections Management, requires <u>all</u> project budgets to include funding for the basic management of project-generated collections. Collections management includes:

- cataloging
- labeling
- conservation examination and treatment (including preparation)
- initial storage of objects and specimens
- organization and storage of project documentation (field data, reports, and other associated archival materials)

Do not accept project-generated collections that lack such basic documentation and means for protection. As noted above, DO #24 requires project budgets to include funding for basic collections management. It is not the responsibility of the park's museum program to fund cataloging and initial storage and organization of project-generated specimens and archives. You can contact your regional/SO curator or the Senior Curator of Natural History for advice.

> ***All resource management projects that generate collections must provide funding for accessioning, cataloging, and labeling of specimens, as well as initial conservation and storage of both specimens and related archives. Budgets should include sufficient funding for NPS or contract cataloging or specimens and archives, storage materials, and equipment, such as cabinetry.***

3. *What is involved in preparation of specimens?*

The initial step in processing is the preparation of the specimen (although it can be part of the stabilization process). If you lack critical data about the specimen (such as measurements), it is important to obtain the information at this time.

Anticipate specimen use, so that you can make correct decisions about:

- applying appropriate preparation techniques
- conforming to disciplinary standards
- positioning and exposing diagnostic features
- possibly exposing additional features commonly used for descriptive and comparative research

You also must ultimately decide w
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appropriate subject matter experts

> ***Processing can require specia***
> ***sure that you have all of the n***
> ***processing obligations. If you***
> ***backlog of unprocessed or pa***
> ***little or no utility.***

4. *What is involved in accessioning biological specimens?*

For information concerning accessioning of museum collections, see *Museum Handbook*, Part II (*MH-II*), Chapter 2. Additional accession information relevant to biological acquisitions that you should document includes:

- What taxonomic groups of specimens are represented by the acquisition?
- What methods of preservation are represented by the acquisition?
- Where was the acquisition collected?
- When was the material collected?

You should also include the following materials in the accession folder:

- a copy of the research proposal
- a copy of the research/collecting permit(s)

It's also helpful for researchers if you also provide a cross-reference to these documents' physical locations in the park archives in the ANCS+ catalog record(s).

Do not assume responsibility for specimens that have not been appropriately stabilized and prepared (such as a backlog of unprepared specimens maintained in freezers).

5. *What is involved in cataloging biological specimens?*

For information concerning cataloging biological specimens, see *MH-II*, Chapter 3 and the *ANCS User Manual*, Chapter 2, Section V. You also should include the following:

- When was the specimen collected?
- When was the specimen stabilized and prepared?
- Who stabilized and prepared the specimen?

6. *How should I label specimens?*

Depending on the specimen and preservation method, you can label:

- the specimen itself (some invertebrates and bones)
- support materials for the specimen, such as:
  - labels attached to herbarium sheets
  - microscope slides
  - insect pins
- tags tied to these specimens

- birds
- mammal skins
- fluid-preserved specimens

- labels attached to the outside or placed inside of containers
  - bags
  - boxes
  - vials
  - jars

In many instances, the park acronym and a catalog number may be the only label data. Additional information can be valuable for facilitating collection use and organization. See *MH-II*, Appendix J, Section K, "Natural History Specimens" for information concerning labeling biological collections.

7. *What materials should I use to label specimens?*

Always use stable materials and in an appropriate manner. Most specimens that you acquire will already have been accessioned, cataloged, and labeled. This is required of researchers who have NPS collection permits. Sometimes park staff may undertake these activities for material they have collected.

Paper Labels

Paper products can vary in quality and appropriateness for the preservation of biological specimens. Paper labels that you use should:

- be white
- have a neutral to slightly alkaline pH (pH 6.0-8.0);
- have a lignin content of less than 0.3%
- be of long-fibered cotton stock, although alpha-cellulose, ground-wood papers are also acceptable

Alkaline-buffered papers, which have a pH of 8.5 or higher, are not acceptable unless they are labels applied to herbarium sheets or packets, insect pins, microscope slides, or the exterior of boxes or other containers where they are not in direct contact with the specimens.

You can obtain acceptable archival-quality paper from various vendors. These include firms listed in *Tools of the Trade* or from some full-line office supply stores (although you may have to place a special order).

Plastic Labels

Do not use plastic labels. Most of the plastic labels that have been used with specimens in the past have not been stable. The exception to this general rule is Tyvek®, a stable non-woven polyester.

Metal Labels

Metal labels are sometimes part of a specimen in the form of leg bands or ear tags. Always retain these with the specimen. **Do not use metal for other labels or label attachments**, as:

- most metals will oxidize and corrode when in contact with the specimens

- sharp edges and corners of the metal can cause physical damage to the specimen

Note: If a metal leg band or ear tag attached to a specimen is actively corroding, you may need to remove it from the specimen. Be sure to consult with a conservator and/or you regional/SO curator for guidance.

Inks

Inks must be resistant to light, fluids, and abrasion. Only use carbon-based, permanent, black ink to label specimens. Carbon inks do not fade. Commercial, black printing inks are usually carbon-based. Most laser printer and photocopier toner is also carbon-based. Laser and photocopiers apply toner with a certain amount of heat. This helps fuse the toner particles to the paper. Some inkjet printers now use pigment-based inks. Keep in mind though that only black, carbon-based pigments are acceptable for labeling biological specimens.

Liquid inks vary in quality. Black inks suitable for labeling should be drafting inks designed for writing on drafting film, using technical pens. These inks tend to be carbon-based with a neutral pH. They adhere well to almost any surface.

You also can use some fiber-tipped pens for labeling specimens. Once again, be sure to choose pens with carbon-based, black, liquid ink.

To test an ink, see how:

- long it takes for the ink to dry so that it will not smear

- well the dry ink resists abrasion

- well it resists water, alcohol, or other fluids that may be used in specimen preservation

For information concerning acceptable permanent inks, refer to *Tools of the Trade*.

Label Attachments

Attach tags to specimens with cotton thread of a thickness appropriate to the size of the specimen. The attachment should be:

- long enough to permit the tag to be read on both sides without stress on the specimen

- short enough that it does not become entangled with the specimen or adjacent specimens

Do not use plastic or metal ties when labeling specimens. These can deteriorate from contact with the specimens. They also can cause mechanical and/or chemical damage to the specimens.

Herbarium Sheet Labels

Attach labels to herbarium sheets and specimen packets in botany collections using methylcellulose paste. Other types of adhesives may break down over time and cause:

- labels to separate from sheets
- deposits of deterioration products on labels and sheets

Methylcellulose paste is compatible with the sheets, packets, and labels. To make this adhesive, follow these steps:

1. Choose a very pure, high-viscosity methylcellulose powder (such as Methocel A4M, a grade A, 4,000 viscosity methylcellulose made by Dow Chemical).
2. Mix the methylcellulose powder with distilled or deionized water.
3. Form a thick gel (following the manufacturer's directions).
4. Dilute the mixture with ethanol or an ethanol and water solution.
5. This creates a quick drying adhesive for paper materials.

Methylcellulose may not work well to attach paper labels to all surfaces. To adhere a label to a glass vial you may need to use an acrylic adhesive. Self-adhesive, foil-backed, paper labels with an acrylic adhesive are available from various conservation suppliers.

Labeling Directly On Specimens

You can directly label bone, shell, and other fairly smooth-surfaced specimens. Use a stable acrylic resin (such as Acryloid® B-72) to seal the surface below the number. If you don't seal the surface, the ink can penetrate and disperse through cracks. This can cause permanent alteration or requiring aggressive scraping to remove labeling errors. See *Conserve O Gram* (*COG*) 1/4 for additional information.

8. *How should I handle biological specimens during processing?*

To protect specimens during processing:

- provide dedicated, open workspace
- use stable work surfaces
- provide ultraviolet-filtered lighting with good color rendering capacity (a Color Rendering Index of 90 or higher)
- maintain clean surfaces
- remove clutter

- wear nitrile gloves
- maintain sufficient space for each specimen
- handle only one specimen at a time
- use trays or carts to move specimens to and from work areas
- keep food, fluids, and other contaminants away from work and storage areas
- avoid working with specimens in areas where environmental conditions are outside an acceptable range
- don't handle or move specimens more than necessary (use a padded turntable for examination to reduce handling)
- request assistance if needed to safely handle or transport a specimen

9. *What should I know about preparation materials?*

Most specimens have been fully stabilized and prepared prior to receipt. The materials used in these processes can affect the preservation and utility of the specimens. It is impossible at this time to state the best preparation techniques with certainty. Therefore, it's always important to carefully document all methods and materials to help determine appropriate use of the specimens over time and to aid future conservation efforts.

10. *How should I document a specimen's condition during processing?*

Prepare condition reports to document a specimen's condition. Collections care routinely involves condition reporting. It's impossible for you to prepare a condition report for each specimen. Therefore, you'll need to prioritize specimen condition reporting. At a minimum, prepare condition reports for:

- type specimens
- endangered or rare species
- unique and historically important specimens
- specimens that are removed from the collection to be sent on loan, or to be used for interpretation or exhibition
- specimens that need treatment

ANCS+ contains a condition report module that you can use to document the condition of specimens in your collection. See the *ANCS User Manual*, Chapter 3, Section IV: Condition Reports Supplemental Record, for additional information.

Your collection may require a more detailed condition examination. You also may require additional information concerning appropriate care for certain specimens. Discuss these needs with your regional/SO curator. He or she can assist you to hire a natural history conservator to conduct a Collection Condition Survey (CCS) of your collection. For additional information concerning a CCS, see Chapter 3, Section D.

11. *Are there any special*

If the specimens were not fully prepared when received at the park, the health and safety issues may be similar to those for stabilization. If the *health and safety concerns during processing?*

specimens have been fully prepared, the risks will be primarily physical or chemical. If you know about all stabilization and preparation materials, it's possible for you to mitigate or eliminate chemical threats through the use of engineering controls and personal protective equipment (PPE). You can reduce the physical risks by paying careful attention to proper handling and storage techniques.

12. *What do I need to know about loans of specimens?*

For information concerning incoming loans, see *MH-II*, Chapter 2, Section P. For information concerning outgoing loans, see *MH-II*, Chapter 5. The following additional standards pertain to loans of biological specimens:

Type Specimens

- are never loaned in some disciplines (e.g., mammalogy)
- are routinely loaned in some disciplines (e.g., invertebrate zoology and botany)
- are usually subject to more stringent loan conditions than non-type material

Important Notes Concerning Transport of Type Specimens:

- The best method of transport to ensure a type specimen's security is hand delivery.
- Specimens shipped by air or mail may be subjected to various types of electronic, chemical, or radiological examination and treatment. Such procedures may damage the specimen; either physically and/or render it useless for certain types of research.
- Some commercial carriers do not accept animals, either alive or dead, for transport. Consult with your carrier in advance concerning their policies.
- If you must send a type specimen by post or commercial carrier, be sure that you can track the package.

Other Important Points Concerning Loans

- rare species or unique specimens are almost never loaned
- entire holdings of a series of specimens are not sent in a single loan
- normal loan duration is six months with provisions for extensions upon request
- shipping containers for outgoing loans are used to return the loans
- loans are not shipped during the end-of-year holiday season due to the risk of delays or losses due to the increased volume of holiday mail
- loan shipments (and indeed, any shipment of specimens for any reason) must fully comply with all applicable State and Federal regulations regarding:
  - shipping documentation

- the shipment of endangered species

- transporting hazardous materials

Be sure that the borrowing institution uses the NPS annotation label (Form 10-510) to note any annotations. The NPS annotation label is available in ANCS+. It's a good idea to send several blank NPS annotation labels with the loan paperwork for the borrower to use, if needed. Upon the loan's return to the park, be sure to note label annotations on the specimen's catalog record in ANCS+.

13. *What techniques should I use when packing and shipping specimens for loans?*

For information concerning proper packing and shipping techniques, see Chapter 6, "Handling, Packing, and Shipping Museum Objects." To ensure proper handling of specimens, you also should:

- use a rigid container (ideally a watertight container) for shipping to protect from external physical forces and environmental risks
- include appropriate invoices, permit information, and other shipping documentation to avoid unnecessary opening of the container
- provide instructions on how to properly open and remove the contents of the shipment
- provide appropriate support and cushioning in the container to protect the specimens from mechanical damage
- provide reasonably stable materials in contact with specimens
- wrap each specimen individually for protection and to contain specimen parts in the event of damage
- be sure address information is correct and legible, and that copies of the shipper and recipient addresses are inside the package
- follow all applicable laws and regulations regarding the packaging of any hazardous materials for any shipping method

There is no guarantee that the same care will be provided when the loan is returned, but hopefully your demonstration of proper methods and materials will serve as a positive example for loan recipients.

14. *What are the regulations pertaining to shipments of hazardous specimens?*

If you ship any hazardous materials (HAZMAT), including some specimens (such as radioactive, toxic, flammable, or otherwise dangerous specimens) via a **commercial carrier** (Federal Express, UPS, or similar firms) you must comply with all State and Federal regulations, especially Title 49, Code of Federal Regulations (49CFR).

YOU CANNOT SHIP HAZARDOUS MATERIALS USING THE U.S. POSTAL SERVICE. IT'S ILLEGAL.

In the United States, the U.S. Department of Transportation (DOT) administers the Federal regulations pertaining to transportation of HAZMAT, known internationally as dangerous goods. 49CFR, Parts 100 through 185, govern the transportation of hazardous materials in the U.S. As noted above, all commercial shipments of hazardous material must be in accordance with the Hazardous Materials Regulations (HMR) found in

Parts 171 through 180 of Title 49, CFR.

According to 49CFR, you **CANNOT** offer a HAZMAT shipment to a commercial carrier for transportation unless it has been packaged, labeled, and prepared for shipment in accordance with the Hazardous Materials Regulations (HMR) (see Parts 171 through 180 of 49CFR). The regulations also require that:

- All packages and containers that you use for shipping by commercial carrier must meet the requirements of the HMR

- Individuals who package, label, and/or prepare shipping papers for hazardous shipments must take a HAZMAT shipping training course. The training must include general awareness and familiarization, function-specific, and safety training.

If your park needs to transport a specimen that is considered HAZMAT, you have three options:

- **Use a U.S. Government vehicle** driven by a properly trained park employee who is knowledgeable of any risks posed by the specimen(s). Such shipments are not regulated by the requirements of the HMR noted above.

- **Hire a Commercial Carrier <u>and</u> a hazardous materials packaging contractor**. The contractor (who has been trained and certified in all DOT HAZMAT regulations) will prepare your package for shipment according to the HMR. The contractor will then forward your shipment to the commercial carrier. Companies that offer these services are usually located near large international airports or port facilities.

- **Complete a HAZMAT shipping training course that meets DOT requirements**. Several firms and organizations offer such courses, which are classroom-based, distance-learning/Internet, or via a CD-ROM or other method. The DOT has a CD-ROM based training program. Once you have completed the training you can legally pack such shipments for commercial transport.

For additional information concerning transportation of hazardous specimens and training requirements, consult the DOT:

U.S. Department of Transportation
Research and Special Programs Administration
Office of Hazardous Materials Safety
400 7th Street, SW
Washington, DC 20590
(800) 467-4922; (202) 366-8553
http://hazmat.dot.gov

D. Storage of Biological Collections

1. *How should I store biological collections?*

To ensure proper storage, consider:

- location

- security
- organization
- housings
  - storage designs
  - storage systems
  - storage materials

2. Where should I locate storage?

Locate biological collection storage in an area:

- where there are minimal natural or human-caused hazards
- where you can control access
- where you can organize the collection in a logical manner
- that staff can easily monitor and control the environment

Off-site facilities, basements, attics, and irregular or fragmented spaces do not serve the interests of good collection management, care, or use. Storage should meet the standards of the NPS Checklist for Preservation and protection of Museum Collections ("Museum Checklist"). For additional information concerning the Museum Checklist, see Appendix F: NPS Museum Collections Management Checklists.

3. How can I ensure the security of biological collections in storage?

Provide appropriate security for the specimens through:

- control of access and use
  - policies
  - procedures and other standard operations
  - key control
  - restrictions
- physical security
  - door and cabinet locks
  - staff supervision of all collection access
  - electronic detection and surveillance systems (alarm systems, coded keycards, closed circuit television surveillance, etc.)

For further information concerning the security of collections, see:

- Chapter 9, "Museum Collections Security and Fire Protection."
- ASIS Standing Committee on Museum, Library and Archive Security. *Suggested Guidelines in Museum Security*. Alexandria: ASIS International, 1997. Available at on the web at:

<www.stevekeller.com/steve/pdf_files/SecurityStandards/GuidelinesRev97.pdf>.

- Layne, Stevan P. *The Cultural Property Protection Manual*. Denver: Layne Consultants International, 2002.

4. *How should I organize my park's biological collection?*

You can organize your collection:

- following disciplinary standards that comply with the most recently accepted classification system for the taxonomic group in question
- based on a progression from primitive to complex forms, often reflecting a described classification system
  - begin subdivisions within the broadest pertinent taxonomic division (phyla or class)
  - continue the phylogenetic arrangement at least to the family or subfamily level

Below these levels it is common to use an alphabetic arrangement:

- genera are organized alphabetically within a given family
- species are organized alphabetically within a given genus
- such organization may continue to sub-specific levels as well

Organization beyond the classification system may vary among disciplines and/or parks:

- Parks with large collections of specimens of the same genus or species (or subspecies, if applicable) may want to arrange specimens alphabetically by geographical designations for the collecting locality (such as state, park district, or county).
- Beyond classification and geographical arrangement, arrange specimens numerically by catalog number.

If you organize your park's biological collection this way, every specimen has a designated and predictable location. You can then easily retrieve and replace specimens and conduct periodic inventories without difficulty.

5. *What about other methods of arrangement?*

Sometimes you may need to adapt your arrangement patterns to provide effective use of space for:

- over-sized specimens
- specimens with multiple parts that are not best accommodated in the same storage unit (dry study skins with parts preserved in fluids)
- collections from more than one park

Remember: Be sure that your method of arrangement:

- provides appropriate protection for the specimens

- enables the specimens to be accessed with ease for research use

For additional assistance deciding on a suitable arrangement system, consult:

- Your regional and network-level contacts:
  - regional /SO curator
  - regional chief scientist
  - network inventory and monitoring coordinator
- NPS Senior Curator of Natural History
- Park scientists/natural resource management staff
- Major research users of your park's natural science collection

6. *Are there any other issues related to collection arrangement that I should consider?*

After you organize your biological collection based on an acceptable classification system, and arrange it in a simple and logical pattern, be sure that you can easily locate specimens. You can facilitate this by:

- signage
  - label each aisle of storage units to indicate the beginning and ending groups housed within the aisle
  - label each cabinet, drawer, and shelf to indicate the beginning and ending groups in the unit
- floor plans that detail where the various specimen groups are located

The ultimate goal is to allow ease of access to a specimen with minimal handling of other specimens.

7. *What issues should I consider when planning a new or upgraded storage facility for biological specimens?*

Discuss your storage needs with your regional/SO curator, park and regional/SO natural resource management staff, network inventory and monitoring coordinator, park maintenance staff, park partners such as local universities, other agencies, and museums, and other subject matter experts. Refer to Chapter 7, "Museum Collections Storage" for NPS standards and requirements for collections storage. Also refer to:

- Rose, C., C. Hawks, and H. Genoways (eds.). *Storage of Natural History Collections: A Preventive Conservation Approach*. Washington, D.C.: Society for the Preservation of Natural History Collections, 1995.
- Rose, C. L., and A. R. de Torres (eds.). *Storage of Natural History Collections: Ideas and Practical Solutions*. Washington, D.C.: Society for the Preservation of Natural History Collections, 1992.

For ordering information concerning either volume, visit the Society for the Preservation of Natural History Collections' (SPNHC) website at: <http://www.spnhc.org/>.

Things to consider for biological collections storage facilities include:

- Have a dedicated storage area. Do not co-locate offices, collections processing, supply storage, or any other functions within collections storage areas.

- Provide 350 lbs. per square foot floor-loading capacity for storage areas that will house compact or mobile storage systems.

  - This will also permit you to safely move cabinets, collections on pallets, or objects in crates using lift equipment such as power lift stackers and pallet trucks.

  - Make sure that access corridors between freight elevators, storerooms, and exhibit areas have similar floor loading capacities.

- Ensure that the entrance to any storage area is large enough in both dimensions to accommodate full-unit cabinets and large objects.

- Avoid dropped ceilings in all storage areas, and, to the extent possible, elsewhere in the building. Dropped ceilings:

  - provide a habitat for pests

  - disguise the source of leaks

  - contain materials that can generate dust and debris that foul particulate filtration systems

- Avoid raised decks or other raised flooring for compact storage systems. These provide a habitat for pests. Install compactor tracks into properly leveled and coated concrete floors (see below).

- Install a sanitary perimeter around any building that houses collections. This is a 3' wide pea gravel border, 4" deep, along the outside of the exterior walls.

  - The trench should slope away from the building and be lined with a polyethylene membrane to inhibit plant growth.

  - Use non-flowering plants for landscaping outside the sanitary perimeter. Flowering plants attract dermestid beetles.

  - Avoid attaching mercury vapor or tungsten lighting to buildings as these attract insects.

- Equip all storerooms with fire detection and water-based, automatic fire suppression systems.

  - Program for, and ensure regular testing, inspection, and maintenance of the systems.

  - For assistance, contact your regional structural fire management officer (SFMO) and regional/SO curator.

- Label all pipes and ductwork so that staff can adequately protect collections that may have to be stored below them. Do not locate any pipes (other than sprinkler lines and minimal ductwork) inside storage areas.
- Install seals around all duct and pipe chases where they pass through walls, floors, or ceilings. You can block these passages with "Stuf-it"

copper wool gauze to keep insect pests and rodents out of storage areas. "Stuf-it" copper wool gauze is available from:

Allen Special Products, Inc.
1610 Bethlehem Pike #B3
Hatfield, PA 19440
(800) 848-6805

- Avoid interior duct linings. Where needed for noise control or to reduce condensation, use external duct linings.

- Install climate control equipment outside the storage room. This eliminates the need to access the room to maintain the equipment. This will also help protect the collections from equipment leaks.

- Filter all incoming and recirculated air to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90-95% level.

- Plan for a moderately dry environment.

  - The relative humidity (RH) range that is most suited to the majority of natural history collections is 40-60%. This assumes that the building fabric is designed for this range.

  - Specimens and objects inside well-sealed cabinets can withstand external environments from 30-65% RH over the course of a year. In a temperate climate, the collections inside the cabinets will enjoy a very stable RH somewhere between 45% and 55%.

  - Most natural history materials will preserve very well at a RH of 40-50%.

  - Some materials are very sensitive to mechanical damage at a RH below 40%, (teeth, bone, and shell). Fluctuations in RH below 40% can cause these materials to crack and spall, even without the impetus of mechanical damage.

- The optimum temperature for storage of biological collections depends upon the type of preservation (dry, wet, low temperature). Consult the appropriate sections of the text for information.

- Avoid all natural light, and use indirect lighting or filtered fluorescent lighting to reduce the potential for damage to collections from ultraviolet radiation.

- Paint walls and ceilings white or a very light color. White reflects much of the visible-light spectrum. You can then reduce the intensity of the light from various light sources in work or storage areas.

  - White or light walls and ceilings permit easy monitoring for dust, and cobwebs and other indications that insects may be present.

  - Most white paints contain titanium dioxide, which absorbs part of the ultraviolet radiation from fluorescent lighting, reducing the UV in any reflected light.

- – Avoid oil-based paints, single-component epoxies, alkyd paints, or oil-modified polyurethane coatings.
- – Select an acrylic emulsion latex (interior or exterior), vinyl acrylic, or acrylic urethane coating for walls and ceilings.

- Coat concrete floors (after appropriate curing) with a solvent-borne epoxy sealer, topped with a moisture-cure epoxy sealer.
  - Avoid all other floor coverings. Anything else will require wet cleaning or will be a source of particulate or gaseous pollutants.
  - When worn, you can replace the topcoat without having to evacuate the collections from the area.
  - Use a clear or pigmented epoxy. Do not use white, it will always appear scuffed.

8. *What storage systems will best protect my park's biological collections?*

The agents of deterioration that pose the greatest risks in storage of collections vary according to the level of containment for the specimens. Collections in open storage are far more vulnerable than those stored in closed storage, as shown in Tables T.3 and T.4., below:

Threat	**Floor**	**Racks/Screens**	**Shelving**
Neglect	Poor	Poor	Poor-Fair

Direct Physical Forces	Poor	Fair	Poor-Fair
Criminal Activity	Poor	Poor-Good	Poor
Fire	Poor	Poor	Poor
Water	Poor	Fair	Fair
Pests	Poor	Poor	Poor
Contaminants (especially dust and outdoor air pollutants)	Poor	Poor	Poor
Visible and UV Light	Poor	Poor-Fair	Fair
Inappropriate Temperature	Poor	Poor	Poor
Inappropriate/Fluctuating Relative Humidity	Poor	Poor	Poor

Table T.3. Quality of protection against agents of deterioration for collections in open storage. Based on work by Barbara Moore and Stephen Williams.

Threat	Poorly Sealed Cabinet	Well Sealed Cabinet (elevated or on compactor storage)	Compactor Shelves
Neglect	Poor	Fair-Good	Poor-Fair
Direct Physical Forces	Good	Good	Fair-Good
Criminal Activity	Good	Good	Good
Fire	Fair	Fair-Good	Fair
Water	Fair	Good	Fair
Pests	Fair	Good	Fair
Contaminants (especially dust and outdoor air pollutants)	Poor-Fair	Good	Fair-Good
Visible and UV Light	Good	Good	Fair-Good
Inappropriate Temperature	Poor-Fair	Good	Fair
Inappropriate/Fluctuating Relative Humidity	Poor-Fair	Good	Poor

Table T.4. Quality of protection against agents of deterioration on collections in closed storage. Based on work by Barbara Moore and Stephen Williams.

For most collections, locked, well-sealed, properly installed and leveled cabinets reduce the risk of most agents of deterioration. Good cabinets:

- exclude pests (most pest infestations are then the result of negligence)
- greatly deter theft
- can eliminate damage from:
  - water leaks
  - light
  - most particulate pollutants
  - soot and other debris during a fire
  - some forms of physical damage
  - the impact of humidity extremes and fluctuations

Cabinets can maintain a reasonably stable relative humidity level (even when you open doors periodically for access). If you keep doors closed, the cabinets will provide acceptable environments through short-term failure of building systems.

> ***Remember: Cabinets do not provide protection against neglect. Lack of appropriate organization, cushioning, and support will still expose specimens to mechanical damage from physical forces. Well-sealed cabinets also will contain any vapor off-gassed by poor quality storage materials. This will increase the potential for chemical damage to collections stored with these materials.***

9. *What types of storage equipment should I use for biological collections?*

The storage equipment of choice may depend on the type of biological collection (dry, wet, low temperature, etc.). Refer to subsequent sections for more information.

One of the best ways to provide proper long-term care for your collections at minimal cost is to use appropriate storage equipment. Good quality cabinets and other storage equipment will last for several decades if properly maintained. Purchase and use standardized storage equipment. This permits:

- bulk purchases, which can result in substantial cost savings
- drawers and other interior fittings to be traded among cabinets to suit specific needs

When purchasing new storage equipment, include the following specifications:

- steel construction (some lightweight aluminum or molded high-density polyethylene shelving may be useful in certain instances)
- high gloss, epoxy powder coatings
- exterior surfaces that are flush (no indentations or recesses other than at door latches)
- no interior spaces of any kind that cannot be reached with a vacuum cleaner - this includes hollow doors unless they are completely sealed
- hinged, lift-off doors, or doors that open completely and fold back flat against adjacent cabinets to facilitate
  - cleaning of the cabinet interiors
  - rearrangement of drawers and shelves
  - installation and removal of specimens
- door locks, generally keyed alike to prevent a proliferation of keys or a tendency to avoid locking the doors
- d-style tubular neoprene or silicone door gaskets

- these “rubberized” materials will off-gas minor amounts of sulfur (herbarium materials are sensitive to sulfur gases)

- you can use either neoprene or silicone foam gaskets for sulfur-sensitive collections, but the d-style gaskets provide a better seal against pests and pollutants and for most biological collections are probably worth the comparatively minor risk from the sulfur

- alcohol-cure silicone sealants (no acetic acid should be present in any sealants used in cabinets)
- powder-coated steel interior fittings
- light-tight construction for all cabinets (where light can enter, so can insect pests and dust)
- leveling feet
- 4” or higher legs

  Note: The GSA contractors that manufacture NPS standard museum storage cabinets also sell cabinet platforms that you can use to elevate the cabinets 6” above the floor. See *Tools of the Trade* for more information.

- casters, or dollies with locking casters for deep shelving units, these

  - allow the units to be easily moved, even when fully loaded

  - help maximize the use of space in a storage area (they are an inexpensive compact storage design)

- removable restraining bars to keep items from toppling from shelving units during an earthquake
- suspension (roller-bearing) or Permaslide® or equivalent systems for pull-out drawers. Avoid friction systems as these rapidly abrade and can deposit fine particulates from the paint on collection objects.

When you acquire new storage cabinets, purchase only white or off-white equipment and containers. This facilitates housekeeping, pest monitoring, and "crumb" monitoring. "Crumb" monitoring refers to examining stored collections for signs of decrepitation (small particles dislodged from specimens as a result of biological, chemical, or physical deterioration). It’s virtually impossible to inspect for pests against anything other than a white or very light background.

For additional information concerning proper storage equipment for biological collections, see *MH-I*, Chapter 7, “Museum Collections Storage” and *Tools of the Trade*. Refer to *Tools of the Trade* for equipment product descriptions and illustrations, vendor contact information, and current Federal government contracts.

10. *What special concerns should I consider when installing new storage equipment?*

Use the following steps when installing new storage equipment. This will help ensure that the equipment will protect the collections and be durable over time. You should use similar steps if you must move storage equipment after the initial installation.

- If possible, arrange for the manufacturer to install the equipment.
- If park staff are moving or installing cabinets:
  - Use mechanized equipment such as a stacker.
  - Move cabinets with a nearly complete complement of shelves or drawers (but without the collections). This helps reduce distortion of the cabinet during the move.
  - Remember that a good quality, steel museum storage cabinet with drawers can weigh as much as 600 lbs.
  - If you move cabinets improperly, this will reduce their capacity to provide protection for collections.
- Test all incoming storage cabinets for off-gassing.
  - This includes any powder-coated cabinets.
  - Coatings may off-gas.
  - Cabinets may contain many other materials besides the coating.
  - Air out all storage cabinets (with doors open) for as long as possible before installation of any collection objects.

Note: Information on test methods is given below.

- Level all cabinets (front-to-back and side-to-side) whenever they are newly installed or moved. Cabinets that are not level will not close properly and:
  - provide limited microclimate control
  - allow dust and insect pests to enter
- After leveling, test all incoming storage cabinets to insure that they are light tight:
  - Place a battery-powered lantern or 9-volt flashlights inside a leveled cabinet, then close and lock the door.
  - Turn off all room lights.
  - Carefully examine the cabinet for several minutes for signs of light from within.
  - If light can be seen, mark the area with a post-it note and examine it under normal lighting.
  - If the light leak is a result of a flaw in the cabinet from anything

other than a minor problem around the door gasket, contact the manufacturer for repairs or replacement.

- You can fill minor leaks around the door gasket. Use 3M® self-adhesive neoprene foam gasket material (or equivalent), which is available in various widths at hardware stores.

- Refer all major problems with door gaskets to the cabinet's manufacturer.

11. *What types of storage materials are appropriate for use with biological collections?*

The storage materials of choice may depend on the type of biological collection (dry, wet, low temperature, etc.). Refer to subsequent sections for more information about storage materials. In general, storage materials that are appropriate for use with biological collections include:

- closed-cell polyethylene foam (Volara® Type A or Plastazote®)
- opaque non-woven (spun-bond) polyethylene fabric (Tyvek®)
- polyester film
- high density molded polypropylene or polyethylene
- pH-neutral, alpha-cellulose, lignin-free, unbuffered papers & boards
- pH-neutral, unbuffered, 100% cotton paper products
- pure cotton fabrics (thoroughly washed)
- polyester fiber (non-bonded, high loft, resin-free polyester fiberfill)
- medium or high density, phenol-formaldehyde-impregnated, exterior grade plywood that is surface laminated with melamine, or with vapor barrier foil/plastic laminates. **Note:** See the Safety Note concerning the use of aluminum foil laminates with certain treated specimens, in #13, below)
- glassware

Contact with alkaline-buffered ("buffered") paper can damage pigments and proteins in bird and mammal specimens. It can also interfere with herbarium chemical taxonomy studies. Always use unbuffered, acid-free materials with natural history specimens, or line buffered trays with unbuffered blotting paper to eliminate direct contact with alkalis.

For additional information concerning proper storage materials for biological collections, see *MH-I*, Chapter 7, "Museum Collections Storage" and *Tools of the Trade*.

12. *Are there any cautions to using the above materials with biological specimens?*

Polyethylene melts at about 250°F. This temperature is far below that at which many bird and mammal study skins, untanned skins, feathered or haired specimens, plant specimens, and paper are damaged by heat alone. If the foam is in direct contact, it will melt and damage the specimens **before** they would ordinarily be damaged by the heat of a fire. Separate from direct contact with specimens by using pH-neutral, 100% cotton rag blotting paper or pH- neutral, smooth-surfaced tissue.

Polyethylene foams and films develop a static charge in low humidity conditions and can damage:

- friable surfaces, such as the periostracum on many shells
- fragile parts such as those on some plant specimens
- hair or feathers

Other cautions concerning polyethylene foam include:

- Polyethylene foam will readily adhere to some small specimens and objects, such as those with fur or with sharp protrusions (a specimen or object can be easily be torn in lifting it from the foam surface).
- Some expanded polyethylene foams have open pores along cut edges that are an appropriate size for some insects to deposit eggs or for insect larvae to pupate. Using appropriate ventilation, seal edges with a hot air gun, or cut the foam with a hot knife to seal the openings.

Considerations for other materials include:

- Polyester film (Mylar D®, Melinex 516®) has a very high melting point, but develops a static charge at humidity levels of about 40% or less.
- Polypropylene may have the same problems as those noted above for polyethylene foams.
- Polyester fiber should always be separated from direct contact with any collection item that has small protrusions or a friable surface.

13. *What materials should <u>not</u> be used for storage of biological specimens?*

Don't use any of the following materials, they can damage specimens:

- polystyrene
- polyvinyl chloride (PVC) plastics
- polyurethane foams and oil-based polyurethane varnishes
- synthetic polymers containing unstable plasticizers or other additives
- alkyd enamel paints
- bakelite (a hard, black plastic), which decomposes when exposed to alcohol and/or formaldehyde vapor
- acidic paper products
- alkaline-buffered paper products (in collections containing proteins, animal pigments, or intended for use in some biochemical or chemical taxonomy studies)
- wood and most wood products, although you can use wood to construct

pallets for large specimens if:

- you use a well ventilated room
- you properly seal the wood
- the collection materials are not in direct contact with the wood

- most uncoated metals (see safety note below)
- most commercial grade textiles
- cotton batting (is extremely hygroscopic and will attract and hold moisture on specimens)
- natural rubber

IMPORTANT SAFETY NOTE: Aluminum metal, and vapor barrier materials made with aluminum foil can be a hazard if used with collections that have been treated for pest control using mercury salts or chlorinated compounds. These chemicals react with aluminum.

E. Maintenance of Biological Collections

1. What is maintenance?

Maintenance includes all of the corrective actions in response to a real or perceived problem. It can include a variety of issues, but the most common maintenance concerns include:

- updating information
- housekeeping in storage and exhibit areas
- emergency preparedness, response, and salvage
- specimen cleaning
- specimen treatment
- pest management

2. What information management issues are related to maintenance of biological collections?

Maintenance includes the following information management issues:

- the need to update information (to reflect ongoing changes in the classification system as researchers develop a better understanding of taxonomic relationships) to:
  - specimens
  - drawer labels
  - catalog records

- databases

  Be sure to document information related to any associated collections of tissue or parasites. You also should obtain reports of further analysis of these collections.

- detailed documentation and analyses of environmental conditions in collection areas

- condition reporting

- recording images of specimens

- deaccessioning specimens (see *MH-II*, Chapter 6, "Deaccessioning")

Maintenance activities may depend on the type of biological collection (dry, wet, low temperature, etc.) in question. Refer to subsequent sections for more information about specific maintenance issues.

Include all pertinent information in ANCS+, especially loan, exhibit, and treatment histories. Also, note all publications in which a specimen has been cited. If this information is available, the value of individual specimens and the collection as a whole is enhanced.

3. *How important is housekeeping for biological collections?*

As with all other collections, good housekeeping provides for the long-term preservation of biological specimens. Proper housekeeping minimizes particulate pollutants and eliminates habitats and materials attractive to insect and rodent pests.

4. *What housekeeping strategies should I use for long-term preservation of biological specimens?*

For NPS housekeeping and storage requirements, see the "NPS Checklist for Preservation and Protection of Museum Collections" in Appendix F: NPS Museum Collections Management Checklists, as well as Chapter 7: Museum Collection Storage and Chapter 13: Museum Housekeeping.

Other steps that you should take include:

- Place polypropylene fiber mats outside the doors to the storage rooms to reduce dust and dirt entering the collection area.

- Use High Efficiency Particulate Air (HEPA)-filtered vacuums as your primary cleaning tool. Unlike conventional vacuums, HEPA vacuums do not redistribute fine particulates into the area being cleaned. See *Tools of the Trade* for product information.

- Avoid wet cleaning in collection areas. If necessary, use spot cleaning to remove stains.

  - There is no need for regular wet cleaning in storage areas.
  - Large areas of damp carpet or floors can raise humidity levels.

- Do not use spray cleaners or aerosol cleaners in collection areas.

  - Do not use these in any space that shares a ventilation system with collection areas.

- Spray on cleaning rags outside collection areas, only.

- Do not use chlorinated cleaners anywhere in collection areas. For safer cleaning alternatives, see *COG* 2/21 “Safer Cleaning Alternatives for the Museum and Visitor Center.”

- Use specialized cleaners (such as Brillianize®) for many plastics, such as exhibit cases. Never spray directly onto the case surfaces, or on rags while in collection areas.

5. *What should I know about emergency management, response and recovery?*

Emergency planning and management is vital. Be sure that you are prepared to deal with all emergencies and potential disasters. Have an up-to-date Emergency Operations Plan (EOP), conduct drills, and ensure that all staff are aware of their responsibilities in event of an emergency. This will reduce damage to, or loss of, life or property.

For additional information, refer to *MH-I*, Chapter 10, and your park’s EOP. For questions about your park’s EOP, consult your chief ranger, safety officer, and regional/SO curator.

6. *What do I need to know about salvaging biological specimens following an emergency?*

Salvaging specimens after an emergency or a disaster is usually geared towards stabilization. It normally occurs within the first 48-hours after the collection and/or area is secured. Initial stabilization may involve some treatments. However, these treatments are not designed for restoration or repair, but to eliminate further damage.

There are a number of salvage techniques for many kinds of specimens. A very useful reference is:

> Ball, C. and A. Yardley-Jones. *Help! A Survivor’s Guide to Emergency Preparedness*. Museum Excellence Series: Book 3. Edmonton: Museums Alberta, 2003. Ordering information at: <www.museumsalberta.ab.ca>.

There are conservators who have extensive experience in salvage of biological materials. Be sure to include their names and contact information in your park’s EOP response call list. Information about appropriate conservators is available on the web at <http://www.aic-faic.org/guide/form.html>.

Following an emergency, many specimens and/or collections may require treatment. These treatments can be extremely complex. Refer such work to a professional conservator.

7. *What about cleaning biological specimens?*

Cleaning of specimens poses a variety of problems:

- Removing particulate matter on most specimens can risk mechanical damage.

- Vacuuming some specimens, such as study skins, will remove ectoparasites that may be useful in verifying the identity of the host organism.

  - Before you vacuum or otherwise clean any research specimens, be sure that the “pest” is indeed a “recent” infestation rather than an ectoparasite.

To ensure that specimens are not damaged during cleaning, follow these general guidelines:

- Carefully vacuum specimens using a HEPA-filtered vacuum and small tools.
  - Do not dust wipe specimens or use forced air.
  - For some hard-surfaced specimens, you can use a soft brush to brush surface dust into the nozzle of a HEPA-filtered vacuum.
- Restrict your cleaning to specimens that are otherwise in good condition.
- Do not attempt to vacuum specimens with:
  - flaking skin, scales, periostraca, or paint
  - loose feathers or hair
  - fragile parts or appendages
- Avoid cleaning botanical specimens, herbarium sheets, and insects.
- Consult a conservator for advice before cleaning any group of specimens for the first time.

Consult with a conservator before attempting any cleaning that may require water or organic solvents. This applies to all types of specimens and whatever sort of material is to be removed from them.

8. *Are there any other concerns regarding treatments of biological specimens?*

When specimens have suffered mechanical, biological, or chemical damage, you should stabilize the material by non-interventive means rather than to try to repair the damage:

- If there are detached parts, contain them so that they will not be lost. Don't attempt to reattach them.
- You can stabilize a cracked or broken specimen with an appropriate support.

Specimens with historic or interpretive value can be treated, but only by a conservator. Even in these instances, all repair materials must be easily distinguished from original specimen materials.

NOTE: Avoid any action that might compromise the integrity of research specimens.

9. *Are there any health and*

Many of the health and safety concerns can be mitigated by the use of proper personal protective equipment (PPE). This includes gloves and the *safety concerns related to maintenance of biological collections?*

use of other appropriate equipment, such as HEPA-filtered vacuums.

Activities beyond routine maintenance may require you to:

- have full knowledge of potential material interactions
- use properly ventilated laboratory facilities
- use respirators and additional PPE

> ***The use of some personal protective equipment (PPE), such as respirators, requires a medical evaluation, formal training, and fit testing. For additional information concerning respirator use, see COG 2/13.***

10. *Should I document cleaning, treatment, and salvage activities?*

Yes. All cleaning is essentially an irreversible treatment. Always document all cleaning activities (whether done by collection staff or a conservator). Provide written documentation and photographs or other images as well. You also should document any treatment (however simple it may appear to be) in writing, and in photographs or images taken before, during, and after the treatment.

During emergency salvage operations, it's acceptable for you to eliminate individual specimen reports. However, you'll need to document all steps in the overall immediate salvage (in writing and in some imaging system). Record specific damage to particularly valuable specimens and specimens on loan from other museums. Note the specific salvage methods used. Such information may be important for insurance purposes as well as for the future preservation and utility of the specimens.

11. *How can I protect biological specimens from pests?*

In the past, pest management incorporated repeated application of pesticides. This often involved multiple types over time. There are numerous problems with this approach, including:

- laws and regulations
- health and safety
- environmental quality
- questionable effectiveness
- materials interactions

Practice the principles of Integrated Pest Management (IPM). IPM is the best approach to dealing with pests in museum collections. It is a holistic, environmentally-friendly, and sustainable means of pest control. IPM does not exclude the use of pesticides. It does however, offer many alternatives for achieving the same goal. Because dry collections are at greater risk from pests than other types of collections, refer to Section III for more information about IPM and pest management.

> ***The National Park Service implemented an IPM program in the early 1980s. Since then, the NPS has reduced pesticide use by over 60 percent, while also improving the effectiveness of Servicewide pest management efforts.***

SECTION III: DRY BIOLOGICAL COLLECTIONS

A. Overview

1. *What are dry biological collections?*

Dry collections consist of those specimens that are preserved in a dry state.

2. *Why are some biological specimens preserved in a dry state?*

Two factors influence decisions about preserving specimens this way:

- **Rigidity.** Some specimens can be preserved naturally (starfish) or artificially (vascular plants) with sufficient rigidity to accommodate normal handling. Such specimens often are suitable for dry preservation.

- **Specific characteristics.** Drying may provide the best available means to preserve natural colors (for example, butterflies) or distinguishing features (such as skeletal parts or surface details). Such specimens in a dry state may have great potential for interpretation and research.

3. *What types of biological specimens are usually included in dry collections?*

Plants

- Non-vascular (selected forms of lower plants such as lichens and many fungi)

- Vascular (flowering and coniferous plants)

Animals

- Invertebrates (selected forms such as many insects, corals and some crustacea, mollusks and echinoderms)

- Vertebrates

  - fish (skeletal parts, mounted specimens)

  - reptiles (skeletal parts, scutes or shells, large skins, mounted specimens)

  - birds (skeletal parts, skins, mounted specimens)

  - mammals (skeletal parts, skins, antlers, horns, mounted specimens)

Ancillary Collections

In addition to the specimens, ancillary or support collections are commonly preserved in a dry state. Examples include nests, eggs, replicas, scats, wood samples, labels, and specimen or collection records.

Note: Some biological collections may include photographs used to represent the voucher specimen, especially for some threatened and endangered species. An example of this is a photograph attached to a labeled herbarium sheet.

4. *What are the primary agents of deterioration that affect dry collections?*

Under certain conditions, dry collections can be damaged by all of the agents of deterioration. They are particularly susceptible to neglect, pests, contaminants, visible and UV light, inappropriate levels of temperature and humidity, and improper handling.

5. *How does neglect affect dry collections?*

Neglect can cause collections to become:

- damaged
- lost
- disordered (a lack of organization that impedes collection access)

Major causes of neglect include:

- insufficient knowledge and skills
- failure to provide adequate documentation
- apathy
- lack of administrative support
- an imbalance of resources

6. *How do pests threaten dry collections?*

Dry biological collections contain organic material that is attractive to many insect pests. Fresh material that is not thoroughly dry is highly at risk. However, even dry material is attractive to some pests. The species of insect pest varies according to the type of collection. Some insect pests prefer dried plant materials, while others feed on animal materials.

Vertebrate pests (such as mice) can damage any material either through nesting or feeding. They can also cause soiling with body fluids or excrement.

7. *How can contaminants adversely affect dry collections?*

Contaminants may occur in particulate or gaseous forms. Specimens can be contaminated due to:

- particulates such as dust and soot from atmospheric pollutants
- emergencies
- poor storage and exhibit designs

Particulates can:

- be abrasive
- soil surfaces
- obscure fine details
- attract and hold gas-phase pollutants on the surface of specimens, promoting chemical damage
- necessitate repeated cleaning of collections that:
  - is a drain on a museum's resources
  - causes wear and tear on the collections

- has the potential for severe damage during the cleaning process.

Specimens may acquire other particulate contaminants such as:

- asbestos from deterioration of building materials
- polychlorinated biphenyls (PCBs), lead, and cadmium as a result of the deterioration of paints used in buildings or on storage furniture
- other chemicals used for preparation treatments or pest control

Not all of these cause chemical or physical deterioration of the specimens, but they may have an impact on use of the specimens for interpretation or research.

Other points to remember include:

- Gaseous pollutants are generally inorganic or organic vapors that form acids when they react with moisture in the air.
- Inorganic acid gases, primarily sulfur and nitrogen oxides, are present in very high concentrations near urban centers. They may be high in some rural areas as well. In a museum, they contribute to deterioration of many materials. However, they will have the greatest effect on cellulosic materials stored or exhibited outside of cabinets.
- Organic acid vapors cause deterioration to most dry specimens and their documentation at varying rates, according to:
  - the type and concentration of pollutant
  - the nature of the materials in the collection

  Organic acids can:

  - cause chemical disintegration of organic materials
  - attack calcareous materials (materials containing calcium such as shell, eggshell, and coral)
  - damage to calcareous materials can range from unsightly surface alteration to complete conversion to a powder

  The major sources of organic acid pollutants are:

  - wood and wood products (including wood pulp paper and cardboard)
  - additives in some plastics and fabrics
  - certain adhesives and coatings, especially alkyd enamel paints, *including the baked enamel paints used on some storage furniture*

8. *How does visible and ultraviolet light affect dry collections?*

Most dry specimen materials are either very sensitive or moderately sensitive to visible light. Visible light causes fading of biological pigments. Fortunately, "structural colors" in animals are not greatly affected by visual light. These include multiple iridescent colors and some blues and greens that are found in feathers. Others include colors in the exoskeletons and wings of many insects.

As with visible light, most dry specimen materials are also either very sensitive or moderately sensitive to ultraviolet radiation. Ultraviolet radiation causes:

- alteration of biological pigments (fading or shifts in color).
- damage to chemical bonds in plant and animal materials
    - UV breaks down the structure of the materials to leave them weakened or embrittled
    - this loss of structural integrity can alter the appearance of structural colors

9. *How does temperature and relative humidity affect dry collections?*

High temperatures contribute to:

- desiccation
- denaturation of proteins
- lipid and resin migration

In general, the rate of any chemical reaction that damages specimens will double with each 10°C/50° F rise in temperature.

Temperatures below freezing:

- cause expansion of free water, which can result in cell rupture in fresh plant and animal specimens
- permit lipid migration (via ruptured cells) in fresh animal specimens
- will not stop the growth of microorganisms unless the temperatures are below -20°C/-4ºF
- will not stop enzymatic activity
- increase the rate at which lipids oxidize, which can cause damage to pigments and proteins
- may cause migration of salts in tanned skins. This can lead to collapse of capillaries in the skin

Temperature fluctuations can result in expansion and contraction of some materials, such as teeth. This can cause cracking.

Excessive moisture in the air (above about 65% relative humidity) encourages:

- mold

- pest infestations
- chemical reactions that can be damaging to organic material
- deformation of material such as tanned or untanned skins and wood samples (deformation is also caused by fluctuating relative humidity)
- softening of some adhesives

Relative humidity below 40% may contribute to embrittlement of rigid materials such as:

- teeth
- ivory
- bone
- mollusk shell
- the outer covering on some mollusk shells (the periostracum)
- wood samples

Embrittlement will leave these specimens very susceptible to mechanical damage.

Fluctuations in relative humidity can cause cracking or splitting of these materials. This is especially true at humidity levels below 40%.

> ***Maintain relative humidity levels below 40% to promote the preservation of freeze-dried specimens that are prone to deteriorate rapidly at higher levels of RH.***

10. *Are there any special rules for handling dry collections?*

Yes. You can easily damage dry collections by improper handling, inadequate support, carelessness, and poor storage techniques. In addition to the recommendations in Chapter 6 and those previously noted in this appendix, use the following handling guidelines to prevent damage to your dry collections:

- Ensure that everyone who uses the collection knows how to properly handle herbarium specimens. Develop written guidelines for use.
- Use large storage trays to move specimens housed in envelopes and small specimen trays.
- Used a padded cart to move material from room to room.
- Avoid handling specimens with your bare hands. Wear *unpowdered* nitrile gloves. As with other collection items, gloves will protect the specimen from oils in the hands, but they'll also protect you from specimens that may cause you to have an allergic reaction.

- Use a light colored work area, so that any material that breaks off can easily be seen and retrieved.

- If you require extra light, use it sparingly.

- Use forceps or gloved hands to carefully move loose material.

Herbarium Specimens

- Do not overcrowd specimens:

  - Don't place too many specimens on one cabinet shelf.

  - Leave enough space on each shelf to allow for easy expansion of the collection in the future.

- When you access a specimen, always remove the entire genus folder.

  - Never attempt to remove just one herbarium sheet from a stack of folders. This can damage the specimens.

  - Support the bottom of the genus folder with both hands when moving it.

- Move herbarium sheets by providing complete support from the bottom.

- Don't shuffle sheets as if they were cards or pages of a book.

- Do not turn sheets upside-down.

  - Stack sheets neatly to the side if specimens on the bottom of the stack are needed.

  - Be sure that the edges of sheets never hit or scrape specimens below.

- Whenever you remove a folder from storage, place a marker in the location to ensure that the folder is returned to its proper place.

- Do not bend sheets to force them under a microscope. Use a hand lens or long-armed microscope.
- Have fragment folders close at hand for attachment to herbarium sheets if needed. If a portion comes loose, place it in a fragment folder attached to the specimen's sheet immediately.

- Equip the research area with work surfaces that are large enough to accommodate a number of herbarium sheets, as well as additional space to ensure that the individual sheets will not strike each other, which may damage a specimen.

The most common cause of damage to herbarium specimens is through improper handling of herbarium sheets.

Insect Specimens

- Have empty pinning boxes close by in case they are needed for temporary placement of specimens.

- Do not leave drawers or specimens out of storage cabinets overnight, as they are more likely to be infested when outside cabinets.

- Remove boxes or the entire cabinet drawer; do not remove just single specimens from a cabinet for use.

- Leave specimens in the pinning box when viewing under the microscope.

- Use extreme care when removing an individual specimen from a storage box for such purposes as examining the ventral side of the specimen. Do not hit other specimens in the box.

- If there is not enough room on the pin above the specimen to safely grab it with your fingers use pinning forceps:

  - Use pinning forceps with the smaller size pins that flex easily.

  - Carefully pull the pin straight up from the pinning bottom of the box with an easy, smooth motion.

- Avoid unnecessary shaking of the specimen on the pin; do not jerk or quickly pull at the pin. Rough handling can cause sections of the specimen to fall off.

- If the underside of the pinned specimen must be viewed:

  - Pin the specimen into a large eraser or a piece of cork for easier handling.

  - Other possible pinning surfaces include a pinning box with all but one side removed, or an "L-cork" (two pieces of cork joined in an L-shape). Hold the "L" on either the backside or bottom, as needed to view the specimen.

Bird and Mammal Collections

Important Note: Be very careful if you don't know a specimen's complete treatment history. In such cases, assume that it's been treated with pesticides. For additional information concerning contaminated collections, see Question 12, below.

- Wear a white lab coat or lab apron. Animal hair, feather fragments, and insect frass are most likely to be seen against a white background.

- Handle/examine specimens on clean, cushioned, white or light-colored work surfaces. You can use a covering of 1/8" polyethylene foam to cushion a table or desktop effectively.

- Don't remove taxidermy mounts from their original supports.
  - The specimen armatures are under tension.
  - If you remove the rods extending from the feet from their original support, the armatures can move and damage the specimen.
- Handle freeze-dried specimens as little as possible and with great care. Freeze-dried specimens are extremely fragile.

11. *What security issues are related to dry collections?*

Theft is an increasing concern. This is because these collections are often subject to less stringent security measures than many cultural collections. Specimens at risk of theft include:

- ivory
- rhinoceros horn
- horn sheaths and antlers
- some claws and talons
- tanned skins
- skulls
- mollusk and egg shells
- insects
- seeds
- hallucinogenic plants
- specimens of rare, endangered, and extinct animals and plants

Supplementary archival materials, such as original scientific artwork, photographs, and field journals kept by well-known scientists are also vulnerable to theft.

12. *Are there any health and safety concerns associated with dry collections?*

Toxic materials may be present in various forms. This is usually a result of previous treatments. This includes chemicals that may have been used in specimen preparation or processing, such as:

- tanning with chromium salts
- use of asbestos in some taxidermy preparations
- residues from pesticide treatments such as arsenic, DDT, and mercury salts

Other potential hazards include:

- residues from inadvertent contamination of specimens by asbestos from deteriorating building materials

- lead paint dust from old cabinets

- mold spores from past exposure to liquid water or prolonged high relative humidity

Some park staff and collection users may have allergic reactions to hair, feathers, dander, insect debris, and certain specimens (such as poison ivy). Specimens with thorns, spines, or quills, claws, talons, antlers, horns, and long beaks, can cause physical injury during handling. At the same time, handling biological material during stabilization and preparation can pose the risk of numerous biohazards, varying with the specimen.

For additional information concerning handling of contaminated collections, refer to the following *Conserve O Grams*:

- 2/2 “Ethylene Oxide Health and Safety Update”

- 2/3 “Arsenic Health and Safety Update”

- 2/4 “Diclorvos (Vapona) Update”

- 2/10 “Hazardous Materials in Your Collection”

- 2/11 “Health and Safety Risks of Asbestos”

- 2/14 “DDT Health and Safety Update”

- 2/16 “Chronology of Pesticides Used on National Park Service Collections”

- 2/17 “Physical Properties and Health Effects of Pesticides Used on National Park Service Collections”

- 2/19 “Guidelines for the Handling of Pesticide Contaminated Collections”

B. Special Concerns for the Stabilization of Dry Specimens

1. *How are dry specimens stabilized?*

Dry stabilization is used for many biological collections. However, the activities can vary significantly between disciplines. For example:

- some non-vascular plant specimens (such as lichens) and some types of invertebrate specimens involve simple desiccation, such that the specimen does not need further physical alteration before it is ready for use

- for some non-vascular plants and most vascular plants, researchers use plant presses for positioning, compressing, and drying (with or without heat) individual specimens

- some invertebrates are treated with chemicals to either control bacterial decomposition of soft body parts by removing fats or oils, to degrade soft body parts to facilitate removal or to relax the specimen

- insects are typically pinned and carefully positioned before being dried
  - some insects (for example, butterflies) are occasionally dried without positioning
  - these specimens are rehydrated and positioned as part of the processing stage or because they will be used for analysis of nucleic acids (rehydration will damage or destroy DNA)
- skins of various vertebrates, particularly oversized specimens, are flattened and dried (or tanned)
- whole skins and wings, or detached wings of some birds are shaped and dried
- skins of smaller birds and mammals are positioned and dried after being stuffed with a fibrous material (for example, cotton or polyester fiber) and supported with rigid materials (for example, wire, wood, or paper board)
- the flesh is normally removed from skeletal parts of vertebrate specimens to facilitate drying

Stabilization should be the first step in preservation. Take care to ensure that stabilization practices comply with disciplinary standards.

2. *What protection concerns and practices are involved with stabilization of dry specimens?*

During stabilization, you should:

- ensure the relationship of the specimens and their data
- protect the specimens from pests
- maintain the specimens in a dry condition

The agents of deterioration that most often damage specimens during stabilization are neglect, pests, and high relative humidity. (See Table T.5 below.)

PRIORITY 1	PRIORITY 2	PRIORITY 3
Neglect	Visible light and UV radiation	Criminal Activity
Pests	Contaminants	Fire
Inappropriate RH	Physical Forces	Inappropriate T
	Water	

Table T.5. Agents of deterioration during stabilization of specimens for dry collections.

Well-trained staff and proper procedures reduce the risk of neglect during stabilization. Appropriate use of screened or other enclosures, and careful procedures will reduce the potential for pest infestations. Proper ventilation during drying will reduce the potential for mold and rot that are fostered in fresh specimens by their moisture content and high relatively humidity.

C. Special Concerns for the Processing of Dry Biological Specimens

1. *Are there any general observations about processing of dry specimens?*

- Dried, compressed non-vascular plants and most vascular plants are strapped or glued to herbarium sheets along with appropriate labels.
- Dried skins of various vertebrates, particularly oversized specimens, are often tanned as part of the processing treatment.
- Skeletal parts of vertebrate specimens receive processing treatments, such as mechanical cleaning, cleaning by insects or other invertebrates, and chemical baths, to remove non-osseous tissues and some fats.
- Final preparation of many dry specimens may involve placing the specimen or its parts in a container, such as a box, packet, tray, or vial.

> ***Remember: Processing requires special expertise, time, and facilities. Be sure that you have all of the necessary resources before accepting processing obligations. If you don't, your collection will have a backlog of unprocessed or partially processed specimens. <u>Such collections are of little or no utility</u>.***

2. *What are the agents of deterioration that affect dry collections during processing?*

The primary agents of deterioration for dry specimens during processing are neglect, physical forces, and pests (see Table T.6 below). Insufficient knowledge and skills can result in poor processing techniques, rendering a specimen useless. Dry organic material without protection is at risk to pest damage. Many processing treatments result in damage by physical forces as specimens are labeled, reshaped, or shipped for loans.

PRIORITY 1	PRIORITY 2	PRIORITY 3
Neglect	Contaminants	Criminal activity
Physical Forces	Water	Fire

Pests	Inappropriate RH	Inappropriate T
	Visible light and UV radiation	

Table T.6. Impact of agents of deterioration on specimens during processing.

D. Special Maintenance Concerns for Dry Collections

1. *What should I do about migrating lipids that are staining the specimen or surrounding materials?*

This can be a complicated cleaning problem. It may indicate that the specimen was not properly processed initially; not all lipids were removed. As lipids migrate from specimens and deteriorate, they can stain the surface of the specimen. They also can:

- stain other surfaces
- collect dust
- dissolve some inks
- develop unpleasant odors
- attract pests

As a result, it's sometimes in the best interests of the specimen (and collection workers) for you to remove migrating lipids.

Traditionally, lipids were removed by "degreasing" treatments that involve various solvents. Many of these solvents pose serious threats to human health and safety. Some degreasing treatments involve hot water or steam, which may damage specimens. Labile lipids (the unsaturated fats and oils that migrate out of specimens) are polyhydric alcohols. Most can be removed with ethanol.

> ***Always refer to a natural history conservator before cleaning a specimen with water or other solvents. This applies to all specimens and all types of material to be removed from the specimen.***

Important Note: (After first consulting a natural history curator), be extremely careful when removing lipids. You do not want the solvent to cause deterioration of other organic material, such as collagen. This can lead to the deterioration of a specimen.

2. *How should I protect dry specimens from pests?*

Practice the principles of Integrated Pest Management (IPM). IPM is the best approach to dealing with pests in museum collections. It is a holistic, environmentally-friendly, and sustainable means of pest control. IPM does not exclude the use of pesticides. It does however, offer many alternatives for achieving the same goal. IPM includes both **passive** and **active measures**.

NPS *Management Policies* (2001) requires that "The Service, and each park unit, will use an IPM approach to address pest issues. Proposed pest management activities must be conducted according to the IPM process prescribed in Director's Order #77-7: Integrated Pest Management."

For additional information, policies, and procedures, see *MH-I*, Chapter 5, "Biological Infestations," Director's Order #77-7, *Integrated Pest Management* (forthcoming) and the *Integrated Pest Management Manual*. You can also consult with your park's IPM coordinator and your regional/SO curator.

3. *What passive IPM measures should I take to protect the collection?*

Passive measures are proactive ongoing daily activities that can significantly reduce the risks of pest infestations. Examples include:

- appropriate housekeeping procedures
- ensuring that food, drink, smoking, and live plants are never allowed in *or near* collections areas
    - Never locate break rooms or other areas were food is stored, prepared, and/or consumed near collections areas.
    - Be sure that garbage and other debris (including recycling materials) for disposal are never stored nor allowed to accumulate near collections areas.
- good work habits, such as replacing specimens in cabinets or other containers after use
- proper storage (using closed storage units)
- basic preventive practices, such as the quarantine of incoming specimens
- not storing curatorial supplies in collections storage areas
    - packing materials can contain pests; store these and all other supplies away from collections areas
- eliminating or reducing one or more of the four requirements for pest survival
    - nourishment
    - water
    - shelter
    - proper climatic conditions
- surveillance
    - periodic inspections, especially of materials particularly prone to pests (freeze-dried specimens) and natural traps (windows and spider webs)

- use of sticky traps (with or without pheromones)

- documentation

  - inspection dates

  - cleaning activities (what and when)

- proper design of facilities

- proper storage equipment

> ***Remember: Passive measures do NOT include ongoing or scheduled application of toxic chemicals on specimens.***

4. *What active IPM measures should I take to protect the collection?*

Active IPM measures are your responses to the discovery of possible pest problems, such as:

- pest damage
- pest excrement
- pest remains
- live pests

> ***Always keep good collection records. They can help you determine if the evidence of pests represents a new problem or a pre-existing problem that has been addressed in the past.***

When you discover a pest problem, the active measures that you can take range from surveillance to eradication procedures.

The first steps that you should take are to:

- Identify the problem:

  - What evidence is there?

  - What species of pest is it?

  - What life stages of pests are involved?

  - Are there active pests present or is it possible that the evidence is from an old infestation that is no longer active?

- Isolate the problem

  - Bag potentially infested specimens in polyethylene sheeting. Monitor them for evidence of pest activity to verify that there is an active infestation.

- Determine the magnitude of the problem. Find out how much of the collection is infested.

- If possible, move affected material away from the rest of the collection.

- Thoroughly inspect and clean the infested areas and materials.

- Replace storage supplies that may have been associated with the infestation.

Maintain close surveillance of the infested area and materials. A good option is to use pest "sticky" traps.

5. *What should I do if eradication is necessary?*

If active measures require eradication procedures, you have several options before you should use hazardous chemical pesticides:

- various kinds of traps
- freezing temperatures
- temperatures of 60°C/140°F
- low-oxygen or anoxic (without oxygen) environments

See *COG* 3/8 "Controlling Insect Pests: Alternatives to Pesticides."

6. *What kind of traps can I use?*

Various kinds of traps can help eradicate pests, but their success will depend on the pest species and circumstances.

- **Sticky traps** involve a variety of forms (boxes, fly-paper, boards) having surfaces with a sticky adhesive to trap pests. Place sticky traps in high-risk areas throughout the facility and inside specimen cases.

  - Check the traps frequently. Use an established schedule
  - Identify and record any pests that you discover.
  - Replace traps as necessary.

  See *COG* 3/7 "Monitoring Insect Pests with Sticky Traps."

- **Pheromone traps** may involve sticky traps, but with the addition of species-specific pheromones.

  - Pheromones are natural scents insect species use to communicate with each other.
  - Pheromone traps tend to be sex-specific in effectiveness.
  - Certain pests can be strongly attracted to the traps from the surrounding area. This provides an extremely effective early warning system of pest presence.
  - Pheromone traps are only available for certain insects such as

cigarette beetles (*Lasioderma*), drug store beetles (*Stegobium*), Indian meal moths (*Plodia*), and warehouse beetles (*Trogoderma*).

- Other types are being developed and may be available soon.

- **Snap traps** (mouse traps) can be used for rats and mice, although they are sometimes messy.

- **Glue boards** are similar to sticky traps but larger.

  - They are often used against rats and mice.

  - Although glue boards are cleaner to use than snap traps, they will not kill the animal. Use snap traps to ensure the pest's quick and painless end.

- **Small electronic devices** that emit high frequency sound waves are sometimes used as a deterrent, in place of traps.

  - They are usually targeted against mice, rats, and other rodents.
  - The effectiveness of such devices is questioned. According to Health Canada's Pest Management Regulatory Agency, "Rodents may adapt to the devices over time and return to areas within the device's range" (Health Canada, 2001).

7. *Are there any cautions related to traps that I should consider?*

Yes. Be sure to bear in mind the following:

- Don't allow traps to become a food source for other problem pests.

  - Conduct regular monitoring of all pest traps.

  - Dispose of traps when they are no longer useful (if they contain a large quantity of trapped pests or loose their "stickiness").

- Avoid the use of pheromone traps or baited traps inside collection storage areas or cabinets if there is a risk of attracting pests into the collection area from an outside location.

8. *How can I use freezing temperatures to eliminate a pest problem?*

You can use freezing temperatures to kill pests in specimens or storage materials. Be sure to properly encapsulate the materials and follow these procedures:

- Encapsulate the items in two layers of well-sealed polyethylene bags or sheeting.

- Freeze the specimen as rapidly as possible. Slow cooling allows some insects to produce a "natural antifreeze."

- Freeze the materials for at least fourteen days at -20°C/-4°F.

  - Shorter periods may be effective with some species or if colder temperatures are used.

  - For temperatures above -20°C/-4°F, much longer periods are required for complete insect pest eradication.

- Do not use shorter periods interrupted by thawing. This will produce freeze-hardy insects. Insect eggs will not be completely eradicated during the shorter freezing periods.

Be sure that the specimens and other materials have thawed completely before you remove the polyethylene wrapping. This will prevent condensation of moisture on the specimens. During thawing, moisture should condense on the polyethylene.

For additional information concerning freezing for pest control, see:

- *COG* 3/6 "An Insect Pest Control Procedure: The Freezing Process."
- *CCI Notes* 3/3 "Controlling Insect Pests with Low Temperature." By Tom Strang. Canadian Conservation Institute, Ottawa (1997). Available for $2.00 USD (+shipping) from the CCI website at: <http://www.cci-icc.gc.ca>.

9. *How can I use heat to eliminate a pest problem?*

All life stages of insects can be eradicated by subjecting the affected materials to a temperature of 60°C/140°F. Use this method for infested storage materials that have high melting points, and for stacks of dry herbarium specimens. **Do not use this process for animal specimens.**

For an inexpensive and rapid heat treatment:

1) Encapsulate the items to be treated in 6mil black plastic.

2) Then place the encapsulated materials in a clear plastic "greenhouse" and use solar energy to create the heat.

This system was developed by Tom Strang of the Canadian Conservation Institute (CCI), and is fully described in:

> *WAAC Newsletter*, 23:2 "Solar Bagging: Putting Sunlight to Work to Eliminate Insect Infestations in Mere Hours." By B. Baskin. Western Association for Art Conservation (2001). Ordering information available at: <http://palimpsest.stanford.edu/waac>.

10. *How can I use a low-oxygen environment to treat a pest problem?*

Another method to eradicate pests in dry specimens and storage materials is to create a low-oxygen or no-oxygen (anoxic) environment. You can create a low-oxygen or anoxic environment by using carbon dioxide or nitrogen gas in a commercially available chamber. Or you can use an oxygen scavenger in special made-to-order enclosures. These methods require specialized training or assistance for effective use. See *COG* 3/9 "Anoxic Microenvironments: A Treatment for Pest Control."

11. *If necessary, can I still use chemical treatments to eliminate a pest problem?*

If all of the non-chemical methods listed above fail to eradicate the pests affecting your collection, you may need to utilize certain chemical treatments. Discuss the matter with your park's IPM coordinator, safety officer, and regional/SO IPM coordinator if necessary. There may be a least-toxic alternative that will work.

Do not attempt to apply any chemical insecticides yourself. NPS policy and local and state laws require that only individuals with formal training and certification can apply most chemical pesticides.

Only use chemical insecticides on non-collection materials. Such applications include around baseboards in a storage room or possibly to disinfest curatorial supplies.

12. *Where can I find additional information concerning IPM and pest control?*

For additional information, see the NPS *Integrated Pest Management Manual*, available on the web at <http://www1.nature.nps.gov/biology/ipm/manual/ipmmanual.htm>. The manual includes a module on museum pests.

Your park's IPM coordinator, safety officer, and natural resource management staff can assist you to develop an appropriate program to protect your collection. You also may wish to consult your regional/SO IPM coordinator, local university entomology faculty, county extension agent, local university natural history museum staff, or other specialists.

SECTION IV: WET BIOLOGICAL COLLECTIONS

A. Overview

1. *What are wet collections?*

Wet collections are specimens kept in a liquid preservative to prevent their deterioration.

The best available resource on the nature and care of wet biological collections is:

> Simmon, J. 2002. Herpetological Collecting and Collections Management. Rev. ed. Herpetological Circulars No. 31. Society for the Study of Amphibians and Reptiles. For ordering information, visit the "Bibliomania! Herpetological Literature" website at: <http://herplit.com/SSAR/circulars/HC31/simmons.html>.

2. *Why are these specimens preserved in a wet form?*

Certain biological specimens are preserved in a wet form due to:

- convenience
- an intent to preserve body form and soft parts for a variety of uses

When color preservation is not critical and dry preservation sacrifices qualities needed for other intended uses, fluid preservation is beneficial.

Note: The size and flexibility of the specimen (or its parts) must allow effective chemical fixation, chemical preservation, and possible storage inside rigid containers (for example, glass jars, or metal or plastic tanks).

3. *What is fixation?*

Fixation is a stabilization process in which the fixative chemically bonds to the specimen to impede deterioration by enzymatic digestion or autolysis. Formalin, a solution of 40% formaldehyde gas in water that is then further diluted, is a common fixative. Usually the final solution contains about 4% formaldehyde in water and is referred to as 10% formalin.

4. *Are all wet specimens treated with a fixative?*

No. Some specimens are not treated with a fixative, but instead are placed immediately in an alcohol. Alcohols replace water in the tissues to reduce the potential for deterioration. Alcohols are considered to be denaturants, rather than fixatives.

5. *What types of preservative fluids are used for wet collections?*

Preservative fluids are those in which the specimen is housed for long-term storage, usually during the processing stage of specimen preparation. Alcohols, primarily 70-90% ethanol and 50-60% isopropanol, are common storage fluids for specimens that have been fixed or denatured.

6. *What types of specimens are usually included in wet collections?*

The following biological specimens are commonly subjected to wet preservation:

- Plants
  - non-vascular (some forms)
  - vascular (particularly fleshy parts such as fruit or succulent vegetative parts)
- Animals

- invertebrates (most forms)

- vertebrates (especially fish, reptiles, amphibians, soft eggs, larvae, many small specimens of birds and mammals, and viscera of birds and mammals)

7. *What are the primary agents of deterioration for wet collections?*

Most agents of deterioration might cause damage to wet collections under certain conditions, **but the primary causes of deterioration are usually related to fluid and container quality**. Other agents of deterioration that can affect wet collections include:

- Neglect (primarily the failure to monitor and maintain fluid levels and concentrations in containers)

- Visible and UV light

  - most natural pigments are very sensitive to the effects of visible light and ultraviolet radiation

  - visible and UV light will trigger photochemically induced reactions that may increase the rate of deterioration in the fluids around specimens

  - light, particularly UV, will also contribute to the deterioration of glass and plastic containers

- Inappropriate temperature (especially temperature fluctuations)

- Inappropriate relative humidity and fluctuations

- Fire (a special concern for collections stored in alcohols)

  - alcohol vapor from poorly sealed containers creates an explosion hazard

  - alcohols may serve as fuel for a fire

- Physical forces

  - earthquakes or other natural emergencies

  - explosions

  - dropping a glass container housing a wet specimen

Note: Fluids provide excellent cushioning against most vibration and minor shock, as long as the containers are not tightly packed with specimens.

- Contaminants resulting from improper mixing of fluids

8. *How can inappropriate temperature and temperature fluctuations adversely affect wet collections?*

- High temperatures will accelerate the drying of specimens removed from fluid.

- Low temperatures (below about 12.7°C/55°F):

- Will cause polymerization of unfixed formaldehyde. This results in milky strands that cannot maintain the equilibrium reaction that is the basis of fixation.

- Prolonged exposure to low temperatures may cause loss of fixation in formalin-fixed specimens.

- Low temperatures can improve the preservation of material that is denatured and stored in alcohol and has never been fixed in formalin.

9. *Can relative humidity adversely affect wet collections?*

Relative humidity has little importance for specimens in fluid. However:

- Excessively low relative humidity will accelerate drying of specimens removed from fluid.

- Excessively high relative humidity will contribute to corrosion of metal and glass containers.

10. *How can wet collections become contaminated?*

- **Fixatives** may have been improperly mixed using:

  - tap water, which is often very alkaline

  - saltwater, which can impede fixation

  This results in poorly fixed specimens that may contain contaminants from water treatments or seawater components.

- **Alcohols**, the main storage fluids, can be contaminated if the initial quality of the alcohol is poor.

  - Low-grade ethanol may be contaminated by acetone.

  - Any chemical used in the collection should be laboratory grade, or higher.

  - Any ethanol that is used in a collection should be ***undenatured***.

  - Denatured ethanol (ethanol that is not potable) will incorporate any of a number of deliberate contaminants, including, aviation fuel, acetone, fluorescent dyes, methanol, and purgatives. Such contaminants make the alcohol unsuitable for human consumption.

- **Containers** with decomposing seals or corroding metal lids have the potential to contaminate fluid preservatives.

  - They can discolor specimens as the decomposition/corrosion products leach into the fluid.

  - Also, any time fluid types are changed (for example, changing between isopropanol and ethanol) one fluid becomes the contaminant of the other.

- **Labels** may react with fluid environments, depending on the materials involved.
  - The dissolution of label inks and colorants are common examples.
  - Metal labels and wires used to attach labels often corrode in fluids.
  - Corroding metals will deposit corrosion products on the specimens and can serve as catalysts for other reactions in the fluids.

Fortunately, the fluid environment is dynamic. It provides an optimum medium for chemical reactions and transfer of products; lipids, pigments, proteins, and other specimen components will leach into the fluids.

- If there are no outside energy sources, such as light, to drive the process, these reactions will eventually reach equilibrium.
- This results in both specimens and their fluid achieving a reasonably stable state, unless someone changes the fluids.

11. *Are there any special health and safety concerns related to wet collections?*

Many types of toxic chemicals are used for stabilization treatments and fluid storage media. To reduce your risk, have well-designed preparation, storage, and research facilities. Also, always use appropriate procedures.

Proper ventilation is extremely important. So is personal protective equipment (PPE). Use goggles designed to protect against spills and vapor, and aprons and gloves appropriate for each chemical.

Most chemicals used in fluid-preserved collections pose risks through inhalation or skin absorption. Some, like **alcohols and picric acid, also pose fire and explosion hazards**. The most common chemical hazards are:

- ethanol - flammable
- isopropanol - flammable
- formalin solutions - formaldehyde is considered to be a carcinogen
- fixatives containing metal salts (arsenic, chromium, copper, mercury)
- acids (acetic, boric, carbolic, glacial acetic, nitric, osmic, picric, pyroligneous, sulfuric, sulfurous, trichloroacetic)
- other chemicals that may be toxic (camphor, chloral hydrate, various glycols, phenoxetol, methanol, thymol)
- dyes and stains (used in clearing and staining specimens)
- unknown fluids - fixatives and storage fluids of unknown composition that may contain toxic substances

Other hazards include:

- cuts from broken glassware
- injuries from attempting to lift heavy jars or tanks
- biohazards that were not eliminated in processing

Note: Many infectious agents are killed by formalin but not all are killed by ethanol. For specimens that have been denatured rather than fixed, handle them with special care.

B. Stabilization of Wet Biological Specimens

1. *What specimen characteristics should I document prior to stabilizing a wet specimen?*

Be sure to document the natural conditions and features of the specimen. Note anything that may be changed by stabilization. The details of such documentation typically follow standard practices of individual disciplines. Examples include color, markings, weight dimensions, sex, reproductive condition, age, and physical condition. It's a good idea to take dimensional measurements when the specimen is still fresh. Fixation or denaturation may cause it to distort, shrink, or swell.

Documentation about specimen history can be useful in determining the integrity of the specimen for research or its safety for use in interpretation. Such information may include the condition of the specimen, environmental conditions, and stabilization methods and materials, to name but a few.

2. *What should I know about the stabilization process for wet specimens?*

A variety of chemicals can be used for collecting, fixing, and preserving specimens. The choice may be based on the kind of organism involved, disciplinary standards, intended use, and legal possession.

Formalin is a common fixative for soft tissues. Some specimens, such as fish larvae and eggs, are usually fixed and stored in formalin solutions.

Because formalin fixation yields acidic solutions that are harmful to calcium-based materials (shell, bone, and the calcium present in many tissues), formalin solutions may be:

- buffered
- subsequently replaced with an alcohol solution

To avoid potential deterioration in the fixative, some specimen parts may be removed prior to fixation (for example, skulls of vertebrates) then preserved by other means.

3. *Is formalin used with all wet biological specimens?*

No. Some specimens are denatured using alcohol, rather than treated with a fixative. This:

- facilitates extracting nucleic acids from specimens for biochemical analyses

- avoids the safety hazards associated with formalin

- averts potential decalcification

The technique works especially well for small specimens, such as insects.

Note: You still may find it necessary to transfer the specimens to a fresh alcohol solution during the processing stage. This depends upon the degree to which displacement of water from the specimens has altered the concentration of the alcohol.

4. *How do I protect specimens during stabilization?*

During stabilization you should:

- Ensure the relationship of the specimens to their data.

- Perform the stabilization treatment in a timely manner to minimize the decomposition of the specimen.

- Use trained people to perform the work.

- Use deionized or distilled water to mix fixatives.

  - Tap water, water from local ponds and streams, or saltwater can be sources of fluid contamination.

  - Contaminants may jeopardize preservation by changing the pH of the solution (this can impede fixation or denaturation).

  - Soaking specimens in certain salt solutions has been used as a method to reverse formalin fixation.

- Use fixative or alcohol solutions for specimens for the same taxa collected at the same place and time.

  - This will ensure uncompromised utility of the specimens for biochemical analyses.

  - Components leached from one set of specimens can contaminate the next set.

- Do not crowd specimens in fixative or alcohol solutions.
  - The amount of water that leaches into the fluid from the specimens will weaken the concentration of the solutions.

  - Crowding also may lead to mechanical damage to the specimens.

Other things to remember include:

- **Alcohols are flammable**. Take special precautions to protect the specimens from fire.

- **Fixation with formalin may not work well at low temperatures**. This is because of the potential for polymerization of formaldehyde.

- **High relative humidity** will rapidly decrease the concentration of both alcohols, which rapidly take up moisture from the air.

- **Low temperatures** will cause polymerization of formaldehyde in formalin solutions used as storage fluids.

- **Improper handling** of specimens during processing, and crowding specimens in containers can result in mechanical damage.

PRIORITY 1	PRIORITY 2	PRIORITY 3
Neglect	Physical Forces	Criminal Activity
Contaminants	Light	Water
Fire		Pests
Inappropriate T		Inappropriate RH

Table T.7. Impact of the agents of deterioration on specimens during stabilization for wet biological specimens

5. *What are the health and safety issues concerning stabilization of wet specimens?*

Health and safety concerns during stabilization involve:

- external parasites
- diseased carcasses
- decomposing tissues
- toxicity or flammability of the chemicals used in the stabilization process

To protect yourself, other staff, and researchers, use:

- appropriate engineering controls, such as biohazard hoods and chemical vapor hoods
- properly chosen gloves and other protective clothing

These are the best means to ensure your safety. If engineering controls are unavailable (as is often the case during field stabilization), you may need to use additional personal protective equipment.

Remember: Before you use a respirator, you must have a medical exam, training, and be fit tested. See COG 2/13 "An Introduction to Respirator Use in Collections Management" for additional information.

C. Processing of Wet Biological Specimens

1. *What general information about processing should I be aware of?*

- In the past, specimens removed from formalin solutions for transfer to alcohol solutions were first soaked in water for prolonged periods to remove the excess fixative. Today, prudent practice involves briefly soaking the specimens in various concentrations of the final storage fluid (for example, 20%, then 40%, then 60%, then 70% ethanol for specimens that will eventually be stored in 70-75% ethanol).

- Many institutions select 70-75% ethanol as the storage fluid of choice. Institutions that lack a Federal permit for undenatured (potable) ethanol can use a 45-55% isopropanol solution. However, ethanol is the best storage fluid because it preserves the utility of the specimens for many biochemical and other analyses. Isopropanol use can also be problematic, as it:

  - has been shown to change the measurements of some specimens (via shrinkage)

  - renders some specimens transparent

  - may soften bone

  - is difficult to mix thoroughly with water

  Note: To apply for a Federal permit for undenatured ethanol, contact the U.S. Department of the Treasury's Tax and Trade Bureau, National Revenue Center at:

  U.S. Department of the Treasury
  Tax and Trade Bureau
  National Revenue Center
  550 Main Street Suite 8002
  Cincinnati, Ohio 45202
  (877) 882-3277
  www.ttb.gov/nrc/index.htm

- Some vertebrate material will be subjected to clearing and staining techniques to expose the position of skeletal elements within the body of the specimen.

- Some specimens with delicate or soft parts may be secured to a support system (for example, glass plate). This will protect the specimen and make it easy to handle during examination.

- Final preparation of wet specimens involves placing the specimen or its parts in a container, such as a glass vial or jar, or a stainless steel or plastic tank.

Processing requires special expertise, time, & facilities. You must possess <u>ALL</u> of these resources before accepting collections that may require processing. If you don't, you'll have a backlog of unprocessed or partially processed specimens of limited use.

2. *How should I label wet specimens?*

Depending on the specimen(s), you can label specimens with:

- tags tied to the specimen
- labels attached to the outside of the container
- labels placed inside the container, but facing out for visibility

If you place multiple, individually cataloged specimens within the same container, be sure that each specimen has a tag with at least its catalog number.

Remember: Any labels that you place inside the container <u>must</u> be resistant to fluid damage (both label and ink).

3. *What materials should I use to label wet specimens?*

Label Materials

- Use good quality, long-fibered, cotton rag labels. These hold up remarkably well in fluid collections.
- The only synthetic polymer that seems to withstand the fluid environment is non-woven polyester, such as Tyvek®.
- <u>Don't</u> use:
  - **Paper treated with formaldehyde** to make it fluid-resistant. This can cause slight acidification of storage fluids.
  - **Metal labels** can corrode and may also cause mechanical damage to specimens. Keep in mind that leg bands and ear tags should remain with specimens, even when stored in fluids.

Inks and Other Media

- Carbon inks do not fade over time. Use only carbon-based, black inks on specimen labels, including barcode labels.
  - Commercial, black printing inks are usually carbon-based, as are most laser and photocopier toners.
  - Laser and photocopiers also apply the toner with a certain amount of heat, which helps fuse the toner particles to the paper.
- Liquid inks vary greatly in quality. Black inks for labeling wet collections should be drafting inks designed for writing on drafting film, using technical pens.
  - These tend to be carbon-based inks with a neutral pH that adhere well to almost any surface.
  - Such inks do not dissolve in water, alcohol, or formalin solutions.
  - **Note:** They do not have to be used in technical pens or on drafting

film during specimen labeling.

- Black liquid inks in some fiber-tipped pens are acceptable for use in labeling wet specimens. Be sure to choose pens with carbon-based inks, and test:

  - how long it takes for the ink to dry so that it will not smear

  - how well the ink resists water, alcohol, and formalin

  - how well it resists smearing or loss from abrasion when wet with any of these fluids

Attachments for Labels

- Cotton thread or string will work well to attach labels to fluid-preserved specimens.

- <u>Don't</u> use:

  - wire or any other metal fasteners

  - plastics

4. *What agents of deterioration affect wet biological specimens during processing?*

The primary agents of deterioration for wet specimens during processing are:

- **Neglect**, including staff with insufficient knowledge and skills to fulfill processing techniques. This can render a specimen useless.

- **Contaminants** can result from:

  - diluting storage fluids with tap water (which often contains a variety of treatment chemicals)
  - using denatured alcohol or low-grade alcohols that contain impurities

- **Light and ultraviolet radiation** can damage wet specimens during processing while out of their fluid medium or while in transparent containers.

- **Fire** is a hazard with both ethanol and isopropanol.

Other agents of deterioration affecting wet biological specimens include:

- **High relative humidity** will rapidly decrease the concentration of both alcohols, which rapidly take up moisture from the air.

- **Low temperatures** will cause polymerization of formaldehyde in formalin solutions used as storage fluids.

- **Improper handling** of specimens during processing, and crowding specimens in containers can result in mechanical damage.

PRIORITY 1	PRIORITY 2	PRIORITY 3
Neglect	Physical Forces	Criminal activity
Contaminants	Inappropriate T	Water
Light	Inappropriate RH	Pests
Fire		

Table T.8. Impact of agents of deterioration during the processing of specimens for wet collections.

5. *How should I handle wet biological specimens during processing?*

To protect wet specimens during processing (or at any other time), be sure to:

- Keep fluid-preserved specimens wet with the appropriate fluid at all times.
- Keep fluid containers closed and sealed when not removing or replacing specimens. The volume and concentration of fluid preservatives will change with evaporation.
- Avoid open flames and sources of heat and sparks. Use lighting and other electrical installations that are designed to be explosion-proof.
- Ask for help when handling large jars or tanks and manipulating large specimens.

6. *Can I keep some wet biological specimens in formalin?*

Yes. Formalin is sometimes used as a storage fluid as well as a fixative. This is less common today due to the health hazards associated with formaldehyde, which is considered to be a carcinogen.

However, formalin is still a common storage fluid for some soft tissues. For example, fish larvae and eggs are usually fixed and stored in formalin solutions. Unlike alcohol, formalin will not dehydrate fish larvae cells causing them to become distorted and difficult to dissect.

Most other specimens can be transferred to alcohol after fixation. If you prefer that a specimen remain in formalin, you may want to buffer the solution if there is a potential for excessive hardening or decalcification of the specimens. You do not need to buffer alcohol solutions.

If you need to buffer a formalin solution, **do not use alkaline chemicals such as calcium carbonate and borax.**

- These alkalis simply raise the pH of a solution, and allow tissues to soften.
- They can also cause fixation to reverse.

- Their impact on the pH of the solution may be short-lived.
- True chemical buffers act continuously to stabilize the pH of the solution to a pH determined by the choice of buffering agent.

An acceptable buffer for formalin is composed of monobasic sodium phosphate monohydrate and dibasic sodium phosphate anhydrate.

Remember: The rationale for keeping a particular specimen in formalin or transferring it into an alcohol solution might be related to its intended research use.

7. *How do I transfer wet specimens from formalin to an alcohol solution?*

If you transfer specimens from formalin to alcohol, be sure to soak them in increasing concentrations of the storage fluid. This prevents damage from osmotic pressures in the tissues. Osmotic pressures result when you move specimens directly into the final concentration of the storage fluid (alcohol) from a formalin solution, which is mostly water. Prolonged soaking in water, rather than graded alcohols, causes two problems:

- fixation may be reversed, allowing the specimens to begin to rot
- specimens may swell as they become hydrated

Note: You can determine alcohol concentrations by using an alcohol hydrometer.

Test Strips

- During the transfer process, you can use formaldehyde test strips to determine approximately how much fixative remains in the solutions.
- There should be some residual fixative in the final storage solution (even though this has potential to acidity the alcohol) because fixation involves an equilibrium reaction.
- If trace amounts of the fixative are not detected, it may mean that specimens were not originally fixed properly or that fixation was reversed during the transfer process.

Water

- Alcohols are usually diluted with water when used as a transfer or a storage medium.
- **Tap water is not acceptable for mixing these solutions**: it contains water treatment chemicals that may have an impact on specimen preservation and utility.
- Distilled water exposed to carbon dioxide in air tends to be acidic.
- **The best choice is deionized water**, which is pH neutral and should contain no harmful impurities.

Mixing

- Don’t mix an alcohol/water solution simply by using fixed volumes, such as 70 parts alcohol to 30 parts water. The result will rarely be 70% alcohol because the concentration is temperature dependent.

- Determine the volume percent concentration of the alcohol.

  - You can use an alcohol hydrometer (available from most laboratory supply companies). Ambient and fluid temperatures must be at about 20°C/68°F.

  - Ideally, measure concentrations using a density meter (also available from laboratory suppliers).

Concentrations

- Check the concentration of alcohols used for specimens that are not treated with a fixative.

- You might have to correct the concentration of the alcohol to create an appropriate storage fluid.

  - If the concentration of the alcohol solution is very low, it may be prudent to replace the fluid entirely, even though this will result in loss of the materials already leached from the specimen.
  - See *COG* 11/5 for methods to correct the alcohol concentration.

8. *Can I transfer wet biological specimens from ethanol to isopropanol?*

No. Do not transfer specimens in ethanol to isopropanol. This change will damage the specimens. Researchers have experimented with transferring specimens from isopropanol to ethanol after conditioning the specimens in increasing concentrations of ethanol. However, this process requires additional research before it can be endorsed as a practice.

9. *What about clearing and staining specimens?*

Some specimens are cleared and stained before being placed in storage fluids, and vice versa. The use of clearing and staining chemicals requires specialized knowledge. The choice of final storage fluid will be determined in part by the solubility of the stains used in the process.

Often the final storage fluid is glycerol. Glycerol supports mold growth, so collection staff sometimes have to mix various chemicals, such as thymol, as anti-fungal agents. These chemicals add to the complexity of preservation problems. When the stains used are not alcohol soluble, a simple way to prevent mold growth is to store the specimens in a mixture of glycerin and ethanol.

10. *Can I keep different wet biological specimens together in the same container?*

No. Various specimen components leach into the fluid. If you mix specimens you risk cross contamination. **This will damage the utility of the specimens for biochemical studies**.

Don’t store specimens together in the same container unless they are of the same species or lot and were collected in the same place and at the same time.

11. *How should I document a wet specimen’s condition during processing?*

As previously discussed, utilize a condition report. In addition to documenting standard conditions, you may want to also note:

- condition of labels and the label attachments to the specimen
- fluid characteristics
  - color
  - transparency
  - pH
  - formalin concentration
  - alcohol concentration
  - fluid-to-specimen ratio
- condition of the container and closure (corroded, poorly sealed, etc.)

Your collection may require a more detailed condition examination. You also may require additional information concerning appropriate care for certain specimens. Discuss these needs with your regional/SO curator. He or she can assist you to hire a natural history conservator to conduct a Collection Condition Survey (CCS) of your collection. For additional information concerning a CCS, see Chapter 3, Section D.

You might find it helpful to include the name of the individual who prepared the specimen in your condition report as well.

12. *What health and safety concerns should I be aware of during processing?*

Special health and safety concerns during processing are the:

- toxicity or flammability of the chemicals
- potential for ergonomic injuries when handling large containers

Engineering controls, such as chemical vapor hoods, along with proper gloves and other protective clothing are the best means to ensure your safety when handling hazardous chemicals. If engineering controls are unavailable, use additional personal protective equipment. **Note:** The use of respirators requires a medical evaluation, training, and regular fit testing. See *COG* 2/13.

To protect yourself, other staff, and researchers, you should also:

- keep spill cleanup kits on hand for all chemicals used in collection processing
- place large tanks on dollies
- use carts to move large glass jars and smaller tanks

13. *What do I need to know about loans of wet specimens?*

For loan shipments, collections staff usually prepare wet specimens by:

- individually wrapping specimens with cotton gauze that has been saturated with the appropriate fluid preservative

- sealing them in multiple plastic bags, so there's minimal risk of fluids affecting the shipping container

> ***Because wet specimens may not have any information other than the catalog number, you may be required to provide additional information about the specimen for the user. Such information typically includes at least the collecting locality and date, and the fluid in which the specimen should be housed while on loan.***

In addition, when packing and shipping specimens preserved in fluids you must:

- include instructions about the type of fluid preservative to be used with the specimens
- insert and seal the bagged specimen in at least one additional polyethylene bag, along with an address label that is visible through the second bag
- place the bags in a sturdy, well-sealed shipping container that has been cushioned on the interior to help protect the specimens during shipment
- comply with all laws and regulations regarding the shipment/transport of biological specimens, rare or endangered species, and hazardous chemicals

Notes:

- As long as you use the shipping method described above (specimens wrapped in cotton gauze saturated with solution and inside plastic bags), your shipment should not contain fluid in an amount to be considered HAZMAT by the DOT. As a result, unless the specimen itself was hazardous, your shipment shouldn't be subject to the Hazardous Materials Regulations, noted previously in this appendix.
- Some commercial shippers (such as Federal Express) do not accept dead animals of any type, including scientific specimens, for transport. Consult with your shipper in advance about any special provisions or requirements of this nature.

D. Storage of Wet Biological Collections

1. *Where should I locate storage?*

You may find it necessary to situate wet collection storage along an exterior wall. Such a location can help mitigate the impact of an explosion on the rest of the building. Note that placement and structural features may be controlled by local building codes. As with all collection storage areas, wet collections should be located where you **can:**

- control access
- organize the collection in a logical manner

- monitor and control the environment

Off-site facilities, basements and attics, and irregular or fragmented spaces are not good choices. Locating collections in such areas does not serve the interests of good collection management, care, or use.

When planning a new wet collection storage area, be sure to consult with your regional/SO curator, regional structural fire management officer, and park staff such as the structural fire management officer, fire inspector, brigade captain, and safety officer. Such NPS staff can assist you with planning a facility that meets both NPS safety and curatorial requirements.

2. *What agents of deterioration pose the greatest threat to wet collections in storage?*

The agents of deterioration that pose the greatest risks in storage are: light, neglect, inappropriate temperature, contaminants, and fire (Table T.9).

- Neglect includes:
  - the improper use of storage equipment
  - careless handling of specimens
  - lack of familiarity with collection organization and arrangement systems
  - failure to monitor storage environments, fluid levels, and container condition
  - mixing of different preservatives or not maintaining the proper concentration of preservative when topping off fluids
- Visible and UV light trigger reactions that can result in changes in fluid quality that may have in impact on specimen preservation.
- Temperature fluctuations cause pressure changes inside storage containers that loosen lids and allow fluid to evaporate.
- Deterioration of containers and closures (gaskets) can result in specimen contamination.
- Collections stored in alcohols can be fire hazards.

PRIORITY 1	PRIORITY 2	PRIORITY 3
Neglect	Physical Forces	Criminal Activity
Contaminants		Water
Light		Inappropriate RH

Inappropriate temperature		Pests
Fire		

Table T.9. Relationship of the agents of deterioration to the storage of specimens for wet collections.

3. *Are there any special considerations for storing wet specimens?*

Yes. In addition to the NPS standards listed in Chapter 4: "Museum Collections Environment" and Chapter 7: "Museum Collections Storage," there are a number of extra requirements for fluid collections. Most of these additional standards are designed to reduce the potential for fire or hazards to staff and visitors from fluid vapors and chemical spills. The following specifications are either required (consult your regional structural fire management officer, local fire marshal, and local building codes) or desirable for storage facilities that house wet specimens:

- Segregate the storage of wet collections from other collection storage, and from all other museum functions (including laboratories where specimens are processed or used in research).
- Store bulk chemicals used in fluid preservation in a separate structure outside of the collection building. If this cannot be done, store chemicals in a room that that is:
  - separate
  - reinforced
  - properly drained
  - properly equipped

Store all flammable bulk chemicals (such as alcohol) in an approved flammables storage cabinet. See Tools of the Trade for product information and firms on GSA schedule.

- Provide separate air-handling systems for wet collection storage, processing, and use areas. Seal the storage areas so that vapor from storage fluids does not contaminate other museum spaces.
- Provide a stable, cool temperature of about 18.3°C/65°F.
- Provide sufficient dehumidification of the environment to keep the RH below 65%.
- Plan to install floor drains and gutters in the room to collect and contain chemical spills.
- Equip all storerooms with heat and smoke detectors, and water-based, automatic fire suppression systems. Ensure regular inspection, testing, and maintenance of the systems.
- Install explosion-proof lighting and electrical systems in rooms that house collections stored in alcohols.

- Filter all incoming and recirculated air to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90-95% level.

- Use UV filters on all fluorescent lighting. Keep specimens in a dark environment when not in use for research.

- If wet collection storage rooms are along exterior walls, you may need to design these as breakout walls. You also may need to reinforce interior walls to help contain potential explosions.

- Provide equipment to properly dispose of chemicals and solutions.

Discuss storage requirements with your regional/SO curator, regional and park structural fire management officers, local fire department, park maintenance staff, park safety officer, park and regional/SO natural resource management staff, and other subject matter experts. Refer to Chapter 4: "Museum Collections Environment" and Chapter 7, "Museum Collections Storage," *COG* 2/18 "Safe Storage and Handling of Natural History Specimens Preserved in Fluid," and *COG* 11/3 "Storage Concerns for Fluid-Preserved Collections" for NPS standards and requirements for fluid-preserved collections storage.

> ***Note: Consult your regional structural fire management officer, park structural fire management officer, local fire marshal, and building codes to see if your jurisdiction has any special requirements for structures that house collections preserved in alcohol or formalin.***

4. *What types of storage containers should I use?*

Containers for long-term storage of specimens preserved in fluid must:

- be durable

- be non-reactive towards the specimens and the storage fluids

- seal well enough to prohibit evaporation of the storage fluid

- comfortably accommodate the specimen so that removal and replacement can be done without causing damage (for example, no shoulders on jars or other containers)

- not degrade from environmental agents of deterioration

- be impermeable to oxygen

You can use these containers to store specimens:

- **Glassware**

  - **Borosilicate Glassware** is the best container material for small to mid-sized specimens. It's very resistant to chemical corrosion. Unfortunately, appropriate sizes of borosilicate jars are difficult to find in the United States. As a consequence, most U.S. collections house wet specimens in soda-lime glass (glass composed of silica, calcium oxide, and sodium oxide).

- **Soda-Lime Glass** is cheap, readily available glass. It has only fair corrosion resistance. This glass will begin to leach its alkaline constituents into distilled water in a matter of minutes. Since most storage fluids have pHs ranging from neutral to moderately acidic, the glass will probably react with the fluids over time.

- **Flint Glass Containers** are also used to store specimens in fluid. Flint glass is made of much the same ingredients as soda-lime glass. It may also contain other components, including lead oxide. Flint Glass is not particularly resistant to acids.

• **Tanks**

- Large specimens are usually housed in tanks made of stainless steel, molded polyethylene, or molded polypropylene.

- Stainless steel tanks will corrode in the presence of the fluids

- Steel tanks may also corrode along the welds at the seams. Most do not seal well enough to stop fluid evaporation.

- Plastic tanks can deteriorate from long exposure to acids, alkalis, UV radiation, and the stress caused by large volumes of fluid.

• **Lids, Gaskets, and Seals**

Lids, gaskets, and seals on containers are often a source of contaminants in the storage fluid. As with the containers noted above, stoppers of borosilicate glass are superior, while other types are not as effective:

- Borosilicate glass stoppers that are manufactured to very fine tolerances seal borosilicate jars very well. These have been used in the United Kingdom for many years.

- Stoppers for commercial grade glassware are not as carefully manufactured, and usually will fit only the container for which each stopper was produced originally. As a consequence, mixing stoppers and containers results in poorly sealed jars.

- Metal caps will corrode. Avoid using them.

- Some plastic lids, such as those made of Bakelite, become brittle in the presence of the vapor from the fluids.

- Polypropylene lids with polyethylene liners work reasonably well on most soda-lime and flint glass jars. They constitute one of the least expensive, but fairly effective closure systems.

- Avoid rubber and synthetic rubber gaskets. They will discolor and deteriorate with age. These gaskets also break down when in contact with the fluid preservative (Simmons, 1995). Gaskets of acrylonitrilebutadiene may be an adequate option (Suzumoto, 1992).

When closures are ineffective, your first option should always be to replace the closure, the container, or both. If that is not feasible, you can use 3M® brand #5086 clear polypropylene sealing tape with alcohol-resistant acrylic adhesive as a temporary means to reduce fluid loss. The tape is available at stores that sell building supplies.

- **Vials in a Larger Container**

  Follow the steps below to store small fluid-preserved specimens:
  - Place the specimens in vials filled with the appropriate fluid preservative.
  - Close the vials with a permeable material (such as high-loft, non-bonded polyester fiber).
  - Place the vials in a larger container filled with the same fluid preservative.
  - Seal the outer container with a lid and liner to prevent evaporation.

  This storage method protects individual specimens from mechanical damage and unnecessary handling. It also helps insure that any fluid loss around the specimens will be minimal.

IMPORTANT: Be sure that the ratio of specimens to fluid in a container does not exceed 30%. Fluid quality is jeopardized (the concentration drops, as does the pH) if specimen ratios are higher than 30%.

5. *Are there any other storage requirements that I should consider?*

Yes. The best way to store small wet collections is inside a flammable storage cabinet. Larger collections can be housed on shelves, including mechanically operated mobile storage (although these may not be acceptable to some fire protection authorities). Be sure that the finish on the shelving will resist the collection fluids.

Use bins or trays within cabinets or on shelves to organize specimen containers. This will protect the specimen containers from excess handling and disorder.

Equip all shelving units with removable restraining bars to help keep the containers in place in the event of an emergency. Such rails will also provide protection against someone accidentally knocking a jar off the shelf. Vibration and compactor movement pose little threat to these collections, as long as jars do not topple from the shelves as a result of shifts in position.

See *Tools of the Trade* and *COG* 11/3 "Storage Concerns for Fluid-Preserved Collections" for additional information concerning storage equipment.

6. *What about arranging wet specimens?*

Sometimes you may need to adapt your arrangement patterns. Most fluid-preserved specimens are stored on shelves. You might want to use an arrangement that accommodates a more effective use of available space (such as storing the same size containers on a shelf).

Over-sized specimens are often housed in large, sometimes very heavy containers. Normally, these are stored at or near floor level. Do not store them above head level.

7. *Are there any special health and safety concerns related to storage of wet collections?*

Yes. In addition to threats of fire and explosion, there are the risks of:

- inhalation of vapor
- skin absorption of chemicals

These risks can occur when removing specimens from large containers. Always open containers under local exhaust ventilation, or use appropriate personal protective equipment. You can minimize these risks and ensure that there is little alcohol or formaldehyde vapor in the ambient air if you:

- Design, maintain and use proper general ventilation systems.
- Use specimen containers that seal well.

To reduce the potential for injuries:

- Keep large containers on dollies or casters.
- Do not store heavy jars or other heavy containers on high shelves.

E. Maintenance of Wet Biological Collections

1. *What does maintenance of wet collections include?*

Proper maintenance includes:

- updating information (including deaccessioning [See *MH-II*, Chapter 6: Deaccessioning, for additional information.])
- ensuring fluid quality and levels
- emergency preparedness and response

2. *How do I maintain fluid quality for wet specimens?*

Monitoring

Conduct frequent monitoring of the wet specimens. This includes:

- The visual inspection of fluid levels.
- The use of a digital density meter and temperature correction tables.
  - These tools allow you to determine alcohol concentrations if fluids have evaporated or become exceptionally discolored.
  - **Note:** You can use an alcohol hydrometer to approximate the concentration, but both the fluid and the ambient air temperatures must be 20°C/68°F to achieve accurate results.

Maintaining Fluid Levels

- If room temperatures do not change over time, you can maintain fluid levels by completely filling containers.

- If temperatures change, pressures within containers will cause the lids to loosen

    - This will eventually compromise fluid levels and concentrations.

    - If this occurs, it's best if you maintain fluid levels at a standard distance (at least one inch) below the lip of the closed lid.

    - This allows for the available space to better accommodate changing internal pressures.

Other monitoring considerations include:

- Avoid excessive air. This promotes oxidation of the fluids (acidification of the alcohol).

- Keep all containers filled to the same level. This facilitates inspections for containers that do not seal properly.

- If a container permits fluid loss, replace the appropriate parts (jar, lid, or gasket).

- If the loss of fluid results from use, you'll need to replenish the preservative.

It's vital that you ensure proper fluid levels and concentrations in each individual container housing wet specimens. This requires constant monitoring of fluid conditions and occasional maintenance.

3. *How are fluids lost or compromised?*

Fluids may be lost or altered by:

- defective lids or seals

- changing temperatures that cause closures to loosen

- leaving lids off of the containers for prolonged periods

- removal and replacement of specimens

- spills

In addition, fluid preservatives may become discolored due to:

- unstable gaskets

- corrosion of metal (such as bails, lids, labels, ear tags, leg bands)

- seepage of body fluids (water in the cells, blood, digestive fluids)

- dissolution of specimen pigments
- breakdown of lipids
- polymerization of formaldehyde into milky strings, due to:
    - exposure to low temperatures
    - a change in the pH of the fluid
- contaminants originally present in the fluids (such as minerals from tap water)

> ***The most common problem related to wet collections maintenance is lack of training. Do not attempt to replenish fluids in a collection if you do not have a proper understanding of how to adjust the overall concentration.***

4. *How do I replace or replenish the fluid preservative?*

Because the primary environments for wet specimens are the storage fluids, **the quality of those fluids are your main concern**. If fluids evaporate from containers for any reason, the concentration of the remaining fluid is altered. Alcohols evaporate more quickly than the water with which they are mixed. Evaporation results in solutions with low alcohol concentrations and low fluid volumes that no longer fill the jars. The space once filled with fluids is now filled with air. The air fosters oxidation of the alcohol, further changing the chemistry of the solution.

First, fix the problem, even if it means replacing the container. When containers are maintaining fluid levels, the only reason for fluid replacement should be to replenish fluids lost because of specimen use.

Use the following procedures to replenish fluid:

- Determine the concentration of the alcohol in the container.
    - Use a digital density meter and temperature correction tables to determine the concentration of the alcohol in the container. ***OR***
    - Use an alcohol hydrometer to approximate the concentration, but both the fluid and the ambient air temperatures must be 20°C/68°F to achieve accurate results. This requires you to:
        a. take several measurements to determine the true concentration of the reduced fluid in the container
        b. carefully mix the fluid to ensure that there is no possibility of measuring pockets of especially high or low concentration
        c. use sufficient amounts of fluid for measurement
- To determine the appropriate concentration of the make-up fluid, use the formula developed by Kelly Sendall and Grant Hughes: $z(x+y) = ax + by$

    z = desired concentration
    x = height of the fluid in a straight sided container

y = amount of fluid to add (in inches or centimeters)
a = measure concentration of the fluid (percent)
b = the concentration of the fluid being added (percent)

5. *Are there any other ways to adjust fluid concentrations?*

Yes. You also can adjust the concentration by simply adding 95% alcohol to the appropriate level in the container and then checking the concentration with the density meter. If the new concentration reaches the target range (70-75% ethanol) or is higher, that is acceptable. Higher concentrations are not likely to damage the specimens, but concentrations below the optimum range will permit deterioration.

6. *When should I replace the fluid?*

You may need to replace the fluid if any of the following circumstances occur:

- If the alcohol concentration in a container is 20% or less and there is still a fairly large amount of fluid in the container, it may not be possible to bring the concentration back to the appropriate level. If that is the case, you may need to replace at least some portion of the fluid.
- If the addition of 95% alcohol to the fluid in the container does not bring the concentration to the appropriate range or higher, you may need to replace the fluid.
- If the fluid contains sediment or other particulate residue that is shown by analysis to be damaging to the specimen, you can filter the fluid to remove the sediment and then return the fluid to the container. If the sediment is an indication of an ongoing deterioration of the fluid or specimen, then you may need to replace the fluid.
- If specimen containers are crowded with specimens the result will be poor fluid quality. To fix this:
  - Separate the specimens into additional containers.
  - Correct the concentration of the fluid in the initial container.
  - Use new storage fluids in the additional containers.

The fluid surrounding a specimen contains components leached from the specimen. Therefore, loss of specimen material results if you completely replace fluids. You can expect additional leaching as the specimen(s) and replacement fluid reach equilibrium. Replace fluids only under very special circumstances.

Note: Specimens that have become deformed when fluids have evaporated completely may no longer be useful for morphological studies. They are often of limited use after rehydration. However, in the dry state, they may be very stable. They also may be useful for biochemical studies, depending upon the type of fluids that were used originally.

7. *Should I be concerned if some fluids are discolored?*

No. Fluids are often discolored; this is not normally a cause for alarm. However, consult a conservator if:

- a fluid has developed a very dark color, and
- there is any evidence that a lid, gasket, or label is undergoing

deterioration and may be leaching components into the fluid

The conservator or a conservation scientist should determine the appropriate treatment. Do not replace the fluid before you have researched the nature of the deterioration.

8. *When should I consult a conservator?*

Never take any action that might compromise the integrity of research specimens. If specimens are damaged, stabilize the material by non-interventive means. This approach is usually preferable to treatment to repair the damage. For example, you can leave detached parts separate as long as they are kept in the same container with the original specimen. Be sure to separately label the parts to indicate their source.

If a condition indicates active deterioration, the specimen may need treatment to halt further decay. An example might be a metal label that has corroded and become attached directly to a specimen by the corrosion products. Because the corrosion and the specimen damage will continue in a fluid environment, it may be best to remove the label and the corrosion salts, then stabilize the label separately. **Do not attempt this type of interventive treatment. Call a professional conservator for assistance.**

9. *Are there any health and safety concerns related to maintenance of wet collections?*

In general, the safety concerns are the same as those for stabilization and processing of wet collections. Remember to utilize proper waste disposal of any fluids that are replaced during maintenance activities. Use proper engineering controls and personal protective equipment. Always move large tanks and other containers on dollies. Move smaller containers on carts.

10. *What should I know about emergency preparedness, response, salvage, and long-term recovery?*

Potential emergencies include chemical spills and leaks, fire, and explosions. Fluid collections can also be damaged by floods and earthquakes, especially if shelves are not properly secured and specimen containers are not protected by restraining bars on the shelving units.

Be sure that your park's structural fire brigade, law enforcement staff, local fire department, emergency medical technicians, and all other emergency response personnel know of all potential hazards and their locations.

The safety concerns that arise during emergency salvage are noted in Chapter 10: Emergency Planning and *Help! A Survivor's Guide to Emergency Preparedness*, available from the Alberta Museums Association. Ordering information is available on the association's website at <www.museumsalberta.ab.ca>.

If specimen containers have broken and fluids have been lost, the most important salvage step is to keep the specimens damp. Ideally, you should keep them damp using the same kind of fluid in which they were stored prior to the emergency. If that's not possible, at least bag (double bag if you can) the specimens in polyethylene with a small amount of deionized or distilled water. Add a little alcohol to help limit the potential for biodeterioration.

Note: Following an emergency, be sure to consult a conservation professional. Complex, extensive treatments may be needed as part of the long-term recovery process. If containers have been broken or were poorly sealed the contents may no longer have utility for some scientific research.

11. *Do I need to document maintenance activities such as replacing fluids?*

Yes. All adjustments of fluid concentration and fluid replacements are essentially specimen treatments that you should fully document in writing. If you discover that containers or labels have contaminated a specimen, note this as well. Any contamination is likely to affect the long-term preservation and the utility of the specimens for research.

During emergency salvage operations, it's acceptable for you to eliminate individual specimen reports, as long as you document all steps in the overall immediate salvage (in writing and in some imaging system). You should record specific damage to particularly valuable specimens and specimens on loan from other museums, and note the specific salvage methods used, as they may be important for insurance purposes.

SECTION V: BIOLOGICAL LOW-TEMPERATURE COLLECTIONS

A. Overview

1. *Why are specimens preserved at low temperatures?*

Specimens are maintained at low temperatures to preserve:

- soft parts for various biochemical analyses
- whole organisms in a viable (able to live and grow) state

2. *What low temperatures are used?*

Cold Storage includes temperatures above the freezing point of water (0°C/32°F), but not above about 8°C/46.4°F (a range of 2°-8°C/35.6-46.4°F is recommended). Cold storage is used to extend the shelf life of microorganisms prepared by specialized lyophilization (freeze-drying) techniques.

Freezer Storage includes temperatures between 0°C/32°F and -80°C/ -112°F. Although such temperatures are often used for temporary storage, expansion of water in cells, ice crystal formation, and dehydration can damage biological materials stored at these temperatures.

Ultracold Storage at about -80°C/-112°F is used for short-term preservation of non-viable samples, such as animal tissue samples.

True Cryogenic Storage includes temperatures that are usually below -130°C/-202°F (the exact temperature is usually determined by the sensitivity of the specimens). -130°C/-202°F is the maximum temperature for long-term stability of plant and animal cells and **-150°C/-238°F or lower is considered to be optimum for preservation**.

You cannot achieve true preservation of fresh biological material at temperatures between 0°C/32°F and -130°C/-202°F, as:

- fresh material will undergo cellular disruption because of expansion of water in the tissues
- dry biological material will be degraded by an increase in the rate of deterioration of lipids and damage from residual moisture

Note: Increased rate of deterioration of lipids, and increased potential for biodeterioration are hazards for many materials stored at temperatures between 8°C/46.4°F and 16°C/60.8°F.

> ***Lyophilization and cryogenic storage options generally require pre-treatment of the specimens using a cryoprotectant chemical.***

3. *What specimens are preserved at low temperatures?*

- Plants
  - Non-vascular (strains of fungi, including yeasts)
  - Vascular (cell lines, seeds, cloned probes, other samples)

- Protists
  - Some algae
  - Protozoa (especially parasitic strains)
- Viruses
  - Plant, human, and animal viruses
  - Cloned viral genomes
- Bacteria
  - Bacterial strains
  - Bacteriophages
  - Plasmids
- Animals
  - Tissues (dissected organs, muscles)
  - Cell lines
  - Blood and blood components (whole blood, serum, plasma, antisera)
  - Semen
  - Venom
  - Other samples (cloned probes, isolated proteins and nucleic acids, cell suspensions)

Note: The largest organisms that can be preserved in a viable state are some insects.

Cryogenic collections are often samples specifically set aside for destructive analyses, using tissues from voucher specimens in traditional collections. Such cryogenic samples are ancillary or supportive to the voucher specimens. However, ancillary collections may include one or more tissue samples from individual specimens, or include samples from more than one collection or institution. Sometimes there is no voucher specimen. Because of these issues and the fact that various tissues may be indistinguishable without biochemical analyses, you need to ensure that your records are extremely accurate.

4. *What agents of deterioration affect low-*

Inappropriate temperature (including temperature fluctuations) is the primary agent of deterioration for low temperatures collections.

temperature collections?

- **Cold Storage** at temperatures of 2-8°C/35.6-46.4°F will extend the life of some freeze-dried cultures that are reasonably resistant to temperature changes, but may be damaged by temperatures outside this range.

- **Ultracold Storage** at temperatures around -80°C/-112°F:

  - will slow the rate of deterioration of tissue samples preserved for DNA analysis but will not stop the deterioration

  - the rate of deterioration increases when samples are repeatedly removed from storage for use at higher temperatures

- **Cryogenic Storage** at temperatures below -130°C/-202°F will preserve specimens well, but is expensive to install and maintain.

Cryogenic Specimens cannot be stored at temperatures above about -130°C/-202°F and below 0°C/32°F, as this will destroy their utility. To prevent such damage, make sure that you have backup systems in place so that cryogenic units can maintain the appropriate temperatures at all times.

The other agents of deterioration in addition to inappropriate temperature include:

- **Neglect** includes a lack of knowledge and skills, failure to follow standards or provide adequate documentation, apathy, lack of administrative support and resources. Common instances of neglect are:

  - marking ampoules illegibly or inaccurately

  - failing to link tissues, cell lines, etc. to identifiable voucher specimens

  - failing to monitor storage environments to ensure that appropriate temperatures are maintained constantly

  - failing to provide adequate backup systems to prevent temperature increases

  - the lack of temperature control during sample use

- **Contaminants** can damage low-temperature collections. Do not allow specimens to come into contact with:

  - other specimens, directly or indirectly (for example, transfer through handling)

  - any non-sterile surface

  Contaminants can destroy a specimen's utility for many types of research. Maintain pristine work areas and utilize appropriate biofilters, proper storage containers, and appropriate handling methods to eliminate specimen contamination.

- **Physical Forces** can damage or destroy low-temperature collections.

- Inappropriate ampoules or ampoules containing excessive specimen tissues can burst when removed from liquid nitrogen. (Liquid nitrogen is used to both transport and store some materials preserved at low temperatures.) This will destroy the specimens and pose chemical, physical, and biological hazards to human safety.

- Freezing at temperatures above cryogenic levels will permit moisture in tissue samples to form ice crystals that will damage tissue structures.

• **Criminal Activity** is usually not a major threat to collections stored at low temperatures. However, some low-temperature collections may require additional security measures if they include:

  - viable organisms that are pathogenic to humans or human resources (for example, to agricultural plants and animals, or water supplies)

  - tissues that may contain pathogenic organisms in a viable state

> ***Institutions that maintain such material must possess permits and sufficient security to ensure that their holdings cannot become a danger to public health.***

5. *What health and safety concerns are related to low-temperature collections?*

As with fresh or semi-fresh biological material, there is the possibility of that **human pathogens are present in low-temperature materials**. These may include either the specimens themselves or as infectious agents in the specimens. Other potential hazards include:

• **Liquid nitrogen**, which is the best storage medium for cryogenic preservation. If you use liquid nitrogen, you need:

  - special personal protective equipment (PPE)

  - special building ventilation systems

  - appropriate ampoules that are resistant to breakage resulting from thermal changes

  - possible replenishment of liquid nitrogen, depending on the system used

  You also may need to equip your building with special piping for delivery of the liquid nitrogen to cryogenic units.

• **Dry ice** (solid carbon dioxide) is sometimes used to protect material removed from cryogenic storage. If you use dry ice:

  - utilize special containers and personal protective equipment

  - do not use dry ice in confined closed areas because of respiratory concerns involving excessively high atmospheric quantities of carbon dioxide

Don't store dry ice in sealed <u>rigid</u> containers. This can cause an explosion when the containers are opened. Use <u>vented</u> containers.

- **Ethylene oxide** is used in some preparation procedures to sterilize the preparation chambers. This chemical requires:
  - special exhaust ventilation
  - personal protective equipment
  - specialized training

To reduce risks to you, other staff, and researchers, be sure to utilize:

- proper procedures
- well-designed preparation, storage, and research facilities
- biohazards hoods for any work with specimens preserved at low temperature
- personal protective equipment, including long insulated gloves and face shields when working with material stored at cryogenic temperatures
- properly fitted respiratory protection, and proper gloves and other protective clothing when
  - handling microorganisms
  - working with liquid nitrogen and ethylene oxide

B. Stabilization and Processing of Low-Temperature Collections

<u>IMPORTANT NOTES CONCERNING LOW-TEMPERATURE COLLECTIONS</u>:

Stabilization of low-temperature collections should <u>not</u> be the responsibility of the park's collection staff. Researchers, research designs, and material utilization will control the conditions of biological specimens and specimen parts intended for low-temperature preservation. Stabilization of such material is beyond the control or operations of the park.

Low-temperature collections can pose serious health and safety risks. They can also involve significant resource commitments (time, money, personnel, space, facilities, and equipment) for operating specialized low-temperature equipment.

No individual should be involved with stabilization of biological materials for low-temperature collections without first receiving specialized training. Such training far surpasses any guidance provided in this appendix. Therefore, the following information attempts to focus on the processing, storage, and maintenance of low-temperature collections. Be aware that serious health and safety risks are still present with these stages of preservation.

Finally, considering evolving issues of national security as they relate to the legality of some preserved biological materials (viruses, spores, toxins, etc.), special permits and security clearance may be required for any possession, handling, or transport of hazardous biological materials. The information contained in this appendix does not address any stage of preservation of such materials.

1. *How should I label low-temperature collections?*

Refer to the previous general discussions of labeling specimens, as well as those noted in *MH-II*, Appendix J, Section K, Natural History Specimens. Other considerations specific to low temperature include:

- **Condensation** on cold surfaces, water solubility of some inks, and impervious surfaces (like plastic ampoules) can create the problems for using inks in low-temperature collections. Staff sometime use alternative methods such as soft pencils or mechanical inscription.

- **Carbon-based, black inks** are the only type of inks that you should use on specimen labels. Carbon inks do not fade over time.

  - Commercial, black printing inks are usually carbon-based.

  - Most laser and photocopier toners are usually carbon-based.

  - Laser and photocopiers apply the toner with a certain amount of heat, which helps fuse the toner particles to the paper.

  Liquid inks vary in quality. A good choice is **black ink designed for writing on drafting film**, using technical pens. These tend to be carbon-based inks with a neutral pH that adhere well to almost any surface.

- **Fiber-tipped pens.** Black liquid inks in some fiber-tipped pens are acceptable for labeling specimen containers.

  - Be sure to choose pens with carbon-based inks.

  - Fiber-tipped pens that contain colored or black dye inks are also available.

  - Many of these products may not function well if water from condensation is present.

  - Cold temperatures will slow the fading of the dyes in these inks, but rate of fading will depend upon both the temperature and the humidity level in storage.

  - Time spent out of the low-temperature environment will permit the inks to fade quite rapidly.

- **Testing of Inks**. Test inks to see:

  - How long does it takes for any ink to dry so that it won't smear?

  - How well does it resist smearing when wet?

  - What's the resistance of the ink to various fluids, minimal abrasive forces, and to prolonged exposure to UV radiation?

Avoid any ink that fails such tests.

- **Bar Coding** is often used for the specimen and sample vials used in low-temperature preservation. Bar coding facilitates rapid inventory and reduced risk of mismatching specimens with data.

2. *What should I know about loans of low-temperature collections?*

For information concerning incoming loans, see *MH-II*, Chapter 2, Section P. For information concerning outgoing loans, see *MH-II*, Chapter 5. You should also be aware of the following additional standards that pertain to loans of specimens preserved at low temperature:

- The use of hazardous biological materials may be restricted.
- Do not loan entire holdings of a taxon for use at a single time (it may be necessary to culture a new colony before allowing specimens to be sent).
- Commercial shipments of hazardous biological materials must be in compliance with all Federal and State regulations, including the Hazardous Materials Regulations (49CFR, Parts 171 through 180).

3. *What agents of deterioration affect low-temperature collections during processing?*

The primary agents of deterioration during processing are:

- Insufficient knowledge and skills (neglect) that can render a specimen useless.
- Contaminants can result from poor handling techniques. Both physical damage and contamination can result from removing improperly sealed ampoules from some types of cryogenic storage.
- If liquid nitrogen has leaked into specimen containers, the containers may burst when exposed to warmer temperatures.
- Inappropriate temperatures can rapidly destroy the utility of specimens preserved at low temperatures.

These agents of deterioration are shown in Table T.10., below.

PRIORITY 1	PRIORITY 2	PRIORITY 3
Neglect	Criminal activity	Light
Contaminants		Water
Physical Forces		Fire
Inappropriate T		Pests

		Inappropriate RH

Table T.10. Impact of agents of deterioration during the processing of low-temperature specimens.

4. *How should I handle specimens during processing?*

The basic rules for properly handling, moving, and placing specimens preserved at low temperature are:

- Keep specimens as close as possible to storage temperatures at all times. Use insulated containers, small tanks of liquid nitrogen, or containers with dry ice to move specimens. Use carts to move these containers.
- Some institutions require that handling tissue samples be done in a chest freezer.
- Keep storage freezers or tanks closed when not removing or replacing specimens. Make sure that all removal/replacement is done quickly.
- Provide dedicated workspace, stable work surfaces, appropriate local exhaust ventilation, and appropriate personal protective equipment.
- Provide UV-filtered lighting with good color rendering capacity (a color rendering Index of 90 or higher) and preferably, lighting free of most infrared (heat) radiation.
- Maintain clean and orderly work areas and eliminate unnecessary risks such food, beverages, and other potential contaminants.
- Maintain sufficient space for each specimen.
- Handle only one specimen container or sample at a time.
- Avoid unnecessary handling.

5. *How should I pack and ship specimens for loans?*

Refer to the general packing and shipping guidelines listed in Chapter 6, “Handling, Packing, and Shipping Museum Objects.” Specimens preserved at low temperatures require additional precautions. Be sure to:

- Provide an appropriately sealed and insulated container that will maintain the required temperature for the specimens/samples.
- Provide appropriate invoices and shipping documentation (including hazardous materials warnings and endangered species documentation where pertinent) to avoid unnecessary opening of the container.
- Provide instructions on how to properly open the container and remove the specimens.
- Provide instructions to the recipient about the type of preservation to be used for the specimens; **especially the required temperature**.

- Send loans by overnight express at the beginning of the week to ensure better control and to minimize risks of thawing prior to delivery.

- Send frozen materials in heavily insulated containers with "ice-packs."

  Note: Dry ice is considered to be a dangerous good. Do not use dry ice in a commercial shipment unless you have received DOT-approved training in packing, labeling, and shipping dangerous goods ***OR*** hire a certified HAZMAT shipping contractor to properly pack, prepare, and label the shipment for transport.

- Be sure that all shipments fully comply with Federal regulations regarding:

  - shipping documentation
  - the shipment of endangered species
  - the shipment of hazardous materials.

- Ensure that the specimens are properly packaged, to protect both the specimens and anyone handling the shipment.

- Mark outside of shipments as "FROZEN MATERIALS - KEEP FROZEN" or "TEMPERATURE SENSITIVE MATERIAL - KEEP REFRIGERATED."

6. *How should I document a specimen's condition during processing?*

Condition reporting of most cryogenic materials is not performed in the traditional manner. Be sure to report any adverse conditions. For example, document samples that have experienced thawing, freezer-burn, and potentially compromised data.

If the cryogenic materials are more consistent to traditional collections (where whole identifiable organisms are maintained), you may be able to use a traditional natural history condition report, as previously noted.

7. *What health and safety concerns should I be aware of during processing?*

Health and safety concerns during processing are primarily associated with human pathogens. However, there also are concerns associated with storage in liquid nitrogen. To prevent injury, be sure to:

- Wear long, insulated gloves to protect the hands and arms against the cold.

- Wear a face shield when accessing material that may have been in the liquid phase of liquid nitrogen.

- Protect all skin against contact with dry ice.

Other hazards that you should be aware of include:

Dry Ice

Do not use dry ice in well-sealed rigid containers. Sublimation of the dry ice can increase internal pressure to the point that the container may explode. Use **vented** containers only.

Don't store containers of dry ice in enclosed areas. As dry ice "melts," carbon dioxide is released. Within enclosed areas, carbon dioxide can build to levels dangerous to people.

Freeze-Dried Specimens

Anyone handling specimens that are being freeze-dried must wear both respiratory protection and gloves for safety. If freeze-dryers are sterilized using ethylene oxide, the staff members who apply the chemical must have special training. They also may be required to have a general license or certification for application of a pesticide and a special license or certification for application of a fumigant. Additional requirements include:

- medical monitoring of personnel
- environmental monitoring for residual ethylene oxide levels
- full compliance with all applicable OSHA regulations

C. Storage of Low-temperature Collections

1. *Are there any special storage considerations concerning low-temperature collections?*

If there are biological toxins or pathogens involved, you MUST possess specialized training, permits, and sufficient security to ensure that the holdings cannot become a danger to public health.

For detailed information concerning the security of collections, see Chapter 9, "Museum Collections Security and Fire Protection."

2. *How should I organize low-temperature collections?*

Organize the collection to enable rapid retrieval and replacement of specimens. Don't let access risk temperature control for other specimens or samples. Place specimens that are frequently used within easy reach. There are two primary methods of organizing cryogenic materials. Both have advantages and disadvantages. Your choice should depend on how your collection is used.

Sequential or chronological organization groups material from a common time and source. Every sample has a definite and predictable location in the storage unit. If a sample has been consumed through prior research, an empty space is left.

- The advantage to this type of organization is the maximization of space.
- The disadvantage is that some research is based on multiple samples of common taxa. This would require the researcher to go through the entire cryogenic collection to obtain the needed samples.

Identification and classification systems organization is another method of arrangement. This involves maintaining samples in groups based on various identification and classification systems.

- The primary advantage is that most material needed for research purposes will be located in one area of the collection. This is less disruptive to the collection as whole.

- The disadvantages are:

  - As new material is added to specific taxa, more space within expensive storage units is required to accommodate expansion

  - The location of individual samples is less definite and predictable than the sequential or chronological organization.

Remember that organization can vary among disciplines and institutions. It may be more practical to simply arrange specimens according to catalog number. Whichever method you choose, be sure that every specimen has a designated and predictable location.

After you have organized your collection, don't forget cabinet signage, labels, and floor plans. Label each low-temperature storage unit with a sign indicating the beginning and ending taxa and catalog numbers. This avoids unnecessary opening of the unit. Use the same method for individual shelves, trays, or other equipment used to hold samples or specimen vials.

> ***The ultimate goal is to allow rapid and easy access to a specimen with minimal handling of other specimen containers.***

3. *What are the primary agents of deterioration that affect specimens in storage?*

The agents of deterioration that pose the greatest risks to low-temperature collections in storage are:

- **Neglect**, such as:

  - the improper use of storage equipment

  - failure to monitor environmental conditions

  - careless handling of specimens

  - lack of familiarity with collection organization and arrangement systems

  - disassociation of specimens from data

- **Inappropriate Temperature**, especially:

  - temperature increases

  - repeated exposure to freezing and warming temperatures

  Such circumstances will cause specimens to deteriorate.

PRIORITY 1	PRIORITY 2	PRIORITY 3
Neglect	Contaminants	Inappropriate RH

Inappropriate T	Water	Light
	Physical Forces	Pests
	Criminal activity	Fire

Table T.11. Agents of deterioration related to low-temperature storage of specimens.

4. *What special features should I include in low-temperature storage areas?*

Refer to the storage requirements listed in Chapter 7: Museum Collection Storage. To reduce biohazards and chemical hazards, and protect the collections from malfunctioning equipment, you also should:

- Segregate the storage of low-temperature collections from other collection storage operations.

- Provide separate air-handling systems for low-temperature collection storage areas. This will:

    - permit cold rooms and rooms that house mechanical freezers to be cooled on a year-round basis

    - allow special ventilation designs for rooms housing liquid nitrogen tanks

- Provide appropriate security measures.

    - Install key code or other electronic entry control devices for storage rooms.

    - If electronic security is not possible, use a highly restricted key system for entry.

    - Consider adding a security window to the door to permit inspection of the room from the exterior.

    - Activate lighting from outside the room. This will facilitate inspections.

- Equip storerooms with water-based, automatic fire suppression systems and provide for regular inspection, testing, and maintenance of the systems.

- Filter all incoming and recirculated air to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90-95% level.

5. *What types of supplies and equipment are used for storage of low-temperature collections?*

Containers. Containers for specimens must be:

- clean (and in some cases sterile)

- able to withstand the temperatures used for low-temperature storage

- non-reactive towards the specimens and any cryoprotectant fluids

- sealed well enough to prohibit ingress of contaminants or release of material from the specimens
- impermeable to oxygen

Glass or polypropylene containers are usually used for many cryogenic or other low-temperature storage methods. Be aware that:

- Polypropylene is rapidly becoming the most popular type of container material.
- Only some polypropylene or glass vials can be used in the liquid phase of liquid nitrogen. Most must be kept in the nitrogen vapor over the liquid to avoid the potential for rupture unless they are further sealed in polyethylene tubing.
- Some polypropylene vial and closure systems have been designed especially for use in tanks containing liquid nitrogen. These are the best choice for shipping samples collected in the field.

Container closures. The closures for containers vary with the temperature at which the container will be stored. There are some vial and cap systems that are designed to withstand liquid nitrogen temperatures, but it's important to carefully consult the manufacturer's recommendations when choosing a system. **Do not use rubber-stoppered vials for storage at liquid nitrogen temperatures.**

Rack and Trays. A good technique for storing specimens inside mechanical freezers is to use stainless steel racks to hold divided cardboard or polypropylene trays containing the sample vials.

- This allows you to easily label the freezer contents and reduces the number of samples exposed to ambient air during retrieval and replacement.
- There are stainless steel racks suitable for use in either upright or chest freezers.
- Stainless steel racks for use with divided polypropylene trays and aluminum canes have also been developed to hold specimen vials for storage in the vapor over liquid nitrogen. These systems permit retrieval of selected vials without exposing large numbers of specimens to temperature changes.
- You can also use divided tray systems for freeze-dried specimens stored in sealed vials in cold storage rooms or in refrigerators capable of maintaining 2-8°C/35.6-46.4°F or less.

Cold Rooms used to store freeze-dried material are maintained at temperatures just above freezing (2-8°C/35.6-46.4°F).

- Cold Rooms require dehumidification of incoming air to ensure that there is not a problem with condensation that could lead to mold growth.

- They require backup power supplies to ensure that the temperatures are maintained in the event of a power failure.

- Cold Rooms will prolong the shelf life of viable specimens that are preserved by freeze-drying, **but do not guarantee long-term preservation**. You may need to periodically grow new colonies and create new specimens to ensure that stocks are maintained.

Mechanical Freezers (standard freezers and ultracold freezers) are also used to store low-temperature collections.

- Freezers can meet virtually any temperature requirement, **but initial costs and operating costs increase as the desired temperature goes down**.

- Many institutions maintain tissue samples in mechanical freezers at -80°C/-112°F.

  - Long-term preservation that would be achieved at true cryogenic temperatures is sacrificed to economics.

  - Most institutions can afford to maintain temperatures of -80°C/ -112°F but cannot afford the cost of lower temperatures.

6. *What else should I know about mechanical freezers?*

Freezers use a lot of energy to obtain temperatures of -80°C/-112°F. They also produce a great deal of heat. Because of this, **only use freezers in rooms that have constant (24 hours/day, year-round) air conditioning or appropriate heat exhaust systems**. You also need to equip the freezers with back-up generators in case of a power failure.

There are two main kinds of mechanical freezers:

- **Upright freezers** are easy for staff to use. However, there is a tendency for temperature gradients to form when the door is opened. This can compromise temperature control.

- **Chest freezers** are less prone to the problem of temperature gradients forming. As noted above, both types become increasingly expensive to purchase and operate as the target temperature drops.

Liquid nitrogen freezers provide an excellent storage medium. They can maintain specimens at temperatures below -130°C/-202°F (usually at least -150°C/-238°F).

- Rooms that contain liquid nitrogen freezers must be properly ventilated:

  - when the freezers are refilled with liquid nitrogen

  - when oxygen levels in the room become too low for human safety

- If a number of liquid nitrogen freezers are housed in the same room, it's best to deliver the nitrogen through pipes from a bulk tank. Don't try to refill the freezers manually.

- Piping for liquid nitrogen has special design requirements, including:

  - insulation

- safety valves

- Use low-pressure tanks to supply the liquid nitrogen. High-pressure tanks can be hazardous to staff during manual refilling. They also can damage the automatic supply units.

- Within the tanks, specimens are usually stored in the vapor over the liquid, but can be stored in the liquid itself.

7. *How should I store specimens inside a freezer?*

Use stainless steel racks to hold divided cardboard or polypropylene trays containing the sample vials. This is a good technique, which:

- allows you to easily label the freezer contents

- reduces the number of samples exposed to ambient air during retrieval and replacement

Stainless steel racks are available for use in either upright or chest freezers.

To hold specimen vials for storage in the vapor over liquid nitrogen, you can use specialized:

- stainless steel racks and divided polypropylene trays

- aluminum canes

These systems permit retrieval of selected vials without exposing large numbers of specimens to temperature changes.

You can also use divided tray systems for freeze-dried specimens stored in sealed vials in cold storage rooms or in refrigerators capable of maintaining 2-8°C/35.6-46.4°F or less.

8. *What about storage of DNA samples?*

Low-temperature storage is not a prerequisite for successful extraction of DNA from specimens. In some cases, it is possible that simply freeze-drying some organ tissues, and then maintaining them in dry conditions might work as well as storing fresh samples at very low temperatures.

The main reason for low-temperature storage for samples preserved for nucleic acids analyses seems to be the ease of extraction when specimens have not been treated by any other methods, rather than the quality of preservation.

DNA can now be removed from highly degraded materials using the polymerase chain reaction (PCR) technique. This method allows DNA to be successfully extracted from increasingly smaller samples of old museum materials. This practice has improved steadily as a result of interest by forensic scientists. As a result, sample size and environmental conditions are not as important as they were when the techniques for DNA extraction were initially developed.

As long as biological tissues have not been contaminated in some adverse fashion, or chemically treated in a way that destroys the nucleic acids, most dry biological specimens can be used for DNA analyses.

9. *Are there any special health and safety concerns related to storage of low-temperature collections?*

The primary health and safety concerns include:

- protection against biohazards
- exposure to high concentrations of carbon dioxide from dry ice
- skin lacerations from exploding ampoules or vials
- injuries resulting from exposure to very low temperatures
- displacement of oxygen caused by evaporation of liquid nitrogen in confined spaces

Consult your regional curator, an industrial hygienist, the Centers for Disease Control and Prevention (CDC), and the National Research Council of the National Academy of Sciences for information concerning the control of specific biohazards. Use face shields and long, insulated gloves when retrieving or replacing samples from the liquid phase of liquid nitrogen. Use long, insulated gloves when working with material in the vapor phase over liquid nitrogen. To protect against low oxygen environments when dealing with liquid nitrogen, equip all storage areas with oxygen monitors, and audible and visible alarms that alert staff to problems before they enter.

D. Maintenance of Low-temperature Collections

1. *Are there any special maintenance issues concerning storage of low-temperature collections?*

Low-Temperature Equipment

Specific maintenance concerns depend on the type of low-temperature equipment that you use. Be sure to discuss these issues with the equipment manufacturer and/or distributor.

Alarm systems are vital! Alarm systems that can warn of power or equipment failures at any time of the day or night are an important part of emergency preparedness for collections preserved at low temperatures. Many "freezer alarms" are designed to be audible or visible only to someone who is nearby when the alarm is triggered. Such alarms are useless 16 hours every weekday and on weekends. Install alarm systems that are monitored 24 hours a day by a UL-listed central station that will immediately notify staff in the event of a power or equipment failure.

Be sure that your park has emergency generators, backup freezers, and/or transportation and storage arrangements in place to move collections in the event of an emergency. This information should be included in your park's Emergency Operations Plan. Make sure that all staff are aware of these procedures and their individual responsibilities.

Staff Training

Be sure that **<u>all</u>** collection staff have been properly trained. The most common problem with the maintenance of low-temperature collections is lack of training. Without proper training, uninformed "good intentions" easily can cause specimen damage. For example, tissue samples and other frozen material may deteriorate if:

- freezers are left open
- specimens are transported from freezers to work areas without temperature protection
- specimens are used at room temperature
- you allow repeated cycles of freezing and warming, which will:
  - cause physical damage to the specimens
  - destroy the viability of cell suspensions when their cryoprotective fluids are allowed to warm to room temperature and then are re-frozen
- mishandled, causing:
  - breakage of vials or ampoules
  - contamination by contact with non-sterile surfaces

Any of these instances can destroy the utility of the material. For this reason, full documentation is required for every sample that has been compromised.

> ***Don't underestimate staff training needs, equipment needs, and operational costs for low-temperature storage. All of these requirements can be quite expensive. As with all other types of museum collections, if you cannot provide an appropriate level of care for them, you shouldn't attempt to maintain low-temperature collections at your park. Such collections would be better housed at an institution that specializes in research and care of such collections.***

2. *What is involved in salvage of low-temperature collections?*

Salvaging specimens after an emergency or a disaster:

- is usually concerned with stabilizing the specimens
- normally occurs within the first 48-hours after the collection or area is secured from the situation

This initial stabilization may involve some treatments. However, such treatments are not designed for restoration or repair, but to keep further damage at bay. **The primary concern for salvage of low-temperature collections is maintaining the proper preservation temperatures**.

Once most collections preserved at -80°C/-112°F or lower have been defrosted and allowed to remain at room temperatures for more than a few hours, they can be damaged by bacteriological and enzymatic processes. Tissue samples are especially susceptible to this type of damage. Freeze-dried materials may last much longer if kept in well-sealed containers and not exposed to moisture.

3. *What is the "best method" of salvage?*

Preplanning

As with all potential disasters and emergencies, preplanning is vital. An appropriate and effective emergency and salvage plan can spell the difference between an inconvenience and a major disaster. Be sure that your park's Emergency Operations Plan (EOP) includes relevant information concerning low-temperature collections if your park maintains such materials, **especially information related to any biohazards.**

- Ensure that all staff:
  - are aware of their emergency responsibilities
  - possess appropriate training
  - have full knowledge of all potential hazards (including biohazards)
  - possess proper personal protective equipment
- Conduct periodic reviews of the potential for biohazards for all low-temperature collections.
- Ensure that you implement adequate control measures for any type of emergency situation involving biohazards.
- To prevent release of hazardous organisms during salvage efforts, request assistance from the Centers for Disease Control and Prevention (CDC) and your state health department.
  - **Don't wait until an emergency to contact these organizations and agencies; by then it could be too late**.
  - Include the CDC and your state health department in emergency pre-planning efforts.
  - Be sure that your park's EOP contains all such relevant information.

Emergency Response

HUMAN SAFETY IS PARAMOUNT! Address all potential life safety issues before you attempt any collection salvage. Ensure that:

- All staff possess full knowledge of potential biohazards.
- Facilities are properly ventilated.
- All staff possess appropriate training and personal protective equipment (PPE).
- The park has procedures for the proper disposal of any biohazards, if portions of some samples are not salvageable.

Once it is safe to enter the area, you can start the salvage operation:

- Transfer frozen specimens to backup freezers or to temporary storage in containers with dry ice or liquid nitrogen. Store the specimen over the liquid, not in it, if possible.

- It may be possible to salvage some tissue samples by freeze-drying. This requires that you maintain sterile conditions throughout the freeze-drying process.

Notes:

- If samples from the same voucher specimens are available at other repositories, heroic salvage efforts may not be worthwhile.

- To be effective, all salvage operations should be targeted toward specimens whose importance has been determined in advance. These must be well marked and placed in storage so as to facilitate salvage activities.

> ***IMPORTANT: Be sure that your museum standard operating procedures include information pertaining to the proper disposal of any biohazards, if portions of some samples are not returned to storage after salvage or research use.***

4. *Where can I get salvage advice and assistance?*

Contact your regional/SO curator, the Senior Curator of Natural History, a natural history conservator, or staff from a nearby large natural history museum or university repository. You can also contact organizations such as:

The American Type Culture Collection
PO Box 1549
Manassas, Virginia 20108
(703) 365-2700
www.atcc.org

The American Type Culture Collection's staff have specialized expertise in dealing with collections preserved at low temperatures. It's a good idea to include this organization on your park's emergency salvage call list.

5. *How should I document emergency salvage efforts?*

Tissue samples are unlikely to survive for more than a few years at the storage temperatures commonly used for their preservation. As a result, management and care issues tend to overlap for documentation, as with emergency salvage. The primary concerns for collections care documentation are:

- How long has the specimen been in storage?

- How often and under what circumstances has the specimen been used?

Tracking this information will provide a reasonable schedule for disposal of specimens that have outlived their utility and therefore are no longer worth the costs of preservation.

During emergency salvage it is acceptable to simply document all immediate salvage steps, both in writing and in some type of imaging system. Record specific damage to particularly valuable specimens and specimens from other institutions, and note specific salvage methods that are used. Such data may be important for insurance purposes or essential in resolving liability issues.

SECTION VI: BIOLOGICAL MICROSCOPY COLLECTIONS

A. Overview

1. *Why are some specimens preserved as microscope preparations?*

Scientists preserve certain specimens as microscope preparations to preserve whole or partial organisms for:

- various kinds of microscopic examination
- some kinds of biochemical analyses, including extraction of DNA

Specimens prepared for microscopy may be found in all biological collections, but are most common in these collections:

- entomology
- mycology
- palynology
- parasitology

It's also common for microscopy collections to be ancillary to more traditional collections. Examples of such ancillary collections include:

- histology
- karyology
- hair samples
- scales
- some gentalia

> ***Be sure that microscope slides of parts tied to another specimen are given the same catalog number as the specimen. Link or otherwise cross-reference all data too.***

2. *How are specimens preserved as microscope preparations?*

There are several basic types of microscope preparations for biological specimens or specimen parts:

- mounted on flat, glass microscope slides of various sizes, usually with round, square, or oblong cover slips
- in micromounts (paperboard, aluminum, or glass slides that have one or more cavities for the specimen(s), usually with a polyester film or glass cover slip on one side or possibly on both sides
- mounted on stubs for scanning electron microscopy (SEM)
- removed from SEM stubs

- prepared as thin sections (cut into very thin slices) for subsequent examination under various levels of magnification

They can also include casts or other replicas of specimens or specimen parts (often used for SEM).

The specimens or specimen parts for microscopy may be:

- immersed in a natural or synthetic liquid or resinous mounting medium, often with a ringing medium (a material used around the margin of the cover slip to protect the specimen and the mounting medium)

- embedded in a solid or semi-solid wax or resin (often used for thin sections)

- dry-mounted without a mounting medium or coating, but often attached to the slide or stub with a small amount of an adhesive

- coated with various metallic (e.g., aluminum, gold, gold-palladium alloy) or non-metallic substances (such as carbon) to improve the image of the specimen/specimen part for SEM, and attached to a stub with a small amount of adhesive

Specimens prepared for microscope slides or for thin sections are often:

- **cleared** (treated with a enzymes or alkaline chemicals that render parts of the specimen transparent to light)

- **stained** (treated with dyes that differentially color various tissues to make them easily visible)

3. *What agents of deterioration affect microscopy collections?*

The impact of various agents of deterioration on microscopy collections is largely unknown. This topic has not yet been adequately examined in scientific studies. As a result, what little that is known comes from observations by collections staff. As with other biological collections, inappropriate temperature, contaminants, neglect, and inappropriate relative humidity levels undoubtedly pose risks to specimens preserved for microscopy. Be aware of the following risks:

Physical Forces

- Glass breakage: specimens mounted on glass substrates are prone to damage from breakage of the glass.

- Specimens mounted on scanning electron microscope stubs are small and usually very fragile.

- Gravity can damage many specimens in mounting media. This is because the media can flow over time and move specimens out from under protective cover slips.

Inappropriate Temperature

The precise temperatures that pose risks vary with the particular medium.

- The mounting, ringing, and sometimes the embedding media used in preparing specimens for microscopy can flow under the force of gravity at room temperatures.

- Elevated temperatures can increase the tendency for mounting media to flow.

- Temperatures at or below freezing may cause the mounting media to fracture.

Contaminants

In general, any gas phase material that can promote the oxidation of an organic substance is likely to cause damage to the synthetic and natural resins used in many mounting and ringing media. This includes peroxides emitted by wood and wood by-products, including many poor quality paper products.

Particulates may also damage specimens prepared for microscopy. This is because they can become absorbed into the surface of some resins, and obscure fine details in the specimens.

Inappropriate Relative Humidity

- Inappropriate relative humidity levels, whether very high or very low are thought to damage some ringing and mounting media.

- It is possible that very high relative humidity could cause some resins to become cloudy or moldy. This would obscure the specimen.

- Very low relative humidity might cause desiccation of mounting, ringing or embedding media. This can lead to physical damage to specimens.

Neglect

Neglect can result in damage to all collections, including microscopy preparations, and is characterized by:

- insufficient knowledge and skills

- failure to follow standards and/or provide adequate documentation

- apathy

- lack of adequate administrative support and funding

Common instances of neglect in microscopy collections include the failure to: link specimen parts to identifiable voucher specimens; provide backup systems to ensure appropriate environmental conditions; provide adequate storage to protect against contaminants.

Visible and UV Light

Microscopy preparations are generally kept in cabinets or boxes that protect them from light. However, during examination, they are apt to be exposed to very intense light. Prolonged exposure will fade the color in some stains. Light sources rich in ultraviolet radiation will not only increase this rate of fading, but may also promote the oxidation (aging, usually accompanied by yellowing) of many media used for embedding, mounting, or ringing.

Pests

Other than insects attracted to the adhesive on paper slide labels, insect and rodent pests are rarely, if ever, a threat to microscopy preparations.

Water

Prolonged immersion in water from a flood or leak will soften some natural and synthetic resins used as various media. Immersion might soften the adhesives used to mount specimens on SEM stubs. It also may damage the ink, paper, or adhesives used in labeling slides, resulting in loss of essential data.

Fire

Fire can cause slides to break, soften media, and may deposit soot on slides and specimens mounted on SEM stubs.

4. *Are there any health and safety concerns related to microscopy collections?*

Yes. Be aware of the following safety issues:

- Any risk from human pathogens that may be present in the specimens is usually greatly reduced if the specimens are mounted in some type of medium.
- The greatest human safety risk is the preparation of the media, due to the toxic nature of some of the chemicals used.
- Once the specimens have been prepared, the risks in subsequent handling of microscope preparations should be minimal. Even so, **always wear nitrile gloves when handling these preparations**.
- Any effort to remount slides or to remove the coatings from SEM specimens can pose significant risks.

There are hundreds of different chemicals and chemical mixtures that have been used in creating microscope preparations in the biological sciences. Some of these include:

- polychlorinated biphenyls (PCBs)
- cyanide solutions (used to remove SEM coatings)
- naphthalene resins or polymers mixed with toluene or other solvents
- organic stains and dyes, many of which are toxic
- chloral hydrate, the common component of most formulations of Hoyer's mounting media, and also an ingredient in many other

mounting media

- phenol
- thymol
- phenolic resins
- Eurparal, a commercial product containing paraldehyde
- cellulose nitrate (flammable)
- formaldehyde
- inorganic and organic acids
- natural plant resin (Canada balsam), which while not a threat in itself, is often thinned with phenol alcohol or xylene
- epoxy resins
- polystyrene resins
- phthalate plasticizers
- metal salts

Refer any interventive treatment of microscope preparations to a conservator or to a specialist in the preparation of the organisms. To ensure human safety and preservation of the specimen, be sure to acquire information on the preparation methods used for any specimens prepared for microscopy.

Of particular concern are:

- the use of toxic chemicals during preparation work
- the impact of toxic chemicals during subsequent handling of the specimens

Be sure to use appropriate engineering controls and personal protective equipment when examining microscope preparations.

B. Stabilization and Processing of Microscopy Collections

IMPORTANT NOTE: For purposes of these guidelines, it is assumed that the conditions of biological specimens and specimen parts intended for a microscopy collection will be under the control of research designs and material utilization. Therefore, the stabilization stage of

microscopy preservation is not a topic of this appendix and should not be part of the responsibility of the collection staff of the park.

Because of the risks to health and safety, as well as the expense of specialized equipment, no individual should be involved with stabilization for microscopy collections without first receiving specialized training that far surpasses any instructions and information provided herein.

1. *What are the primary agents of deterioration that affect microscopy collections?*

For most microscope preparations, there is a great risk of physical damage during processing. This results from direct damage to the specimen during preparation or by damage to the slide, stub, or other support for the specimen during subsequent use. Insufficient knowledge and skills (neglect) can render a specimen useless.

Priority 1	Priority 2	Priority 3
Neglect	Contaminants	Criminal Activity
Physical Forces	Fire	Pests
Inappropriate T°	Water	
Light/radiation		
Inappropriate RH		

Table T.12. Impact of agents of deterioration during processing of microscopy specimens.

2. *How should I handle specimens during processing?*

In addition to following the basic rules for handling collections (listed in Chapter 6), you also should be sure to:

- Keep material in environments that are as close as possible to those used for long-term storage.
- Carefully clean microscope slides of any immersion oils (oils used to enhance viewing when the slides are examined at high magnification) after use.

3. *How should I label microscope slides?*

Paper labels are often used on microscope slides. However, the choice of adhesives for these labels has caused many problems. You can purchase foil-backed, alkaline-buffered paper labels with a neutral acrylic adhesive from conservation suppliers. You can either cut them to fit the slides or other microscope mounts, or order them pre-cut to specifications.

Note: It's a good idea to also use a diamond-tipped scriber to mark the specimen number on glass slides in case the paper label is lost for any reason.

4. *What types of specimen containers should I use for microscopy preparations?*

The primary specimen container for microscopy preparations is usually a microscope slide, SEM stub, or a micromount. Glass slides, SEM stubs, and the new generation of micromounts made from good quality paper and polyethylene terephthalate film (Mylar D® or Melinex 516®) are excellent.

You can purchase various boxes that are available from archival and scientific supply firms to store slides, SEM stubs, and micromounts.

Use These Containers:	Don't Use These Containers:
• molded polypropylene • polyethylene • metal with powder coatings or uncoated aluminum	• wooden boxes • boxes of poor quality paper products • boxes with interiors of cork, acidic paper boards, and various plastics, such as polyvinyl chlorides (PVC) or polyurethane foam • unstable plastic containers (such as pill boxes or gel containers) • polystyrene (can only be used to house specimens that will not be used for biochemical analysis).

Table T.13. Recommended Storage for Microscopy Collections

5. *How should I pack and ship microscopy specimens for loans?*

Refer to the general packing and shipping guidelines listed in Chapter 6, "Handling, Packing, and Shipping Museum Objects." Be sure to also:

- Cushion specimens in their primary boxes to ensure that there is no movement of the slides, stubs, or micromounts during transport.
- Provide an appropriately sealed and cushioned container that will maintain a stable relative humidity for the specimens.
- Provide a legible and accurate mailing address.
- Provide appropriate invoices and shipping documentation, (including hazardous materials warning and endangered species documentation, where pertinent) to avoid unnecessary opening of the container.
- Provide instructions on how to properly open the container and remove the specimens.
- Provide instructions about the type of preservation to be used for the specimen.
- Comply with all laws and regulations regarding the shipment of

endangered species or hazardous materials.

6. *How should I document a specimen's condition during processing?*

For condition reports for microscope preparations, be sure to include information about the support as well as the specimen. For example, be sure to note:

- chipped, cracked, or broken slides or cover slips (slides with these conditions should not be shipped on loans until the specimens can be remounted properly)
- "infingering" of air into mounting media (usually evidenced by bubbles or voids in the media that extend from the edge of the cover slip inwards)
- flow of mounting media (usually indicated by a less-than-centered position of the specimen)
- cloudiness, discoloration, or crazing of mounting media
- voids or cracks in ringing media
- torn or distorted specimens
- faded stains or dyes
- discolored specimens
- dirt or debris on slides, stubs, or specimens
- mold

C. Storage of Microscopy Collections

1. *How should I organize the collection?*

The most important organization concern is to be sure that the arrangement allows access to selected specimens without jeopardizing other specimens. Organization may vary among disciplines and institutions. In most instances, the organization will be first by nature of preservation (slide or SEM stub), then by taxonomic group, and then catalog number, or simply by catalog number. This type of organization ensures that every specimen has a more-or-less designated and predictable location.

Once the collection is organized, be sure to:

- post adequate informational signage and floor plans throughout the area
- label all storage units with beginning & ending taxa and catalog numbers
- label each slide box or SEM stub box with beginning and ending catalog numbers

***Ease of access to a specimen with minimal handling of other specimen containers is the ultimate goal*.**

2. *What are the primary agents of deterioration for microscopy collections in storage?*

The agents of deterioration that pose the greatest risks in storage of microscope preparations are:

- **Neglect** may be evident through the improper use of storage equip-ment, careless handling, lack of familiarity with organization and arrangement systems, or disassociation of specimen and data.

- **Temperature increases** may cause some mounting media to flow, damaging specimens in the process. Exposure to freezing temper-atures may damage some mounting, ringing, and embedding media.

- **Inappropriate relative humidity (high)** can promote mold growth on some specimens, labels, and some media.

- **Low relative humidity** may promote embrittlement of some media, which can subsequently cause damage to specimens.

Priority 1	Priority 2	Priority 3
Neglect	Contaminants	Criminal Activity
Physical Forces	Fire	Pests
Inappropriate Temperature	Water	Light/UV radiation
Inappropriate RH		

Table T.14. Relationship of the agents of deterioration to the storage of microscope preparations.

3. *What are the appropriate environmental conditions for storage of microscopy collections?*

The optimum conditions for storage of microscope preparations have never been defined. However, reasonable conditions for long-term storage are:

- moderate temperatures, probably in the range of 16.6-22.2°C/62-72°F

- moderate relative humidity, probably in the range of 40-50%

4. *What types of storage equipment should I use?*

Store microscopy collections inside closed storage cabinets. Make sure that the cabinets are properly designed and used.

- All slides must be properly supported and positioned horizontally.

- The stubs should remain upright for SEM preparations.

- Microscope slides and micromounts should be stored flat. See Figure T.2., below.

    - Slides stored vertically will allow some mounting media to flow toward the edge of the cover slip. This often results in damage to the specimens.

- Similar harm can occur if specimens in micromounts are stored vertically. This allows the specimens to rest against the edge of a well or cavity, rather than in the center.

The Best Option:

Acquire steel storage cabinets designed to hold boxes of slides in the proper position so that the slides themselves are horizontal. These cabinets are available with smooth roller-bearing drawers that minimize shock and vibration and are the best available option for most microscopy preparations.

Another Option:

You also can use standard museum storage cabinets to house boxes of slides or micromounts in a horizontal position. If you use this option, be sure that the slides are positioned horizontal to the shelves and that the shelves are cushioned with polyethylene foam (such as Volara® Type A).

Figure T.2. Microscope slides stored horizontally in a slide cabinet. Photograph courtesy of the Entomology Research Museum, University of California, Riverside.

5. *Are there any common problems with microscopy collections?*

Yes. They include:

- deteriorating mounting, ringing, or embedding media
- researchers, who may:
  - wish to have an SEM coating removed from a specimen
  - leave a coating of immersion oils on a microscope slide
- a lack of training among staff and/or researchers

6. *What should I do if specimens need to be cleaned, remounted, or treated?*

Aside from gently wiping off immersion oil residues, leave any other cleaning of specimens prepared for microscopy to experts. The removal of SEM coatings can involve the use of extremely dangerous chemicals and is generally not recommended for any biological specimens.

Always refer to an experienced conservator concerning remounting specimens that exhibit deteriorating mounting or ringing media. Most of the common mounting, ringing, and embedding media in collections are not stable. They were chosen for their ability to enhance microscopic examinations, not for longevity. As a result, it is not unusual to see many thousands of deteriorating preparations in a single collection.

Some unpublished studies have been conducted, especially in parasitology collections, to replace deteriorating mounting media. Although there are some successes with certain mounting media, this remains a topic requiring additional research.

7. *What should I know about salvaging microscopy collections?*

Unfortunately, there are no data on the salvage of microscope preparations following disasters. Because most emergencies will result in water damage and subsequent high humidity, the most useful steps probably will involve achieving control over the environment, such as:

- exhausting moisture-laden air from the storage room and replacing it with conditioned (drier) air using specialized dehumidification equipment and fans (leaving specimens in containers and inside closed cabinets)
- air-drying, by removing specimens from containers and cabinets to an area with good ventilation and dehumidification
- arranging to transfer the collection to an environmentally controlled location for examination and possible treatment by experts

8. *Are there any health and safety issues that I should consider?*

As noted above, during any cleaning or remounting process, anyone handling specimens prepared for microscopy can be exposed repeatedly to small quantities of highly toxic materials. When working with such chemicals be sure that:

- all staff have received appropriate training
- all staff possess a full knowledge of the potential chemical hazards
- proper engineering controls are in place

- all staff have appropriate personal protective equipment
- all hazardous waste is properly disposed of

Remember: Human safety is paramount. Address all human safety issues prior to attempting collection salvage. Do not put staff at risk during emergency salvage efforts.

SECTION VII: GLOSSARY

Autolysis:	deterioration of a specimen's cells or tissues due to enzymatic digestion
Denaturant:	chemicals added to ethanol to make it unsuitable for human consumption
Ectoparasites:	a parasite that lives on the exterior of its "host" organism; examples include ticks, lice, and fleas
Exsiccati:	dried fungi specimens that have been identified and labeled
Fixation:	applying a substance that chemically bonds to a specimen to impede deterioration of the specimen by enzymatic digestion
Karyotypes:	a photograph or "map" of a cell's chromosomes
Larvae:	young of any insects that undergo a complete metamorphosis in the course of development into adults
Lipid:	organic fats, oils, and waxes contained in all life forms, which serve as cellular building blocks and provide energy
Lyophilization:	the process of freeze-drying a specimen
Maintenance:	preservation activities associated with corrective actions in response to a real or perceived problem
Periostracum:	the hard outer covering of a mollusk's shell
Processing:	preservation activities beyond stabilization that are related to making the specimen available for use
Pupae:	the metamorphic stage of an insect's life between larvae and adult
Stabilization:	preservation activities associated with halting active deterioration and minimizing the risk of loss, damage, or disorder as it relates to the specimen and its associated information
Storage:	preservation activities associated with housing of the specimens for the sake of access, organization, and protection
Type Specimen:	the specimen used to describe a new species for the first time; type specimens have extremely high scientific value; they are managed as NPS controlled museum property and must be afforded appropriate storage and security
Ultrastructure:	a detailed, complete view of a cell or tissue; visible only through electron microscopy

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SECTION IX: NON-NPS REPOSITORIES WITH SERVICEWIDE OR MULTI-REGIONAL AGREEMENTS TO HOUSE PARK BIOLOGICAL COLLECTIONS

The National Park Service seeks and maintains long-term agreements with qualified institutions to assist in managing park collections. These umbrella agreements establish terms and conditions under which park collections will be preserved, housed, managed, and accessed, as well as the responsibilities of all parties to the agreement.

The Chief Curator and the Associate Director, Natural Resources negotiate the agreements. Parks that place specimens with a cooperating repository must prepare a loan form documenting all specimens.

The contact information for institutions with Servicewide agreements to curate NPS natural science collections are as follows:

A. Low-Temperature Collections

The American Type Culture Collection
PO Box 1549
Manassas, Virginia 20108
(703) 365-2700
http://www.atcc.org/SpecialCollection/NPS.cfm

The American Type Culture Collection (ATCC) makes available for research microorganisms collected in parks. Park collections are on loan to ATCC under the terms of this agreement. Copies of the agreement, which includes related NPS procedures, are available from the Chief Curator at **ann_hitchcock@nps.gov**.

B. Other Specimens

At this time, the National Park Service has no Servicewide agreements with any non-NPS repositories for curation of NPS botanical, animal, fluid-preserved, or microscopy collections. Several parks, regions, and/or networks have agreements at that level; contact your regional/SO curator for additional information.

Appendix U: Curatorial Care of Paleontological and Geological Collections

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APPENDIX U: CURATORIAL CARE OF PALEONTOLOGICAL AND GEOLOGICAL COLLECTIONS

SECTION I: PALEONTOLOGICAL COLLECTIONS

A. Overview

1. *What information concerning paleontological collections will I find in this appendix?*

This appendix will:

- introduce you to the preventive conservation of paleontological specimens
- provide you with the information necessary for the day-to-day management of your fossil collections
- prepare you to carry out the duties associated with the long-term storage of a paleontological collection
- not teach you the skills of fossil preparation or conservation, as practiced by trained preparators and conservators

The appendix includes:

- a discussion of the characteristics of paleontological collections
- tools to help you recognize deterioration
- information about proper storage environments
- health and safety concerns
- a listing of NPS resources and outside organizations that can provide you with additional information

2. *Why is it important to practice preventive conservation with paleontological specimens?*

Fossils may seem to be "hard as stone." You might then assume that fossils require little monitoring or preventive conservation. This isn't the case. Paleontological collections do require an appropriate level of preventive conservation. Without routine monitoring (including good baseline information), the first indication of a problem is usually when a specimen starts to crumble. Often, little can be done at this point. The deterioration is irreversible. This results in:

- damage to the specimen
- the loss of scientific information.

3. *How can I learn about preventive conservation?*

Read about the agents of deterioration in Section E and the proper storage of paleontological specimens in Section F. See Chapter 3: Preservation: Getting Started, and Chapter 4: Museum Collections Environment, for a discussion on the agents of deterioration. For information on exhibits, refer to *Museum Handbook*, Part III (*MH-III*), Chapter 7: Using Museum Collections in Exhibits and NPS CD-ROM publication, *Exhibit Conservation Guidelines*, available from the Harpers Ferry Center (see

Section III. References).

4. *Where can I find the latest information on care of paleontological specimens?*

See Section III. References. This section lists contact information for NPS resources, professional organizations devoted to paleontology and geology, a glossary, Internet resources, and a bibliography.

B. Paleontological Collections and Fossils

1. *What are paleontological collections?*

Paleontology is the study of ancient life. It includes the five kingdoms of life (Monera, Protista, Fungi, Plantae, and Animalia), but most paleontological collections are identified as:

- vertebrates
- invertebrates
- plants

NPS paleontological collections cover the entire span of geological time and represent all five kingdoms of life.

2. *What is a fossil?*

A fossil is any evidence of past life preserved in the earth's crust. Fossils can be divided into two main categories:

- body fossils are the preserved remains of a plant or animal
- trace fossils are indications of past animal activity such as:
  - tracks
  - burrows
  - borings
  - gnaw or bite marks
  - coprolites (fossilized feces)

The study of trace fossils is called ichnology.

3. *Are there other types of fossils?*

Unaltered fossils result from burial conditions that prevent decomposition, such as low temperatures or low humidity. The classic example of an unaltered fossil is a frozen woolly mammoth. Bison and horses also have been found preserved in Alaskan permafrost. In arid environments, mummified specimens may be preserved in caves or in pack rat middens.

Unaltered fossils are extremely sensitive to changing environmental conditions. If you remove such specimens from the field, you must duplicate the field environment within the museum (temperature, humidity, etc.). This will ensure their continued preservation.

4. *How can I identify the fossils in my collection?*

Because a wide variety of plants and animals have fossilized, it's very difficult for anyone to identify every type of fossil. You can consult a paleontologist, but remember that even the experts can't identify all fossils. Most paleontologists specialize in one (or several) plant or animal group(s), fossils from a specific geologic time, or fossils in a given geographic area.

There are many "popular" guides to fossils, but you'll probably need to consult the scientific literature to confirm a fossil's identification.

C. Body Fossils

1. *How did body fossils develop?*

Body fossils formed when an organism died and was rapidly buried. This minimized decomposition and destruction from scavengers. (These fossils escaped the natural recycling process!)

Common burial sites include rivers and lakes or other areas of rapid sedimentation. The death either occurred there or the specimen was quickly transported to the area shortly after death. After burial, the specimen was protected from further transport, scavenging, and some types of decay. Eventually, minerals from ground water cemented the surrounding sediments. Body fossils were preserved by:

- permineralization
- replacement
- carbonization
- molds and casts
- nodules
- amber

> *Organisms, particularly vertebrates with a skeleton made of numerous parts often are represented by isolated bones and teeth. Individuals that died at the site of deposition and were quickly buried are more likely to be preserved as complete, well-preserved specimens.*
>
> *Organisms that were transported are more likely to be incomplete. They also may show signs of transport such as*

2. *What is Permineralization?*

Permineralization is what we commonly associate with fossils. "Petrified" or "fossilized" are words used to describe a fossil preserved this way. Minerals have been deposited in the specimen. It has "turned to stone." Even though minerals were deposited in the specimen, it still may retain part of its original organic structure. If you examine the fossil under a microscope at high magnification, you may see the original organic material with minerals deposited in spaces. The logs at Petrified Forest

National Park are a good example of permineralization.

3. *What is replacement?*

Replacement is similar to permineralization, except that none of the original specimen survived. Minerals *replaced* the original components. The replacement occurred at the molecular level, so all of the original details may be preserved.

4. *What is carbonization?*

Carbonized fossils are often preserved on the bedding planes of shale. These shales were often deposited in water that is low in oxygen. This permitted the preservation of soft-bodied organisms that would not otherwise have been preserved. Heat and pressure of sediments reduced the original plant or animal to a carbon film. Many types of plants and animals that would not normally be preserved in other environments are preserved this way. The best examples are fossil fish from the Green River Formation at Fossil Butte National Monument and the insects and leaves at Florissant Fossil Beds National Monument.

5. *What are molds and casts?*

- A mold formed when the original fossil dissolved. This left a cavity within the surrounding rock. This negative impression preserves the external details of the original specimen. One rare form of mold can form when lava flows around a living tree. Tree molds are found at Craters of the Moon, El Malpais, and Lava Beds National Monuments.
- A cast is formed if this negative impression later filled with sediment. The cast may preserve all of the external morphological details of the original specimen but lacks any microscopic details.
- A steinkern is another type of mold. Steinkerns can result when a shell (such as a snail or clam) filled with sediment and then dissolved. The hardened sediment preserves a reverse image of the formerly hollow inside of the shell.

6. *What are nodules?*

During preservation the original organic material may serve as a nucleus around which minerals are deposited. The minerals may be deposited in layers and eventually the original specimen becomes completely encased in a nodule. Depending on the types of minerals and environment of deposition, the original fossil may be preserved or only an impression may be left. Often the fossil can only be seen when the nodule is cracked open.

7. *What is amber?*

Amber is fossilized resin produced by various trees. Amber results from the evaporation of volatile organic compounds, and oxidation and polymerization. Amber often includes insects or other arthropods and pieces of plants.

D. Trace Fossils

1. *How did trace fossils form?*

Trace fossils result from an animal disturbing sediments (such as burrowing worms, a dinosaur leaving footprints in the mud, or depositing dung). These specimens are usually found in rock.

2. *How are trace fossils usually exhibited?*

Because there are no hard parts to be preserved, trace fossils are generally found as molds, casts, and infillings. They may be difficult to distinguish from the surrounding rock. Larger trace fossils, such as track sites of multiple tracks, are usually left *in-situ*.

Smaller specimens, such as large pieces of rock containing trace fossils, are sometimes transported to the visitor center for an outdoor display. Such specimens may not have been accessioned and cataloged into the museum collection. If not, you should accession and catalog them. Remember: If such fossils are displayed outdoors, or within reach of visitors, the specimens are subject to consumptive use, including wear, deterioration, vandalism, or environmental damage.

Trace fossils are not expendable. Take proper steps to ensure their long-term preservation. Even tracks displayed in a "structure" that prevents visitors from touching them can suffer deterioration, due to environmental fluctuations (Shelton et al, 1993). Ensure that all paleontological exhibits at your park have addressed preventive conservation issues to the extent possible. For additional information, refer to Section I. "Exhibiting Paleontological Specimen" below, and the National Park Service CD-ROM publication, *Exhibit Conservation Guidelines* (see Section III. References).

> *For a more conservation-friendly approach to outdoor exhibits, use reproductions of fossils for visitor center design elements and interpretive dinosaur "track walks."*

3. *What else should I know about trace fossils?*

Trace fossils generally require less preparation than body fossils. Different kinds of trace fossils may require different types of care. For example, caves in the Grand Canyon and the Guadalupe Mountains preserve unaltered dung of the extinct ground sloth. Dung of mammoths and extinct brush-ox are found in alcoves in Glen Canyon. This type of original organic material requires a different preservation approach than slabs of rock with tracks. Such specimens are extremely fragile and break easily; handle them with extreme care.

For storage of dung or other trace fossils of original organic material:

- Store the specimens in cabinets with low humidity.
- Protect the fossils from insect pests.

You may need to build a microclimate within the storage cabinet using desiccants (see *Conserve O Gram* [*COG*] 1/8 "Using Silica Gel in Microenvironments").

E. Factors that Contribute to Specimen Deterioration

1. *How can I minimize deterioration of paleontological specimens?*

Preservation of paleontological collections is a collaborative effort between field paleontologists, laboratory preparators, and curators. Everyone brings a different perspective and expertise to the matter. It's important to understand the concerns and needs of each professional when making decisions about how to care for the specimens.

Preservation begins in the field. You should:

- Work with the paleontologist who collects the specimen and the preparator who prepares it in the laboratory.
- Address conservation issues throughout the project.
- Ensure that everyone is using current conservation techniques. When in doubt, contact the NPS Geologic Research Division (GRD), Paleontology Program Coordinator or the Senior Curator of Natural History for advice.
- Make any necessary notations to catalog records or other documentation, such as:
  - conservation information from the paleontologist or preparator
  - type of glues and preservatives used to stabilize the fossil, both in the field and in the lab

  Note: Be sure to request <u>all</u> preparation data from the preparator. This includes a list of solvents and any other chemicals used on a specimen.
- Follow through with proper curatorial care and museum storage conditions.

2. *How can I identify active deterioration of a paleontological specimen in storage?*

The best way to detect active deterioration is careful, routine observation:

- Note the condition of specimens when they arrive for storage.
- Create a baseline photograph of every specimen upon arrival.
- Are there small bits of unattached bone associated with the specimen, or is the specimen completely intact?
- Is the specimen well supported and padded with an appropriate material such as polyethylene foam?
- Are some delicate parts prone to damage from gravity or mishandling?
- Previously attached bone or rock pieces under/around a specimen are a sign of deterioration and crumbling!

3. *How can I stop active deterioration of a specimen once it's started?*

First, determine the cause of the deterioration:

- Was the specimen mishandled?
- Are the environmental conditions in storage appropriate?
- Did the deterioration occur because of routine cleaning?
- Is the specimen properly supported (such as cavity packing using

polyethylene foam)?

- Is the specimen crumbing due to glue failure or a preservative used during preparation?

You should be able to eliminate some of these causes of deterioration. Others require the skills of an experienced paleontologist. When in doubt, contact the GRD Paleontology Program Coordinator or the Senior Curator of Natural History for advice. Be prepared to discuss:

- the type of paleontological specimen
- what formation it came from
- who collected it
- its present storage environment
- types of preservatives used

The GRD Paleontology Program Coordinator or the Senior Curator of Natural History may suggest that you contact the person who collected or prepared the specimen, or possibly a professional paleontologist who works at another park.

> *Do not undertake any type of conservation procedure on a specimen unless you are an experienced paleontologist with appropriate training.*

4. *What is pyrite disease?*

Pyrite disease is common in some fossil collections. Pyrite disease results from the oxidation of iron pyrite ("fool's gold") in a fossil. Pyrite can be present in bone, invertebrate shell, or plant fossils. The oxidation of pyrite will affect microcrystalline or framboidal pyrite far more than it does larger crystals. The resultant iron sulphate ($FeSO_4$) causes fossils to crumble as the crystals grow and expand. The damage is preventable, but irreversible once it begins.

5. *How can I protect my specimens from pyrite disease?*

Keep the fossils in a stable environment. Temperature and humidity fluctuations promote pyrite "rot." Consolidants, coatings, or adhesives can be of use only if they are introduced to the specimen under vacuum conditions to coat all surfaces internally and externally. Even carefully conserved specimens can explode spectacularly due to pyrite "rot" building up under the protective skin of preservatives.

The only way to slow the oxidation is to lower the relative humidity. If the reaction has not started, keep RH at 45% or lower; if it has started, reduce it to 30% or lower. It's possible to clean the reaction products off the surface of a specimen. This requires a very specific procedure and specialized training. Untrained personnel can easily inflict further damage to, or destroy the specimen.

Remember: Prevention is always better than treatment.

6. *What should I do if I*

Follow these steps:

notice pyrite disease?

- Remove the specimen from its storage environment to a work area.

- Brush away and discard the dry powdery reaction product with a dry, soft brush. If you're fortunate, you may need to do nothing more than rehouse the specimen at this point.

- If you can't keep the RH below 45%, and pyrite problems exist, you'll have to upgrade your storage environment. Possible solutions:

  – Build a microclimate within the storage cabinet using desiccants (see *COG* 1/8 "Using Silica Gel in Microenvironments").

  – Create an anoxic (low- or no-oxygen) environment (see *COG* 3/9 "Anoxic Microenvironments: A Treatment for Pest Control"). For a collection of known reactive specimens, anoxic film enclosures will help slow the reaction. But be aware that it never stops.

  – For a large collection, consider installing climate-control equipment for an entire case or cases.

7. *What else should I consider when confronting pyrite disease?*

Cross-Contamination

The pyrite oxidation reaction liberates sulfuric acid. This can damage other specimens and storage materials. Do not let other specimens touch infected ones. Also, encapsulate specimen labels (don't laminate them) so that they are not in direct contact with the specimen.

Susceptibility to pyrite disease

A fossil's susceptibility to pyrite disease may depend on the types of rock in which it was preserved. Holmberg (2000) noted a good example of this principle:

> Two fossil whale skeletons containing pyrite were obtained from Miocene clay. They were found in different states of preservation, though they had been stored under identical conditions. One of the skeletons was embedded primarily in light-colored clay dominated by the mineral smectite. (Smectite has a high absorption capability and low pH.) The other embedding medium consisted of other clay minerals, mainly kaolinite and illite. (These minerals have a neutral pH resulting from the presence of carbonates, which work as buffers.) Pyrite in the fossil bones from smectite-rich clays was more susceptible to deterioration after exposure than bone containing pyrite preserved in clays dominated by other clay minerals.

F. Handling and Storage of Paleontological Specimens

1. *What factors should I consider when accepting paleontological specimens for storage?*

Specimens collected and prepared by experienced paleontologists should arrive well supported, padded, and stable. The fossils can range in size from less than a millimeter to thousands of pounds. They are stored in many different ways, including:

- attached to the head of a pin inserted into a polyethylene stopper in a vial
- "cavity packed" in their own form-fitted plaster cradle
- in specimen trays of various sizes with polyethylene sheeting used as padding
- small microfossils mounted on special slides that can be stored in a slide cabinet

When accepting collections for storage, be sure to:

- inspect each specimen and make sure each one is well supported and padded
- ask the paleontologist about the materials used for padding:
  - Do they off gas?
  - Are they durable?
  - If the materials used to pad the specimens have loose threads or fibers, such as cotton and cheesecloth, these can easily snag on delicate parts of the fossil. Ask the paleontologist about other options.
- ask the paleontologist to demonstrate how the specimens should be handled.
- see how easily the specimens return to the storage container.
- note if the specimen label can be seen without handling the specimen. If not, discuss other options with the paleontologist.

Remember: Don't accept the specimens if they have not been properly prepared for storage. You can contact the GRD Paleontology Program Coordinator, the Senior Curator of Natural History, or your regional/SO curator for advice.

2. *How do I ensure the preservation of specimens in storage?*

Practice preventive conservation. Be sure to:

- House the specimens in a proper environment. See the CD-Rom publication *Exhibit Conservation Guidelines*, available from the Harpers Ferry Center.
- Use standard geology/paleontology cabinets for most specimens (see *Tools of the Trade* for additional information). As with other collections, you can store small specimens in trays, and cavity-pack them in polyethylene foam.
- For larger specimens, you'll probably need to use open shelf storage.
    - Very large specimens such as sections of petrified logs may require their own pallet for support.
    - To move these specimens, you'll need a pallet jack.
- Protect the collection from dust and excessive light levels.
- Always use proper handling techniques.
- Pad and support each specimen appropriately.
- Use appropriate storage equipment (see *Tools of the Trade*).

> *Improper storage and handling is a leading cause of specimen deterioration. Fossils are often more fragile than they appear, even if they are mostly rock. Many specimens cannot support their own weight, which makes them extremely vulnerable to improper handling.*

3. *What temperature and humidity levels should I maintain in storage?*

For a mixed paleontological collection, keep a stable:

- temperature between 59° and 77°F.
- relative humidity at 45-55%.

4. *Should I be concerned about light levels?*

There is no evidence that light levels (UV or visible) adversely affect fossils. However, they do affect glues and preservatives used to preserve specimens. So be sure to keep light levels as low as possible.

5. *What about dust?*

Airborne dust that settles on specimens is highly abrasive. Cleaning fossils, even with the gentlest techniques, causes damage too. To help eliminate dust in storage areas:

- keep circulating air as clean as possible (use primary and secondary filtering systems whenever possible)
- keep museum cabinet doors closed
- use dust covers on open rack shelving

- practice good housekeeping procedures:
  - consistently carry out all specified duties
  - use appropriate methods as approved by your park's Housekeeping Plan
  - use proper equipment, such as a HEPA vacuum cleaner and a HEPA air purifier (if needed). See *Tools of the Trade* for information concerning supplies and equipment.

6. *What is the proper way to handle paleontological specimens?*

Contrary to standard museum practice, DO NOT wear cotton gloves when handling paleontological specimens. Fossils may be slippery. You can easily drop a specimen. Use your clean, bare hands to assure a good grip.

Some specimens may have special handling requirements. Discuss these issues with the paleontologist who collected or prepared the specimens. Call the GRD Paleontology Program Coordinator or Senior Curator of Natural History if questions arise. Have enough staff available to assist with especially vulnerable or heavy specimens.

In general, handle specimens as you would other museum objects:

- Handle specimens as infrequently as possible.
- Handle each specimen as though it's irreplaceable and the most specimen valuable in the collection.
- Never smoke, eat, or drink while handling specimens.
- Don't wear anything that may damage the specimen. To avoid scratching and snagging surfaces, be careful of breast pocket contents, jewelry, watches, and belt buckles.
- Use only a pencil when examining specimens.
- Save all information that is associated with the specimen, such as tags and labels.
- Know the condition of a specimen before moving it.
- Lift and/or move the specimen by supporting its strongest structural component. Do not lift it by protruding parts, small bones, or attachments. These areas are weak.
- Use a utility cart with padded shelves and raised sides to transport specimens from one room, area, or building to another. See *Tools of the Trade* for additional information.
- Handle only one specimen at a time and use both hands. Use one hand for support and the other hand for balance.

- If you need to temporarily place a specimen in an unstable position for examination, be sure to support it. Exercise extreme caution in these situations. Return the specimen to a stable base or surface as soon as possible.

- Never hurry when handling specimens. Move slowly.

> *If part of a specimen is broken, reattach it as soon as possible to prevent it from becoming separated or lost.*

7. *Are there any other handling issues?*

Researchers will need to handle specimens in order to study them. But don't assume that every paleontologist who requests collections access is aware of all the proper handling procedures.

Be sure that you:

- know how to appropriately handle all of the specimens in your collection.

- thoroughly brief all collections users on proper specimen handling techniques. A good way to do this is to provide all researchers with a copy of your park's "Collections Handling Guidelines."

- require all collections users to sign a statement agreeing to abide by these and any other applicable rules, as a condition of access.

For additional information, refer to:

- Chapter 6: Figure 6.14, "Example of Written Handling Rules for NPS Collections" on page 6:30

- Appendix G: Figure G.6., "Sample Visitor Log" on page G:32, and Figure G.7., "Conditions for Access to Museum Collections" on page G:33

8. *What type of storage equipment should I use?*

Paleontological specimens can vary in size from less than a millimeter to thousands of pounds. You may need to use several different types of storage equipment. Options include:

Standard museum cabinets offer an added measure of security and environmental control. Use cabinets for all specimens small enough to fit safely in a drawer. Take care not to overload cabinets or drawers. As with other collections, use cavity packing and padding to keep specimens in place and eliminate any movement when someone opens a drawer. See Figure U.1. below.

Figure U.1. Cabinet storage of paleontological specimens. Individual specimens are cavity-packed in polyethylene foam-lined specimen trays. Courtesy of John Day Fossil Beds National Monument.

Open rack shelving with a steel frame and ¾ inch plywood shelves, will safely hold moderate size specimens. Use exterior grade plywood and completely seal all surfaces. You can use either a 2-component water-based epoxy paint or a water-based urethane sealant. Line each shelf with polyethylene foam and pad/support each specimen with foam or another suitable material. Another option is to use custom-made reinforced fiberglass jackets (see Figure U.2. below). This is the same principle as cavity packing, but on a much larger scale.

Figure U.2. Paleontological Specimen cradled in polyethylene foam-lined fiberglass jacket. Courtesy of John Day Fossil Beds National Monument.

Remember: Unsupported components of specimens can easily be damaged by gravity. Also, do not over-pack shelves. This will increase the likelihood of damage from handling.

Pallets are a safe technique to store large specimens. Some fossils may weigh thousands of pounds. Pallets are a relatively inexpensive alternative to specially designed, heavyweight shelves. You'll need a pallet jack, a front-end loader, or a forklift to transport these large specimens. Be sure to properly support all specimens, especially before moving them. You will also need to have room for the forks of a loader to get under the pallet without damaging the specimen or support structure. Discuss methods for moving the specimens with the paleontologist who collected or prepared them. You can also contact the GRD Paleontology Program Coordinator or the Senior Curator of Natural History for assistance.

9. *How should I label fossil specimens?*

Labeling Directly on Specimens
You can directly label bone, shell, and other specimens with a hard, fairly smooth surface. Be sure to use a stable acrylic resin (such as Acryloid B-72) to the seal the surface below the number. If you don't, inks can penetrate many surfaces. This can cause permanent alteration or require aggressive scraping to remove labeling errors. See *COG* 1/4 for additional information.

If the surface is too rough or irregular to permit writing directly on the specimen:

- Place a small square of enamel paint (usually white) on the specimen to provide a surface for the catalog number.
- Make sure the paint is completely dry before writing the catalog number.
- Keep the painted area as small as possible in order not to obscure anatomical details.

> *Be careful not to write the catalog number in a place that will obscure any critical anatomical details.*

Other Labeling Strategies
For other types of fossils (those that lack a hard surface), such as the trace fossils discussed above, you'll have to use different labeling methods. Such techniques are similar to those used for other types of collection materials, and may include:

- paper labels tied to the specimen with string
- catalog numbers written on storage containers (using permanent ink)
- labels attached to storage containers
- labels otherwise attached to the specimens in a non-permanent way, such as:
  - a twill tape label (with the catalog number written on the tape in permanent ink) tied to or gently, *but not tightly!* tied around the

specimen
- a similarly-used Tyvek® label

For additional labeling strategies, refer to Appendix T: Curatorial Care of Biological Collections, *COG* 1/4, your regional/SO curator, the NPS Geologic Research Division (GRD), Paleontology Program Coordinator or the Senior Curator of Natural History.

G. Health and Safety Issues

1. *What health and safety issues are related to paleontological specimens?*

Many fossils are oversized and heavy. Don't injure yourself or others. Always:

- Lift properly (use your legs to avoid back strain). For moving and lifting heavy specimens use a:

  – pallet jack

  – forklift

  – other equipment

  Note: Before using any such equipment, be sure that you and others are properly trained in its safe operation.

- Maintain a good grip; don't drop a specimen on someone's foot.

- Wear personal protective equipment (PPE), if needed, such as:

  - Hard hats when working beneath large full skeleton exhibits or whenever you're below overhead hazards that:

    a) might fall on you

    b) you might bump your head against.

  - Respirators if a specimen is being prepared. This will protect you from inhaling hazardous mineral dust.

    Note: Before you can use a respirator, you must first undergo a medical evaluation, formal training, and fit testing. For additional information concerning respirator use, see *COG* 2/13.

Be aware that some specimens may be radioactive.

2. *What types of specimens might be radioactive?*

Fossils from any of these deposits may be radioactive:

- The Morrison Formation and the Glenns Ferry Formation contain uranium.

- Black Shales can emit radon.

- Phosphate deposits like the Phosphoria Formation may include radon-producing minerals.

- Carnotite, which contains uranium, is often found in fossil logs in the Morrison Formation, present in many western parks.

- Sandstone often contains petrified trees and other fossils, which may be radioactive

Ask the collector if the specimens were checked for radioactivity. If not, you'll need to arrange for testing.

3. *How do I test fossils for radioactivity?*

Use a Geiger Counter or a Scintillator. If you do not have this equipment, perhaps a local university's geology department or the state geologist's office can help.

Another option is this low-cost test:

> Place a small piece of unexposed black and white photographic film in a lightproof sleeve and place the specimen on the sleeve. When the film is developed, any fogging will indicate that the specimen is radioactive (Blount, 1990).

4. *What is radon?*

Radon is a radioactive gas resulting from the radioactive decay of radium. Radium is formed by the decay of uranium. As radon decays, it forms radioactive by-products called progeny, decay products, or daughters. These radioactive by-products, if inhaled, can damage lung tissue and cause lung cancer.

Radon is invisible and odorless. It is a dangerous health hazard when it accumulates to high levels inside homes or other structures. Radon is deadly. Indoor radon exposure is estimated to be the second leading cause of lung cancer deaths each year in the United States.

> *If your park's collection contains radioactive fossils, be sure to monitor radon levels in specimen cabinets and storage areas. Your park safety officer can arrange for appropriate radon*

5. *How should I protect staff and the public from radioactive specimens?*

<u>Never</u> be careless around radioactive materials. Follow these general rules:

- Minimize all contact with radioactive specimens.

- Protect everyone from breathing in radon or inhaling or ingesting other radioactive particles.

  - Do not crush, saw, or grind radioactive minerals so as to cause their dust to enter the air, especially indoors.

- As with all museum specimens, never smoke, drink, or eat while handling radioactive minerals.

  Note: Inhalation of radon or breathing in or ingesting radioactive minerals or their dust is the most likely method of radiation exposure.

- Wear latex or nitrile gloves whenever handling radioactive specimens.

- Always wash your hands after handling radioactive minerals.

- Work to minimize deposits of radioactive particulates on staff:

  - Always wear a labcoat or other protective outer wear.

- Store all radioactive specimens appropriately. Post proper labels and signage (see Figure U.3. below). Make sure that everyone knows the nature of the materials that they might be handling. Be sure to provide everyone accessing these collections with guidance on handling, precautions, and procedures.

- You may need to store radioactive specimens in a special cabinet with a venting systems (see Figure U.3. below). Refer to *Conserve O Gram* 2/5 "Fossil Vertebrates as Radon Sources: Health Update" for additional information.

- If possible, store radioactive specimens in a separate, secured room that is vented to the outdoors.

Additional Important Safety Notes:

The general rules stated above are NOT adequate for specimens emitting high levels of radiation. Consult an industrial hygienist or the National Institute for Occupational Safety and Health (NIOSH) for assistance developing appropriate control measures.

Contact NIOSH by telephone at: (800) 356-4674 or on the web at: <http://www.cdc.gov/niosh/homepage.html>.

NIOSH also conducts Health Hazard Evaluations (HHE). A HHE is the study of a workplace to see if workers are exposed to hazardous materials or harmful conditions. To request a HHE, or for more information, see the HHE Program website at: <http://www.cdc.gov/niosh/hhe/default.html>. Requests for a HHE must be in writing. The HHE Program website includes an on-line HHE Request Form.

For additional information concerning a HHE relative to paleontological collections, refer to:

Jiggens, Timothy, E., John J. Cardarelli, and Steven H. Arhrenholz. *NIOSH Health Hazard Evaluation Report: Hagerman Fossil Beds National Monument, National Park Service, U.S. Department of the Interior, Hagerman, Idaho*, HETA 96-0264-2713. Cincinnati:

National Institute for Occupational Safety and Health, 1998. Available on the web at: < http://www.cdc.gov/niosh/hhe/reports/pdfs/1996-0264-2713.pdf > .

Remember:

- There is an inverse square relationship between the level of exposure to radiation from a mineral and the distance you are from it. Radiation levels drop off dramatically the farther you are from the specimen.

- If you plan to use shielding for a radioactive mineral on exhibit, build it using wood and/or acrylic (Plexiglas®).

Figure U.3. Radioactive Specimen Cabinet with Venting System and Safety Signage. Courtesy of Hagerman Fossil Beds National Monument.

> *Always store specimens appropriately and use proper labels and signage that identifies ALL hazardous materials.*

6. *Who should I consult for additional safety information?*

For more information, contact your park safety officer, park or regional public health specialist, regional/SO curator, GRD Paleontology Program Coordinator, or the Senior Curator of Natural History.

7. *Are there any special requirements for loans and shipping of radioactive specimens?*

Yes. The U.S. Department of Transportation (DOT) regulates commercial shipments of hazardous materials, including radioactive articles. These regulations also apply to naturally occurring radioactive substances, such as some fossils. All commercial shipments of radioactive specimens must be in accordance with the shielding, packaging, labeling, and other requirements noted in 49CFR173.426.

Note: The DOT regulations do not apply to shipments of specimens by

NPS (or other Federal) employees in a park (or other U.S. Government) vehicle.

> *If you plan to ship radioactive specimens via commercial carrier (Federal Express, UPS, or another firm), and no one at your park has received hazardous materials transportation training, you will need to hire a certified contractor to prepare any such shipments for commercial transport.*

H. Security and Fire Protection of Paleontological Collections

1. *What are the fire and security considerations for paleontological collections?*

Fire and Disasters. Fossils are just as susceptible to damage due to fire and natural disasters as many other collections. Be sure to:

- Always practice fire prevention, including staff training (such as annual extinguisher training).
- Have an appropriate level of fire protection in every structure where specimens are stored and exhibited, preferably a fire suppression system.
- Have an up-to-date Emergency Operations Plan (EOP). Your EOP should include information about the museum collection, including:
  - the special needs of all collections, including paleontological resources
  - all hazardous collections and materials, including locations and any special requirements

Security. Paleontological specimens have a very high monetary value. The market for fossils is similar to the art market. Collectors compete for prize fossils. There is a thriving black market for fossils. As a result, you may need to implement increased security protection for your collection. Discuss the options with your regional/SO curator, park protection staff, and/or regional law enforcement specialist.

Type specimens. Your collection may include type specimens. Type specimens represent a specimen upon which the description of a new type of fossil taxon is based. As such, it is the specimen to which all future specimens will be compared. As a result, they are priceless to science. Designate all type specimens as controlled property.

> ***Designate all type specimens, monetarily valuable specimens, and all exhibited fossils that are particularly vulnerable to damage or theft as controlled property.***

For additional information, contact your regional/SO curator, regional structural fire management officer, and regional law enforcement specialist.

2. *How can I determine if certain specimens are monetarily valuable?*

You don't have to hire a professional appraiser. You can obtain a good estimate of a fossil's current "market" value by consulting the web catalogs of commercial fossil dealers. When in doubt, contact the GRD Paleontology Program Coordinator or the Senior Curator of Natural History for advice.

Note: Once you've determined a specimen's market price, be sure to note that information on the ANCS+ catalog record.

3. *Are some specimens at increased risk of theft and/or vandalism?*

Yes. There is an ever-increasing commercial market for fossils. Some types of fossils tend to remain popular. These include trilobites, dinosaur parts, amber, and shark's teeth. Skulls, teeth, leaves, and insects can also command high prices.

As with any item, "commercial value" depends on rarity, quality and type of preservation, completeness, or a unique attribute. Some petrified wood can be considered gemstone quality.

Ultimately, all fossils can be potentially sold. Consider all paleontological resources as vulnerable.

4. *How should I best protect specimens at risk?*

Ensure that all museum areas have an appropriate level of security and fire protection. This includes:

- security, access, and other relevant standard operating procedures
- locks (which are always used) on doors, exhibit cases, and storage cabinets
- electronic fire and intrusion detection systems
- a fire suppression system
- fire prevention and fire and security awareness training for all staff
- an up-to-date Structural Fire Plan, Security Plan, and Emergency Operations Plan

These are just a few of the fire and security measures that your park should undertake. For additional information, consult your regional/SO curator and Chapter 9: Museum Collections Security and Fire Protection.

I. Exhibiting Paleontological Specimens

1. *What should I consider when planning or rehabilitating an exhibit?*

Fossils come in all shapes and sizes. First and foremost, consider how you'll place the specimen in the exhibit. Many specimens like shells are simple in shape and can support their own weight. For other specimens, you may have to construct special supports. You should also consider:

- Does the design specify placing the specimen on the floor of the case or attached to the wall?
- Is there a particular part of the fossil that should be clearly visible to illustrate a certain exhibit topic? The exhibit's theme may determine how to display the specimen.

- Does the fossil have projections that are easily broken or snapped off? If so, you may need to build a custom support to position the specimen for easy viewing.

- In some cases adhesives have been used to attach fossils to the exhibit case's interior.

  – Will the adhesive damage the fossil?

    Note: Only use adhesives to mount fossils inside exhibits as a last resort. Be sure to consult with an experienced conservator before using any adhesives.

  – Can it be easily removed or dissolved without damaging the fossil?

  – What is the life of the adhesive?

  – If it becomes dry and brittle, is there the potential for the specimen to fall and become broken?

2. *Are there any other exhibit planning considerations?*

Conservation: Be sure that your exhibits are conservation-conscious. Everyone on the planning team (including contractors) must understand that the preservation of the specimen is paramount.

Security: If you plan to mount a complete skeleton, it's critical that you construct a barrier. The barrier must effectively place the specimen beyond the reach of visitors. There is a strong tendency on the part of visitors to want to touch exhibited specimens. Some parts, such as ribs, can be easily grabbed and ends snapped off. Tails are likewise vulnerable.

Also, as noted above, commercially valuable fossils are at increased risk of theft. For unusual or rare specimens on exhibit, you may need to implement additional security measures. Discuss this matter with your regional/SO curator and park law enforcement staff.

3. *Are there any particular environmental concerns for specimens on exhibit?*

Yes. Fossils that retain their original organic constituents, particularly those from the Pleistocene (Ice Age), may be sensitive to high humidity or ultraviolet light. To ensure their preservation, keep relative humidity levels at 45-55% and eliminate all sources of UV light.

4. *Where can I obtain additional information about exhibiting paleontological specimens?*

Consult the following resources:

- Chapter 7: "Using Museum Collections in Exhibits," in the NPS *Museum Handbook*, Part III: Museum Collections Use

- *Exhibit Conservation Guidelines* CD-ROM, available from HFC.

See Section III. References, for ordering information

- NPS Geologic Research Division, Paleontology Program Coordinator
- NPS Senior Curator of Natural History
- your regional/SO curator
- conservation staff at the NPS Harpers Ferry Center (HFC)
- paleontological/curatorial staff at other NPS units
- paleontological, curatorial, and conservation staff at university, state, or regional natural history museums

J. Preparation and Conservation of Specimens

1. *What is preparation?*

Preparation is the process of readying a paleontological specimen for exhibit, curation, or research use. Preparation can include:

- Removing the rock matrix surrounding some fossils. This enables scientists to conduct a more detailed study of the specimen. It also minimizes the amount of dirt and rock introduced into a specimen cabinet.

  Note: Some specimens must be left in the rock matrix. This provides critical support and stability to the fossil. Also, it may be impossible to remove some fossils from the surrounding rock, such as a fossil leaf or insect.

- Re-attaching broken pieces.
- Applying some type of preservative or consolidant (also called a hardener). This can strengthen the specimen and make it more durable for handling.

2. *Who can I contact to prepare my park's fossil specimens?*

Consult a trained fossil preparator for assistance. Only an experienced fossil preparator (or a curator who has received such training from a preparator) should prepare specimens. If you do not possess such training, contact the NPS GRD Paleontology Program, your regional/SO curator, the Senior Curator of Natural History, or a local university's paleontology department for assistance, recommendations, and/or training opportunities.

Figure U.4. Preparator preparing a specimen. Courtesy of Hagerman Fossil Beds National Monument.

3. *Why should I contact a preparator?*

Fossils differ from other natural history collections; they often require preparation. This is an important intermediate step between their collection in the field and final cataloging and exhibit or storage for research. Only trained professionals should attempt to collect and prepare fossil material. Well-meaning but untrained individuals can easily damage or destroy a specimen. This can rob science of vital data and diminish its value for display, education, or future research.

Protect your collections from such avoidable damage:

- <u>Do not</u> attempt to work on fossils unless you are a trained preparator.

- <u>Do not</u> allow additional preparation to be done by anyone without proof of their qualifications.

- Always document all work done to a specimen and all preservatives used. Keep such documentation in the specimen's catalog folder, accession folder, and/or catalog record. Also, record treatments in the Conservation Module and/or the Preparation Treatment Module of ANCS+.

- Be sure that you obtain all associated records about any fossil deposited in your collection. These records should include all pertinent preparation data. In addition to the general provenience and catalog data required for ANCS+, you should maintain a complete preparation history for each specimen. This record should include:

  - any chemical used to clean the specimen

  - a list of all glues and fillers used

  - any comments the preparator may have recorded. Many labs that do fossil preparation maintain preparation record cards (see Figures U.5 and U.6).

Note: ANCS+ contains a Preparation Treatment Module.

> *Only trained professionals should attempt to collect and prepare fossil material. Unnecessary damage to the specimen can rob science of vital data and diminish its value for display, education, or future research.*

4. *Are there preparators that my park can hire under contract to prepare specimens?*

Yes. You can contract with a museum or university with a fossil preparation laboratory. Parks with paleontology as their focus may have a fully functioning preparation lab. If so, they may be able to assist your park to prepare specimens.

You can hire a trained private practice fossil preparator to work for your park under contract on a project. Check with the Paleontology Program Coordinator in the GRD, the Senior Curator of Natural History, or with paleontologists at other parks on how to proceed if extensive preparation of a specimen is required.

Another option is to use qualified volunteers. Perhaps your park can recruit a retired paleontologist, graduate student, or other individual with fossil preparation skills for the Volunteers-In-Parks (VIP) program. Contact the Paleontology Program Coordinator in the GRD or the Senior Curator of Natural History for assistance.

5. *Are there any special considerations regarding preparation?*

Yes. Fossils should be prepared as quickly as possible. Unprepared fossils are unusable for research, exhibit, or educational purposes and may introduce dust and dirt into storage cabinets.

Also, be aware that:

- Not all glues and consolidants are reversible. Those that contain either alcohol or acetone as a solvent may be reversible. Epoxy adhesives, sometimes used for larger specimens, may not be easily reversed.

- Certain preparation treatments can affect the utility of the specimen:

  - Some hardeners can affect chemical testing.

  - Organic hardeners may contaminate a specimen. This will prevent the use of the Carbon 14 dating technique (for specimens younger than 50,000 years).

  - The ability to extract fossil DNA or study isotopes (to determine the animal's diet) also can be impaired.

  Remember: Many specimens were initially prepared according to the original project's research design and/or the specimen's intended conservation) will not alter or compromise the specimen's relevance to such research or hinder future investigation.

> *It's impossible to predict what scientific sampling techniques will be developed in the future. Therefore, be sure to keep a permanent record of all chemical treatments applied to the specimen. It then may be possible to remove a chemical at some later date (in order to conduct further analysis).*

6. *How much time does it take to prepare a specimen?*

Preparation time depends on the fossil's size, type of preservation, and nature. Such work can be time consuming. A single dinosaur skeleton such as the *Allosaurus* found at Dinosaur National Monument required 7000 staff-hours of preparation over 4 years. Other types of fossils, such as plant impressions in rock, may require little to no preparation. Other fossils might be ready for exhibit or storage within a matter of days or weeks.

7. *Should I have damaged and/or incomplete specimens repaired?*

Yes, if you don't make necessary repairs, any broken parts can easily become separated and lost. Contact an experienced fossil preparator to repair any broken specimens as soon as possible.

8. *Are there occasions when I should not have a preparator repair a damaged specimen?*

Yes. In some cases repair may not be possible. Store the loose pieces in a properly labeled vial or other container. Depending on the nature of the break, the pieces may be too large or heavy to be reattached (like dinosaur bones).

On rare occasions, breakage may be seen as fortuitous: it permits examination of the specimen's internal structure. In these instances, you may decide against repairing the break.

9. *What's the best way to repair specimens?*

Avoid the need for repair. Make certain that specimens are not damaged in the first place:

- Consistently practice preventive conservation.
- Ensure that all collection users know and use proper handling techniques.

If breakage does occur, take time to determine the cause. Was the breakage:

- accidental (someone bumped into the specimen)?
- due to mishandling (the specimen was handled inappropriately)?
- a result of improper storage or exhibit design? Is the specimen:
  - not in a cradle or other support structure?
  - not properly supported or protected?
  - in a support that needs to be modified?

Remember: The best conservation approach is a preventive one. Once a specimen is broken, it is likely to be broken in the same spot again.

10. *What about applying protective coatings to specimens?*

As noted above, it's appropriate and sometimes necessary to use a hardener or consolidant to strengthen a fossil. This can ensure its long-term stability. However, while the anatomical features may be preserved, such treatments can impact research utility (Carbon 14 dating, isotope studies, or the extraction of DNA).

The best protection for fossils on a flat surface (such as leaves, insects and fish on the bedding plane of shale) is a thin clear coating.

For three-dimensional fossils such as bones, the preparator may need to saturate the specimen with a hardener in order to increase its structural integrity. In these cases, a thin covering may not suffice. If this protective shell is damaged or broken and the specimen lacks internal strength, the entire specimen may crumble.

Once again, you need to consider the intended use of the specimen (exhibit, research, or possibly both) before you make any treatment decisions.

11. *Who should clean specimens?*

To a paleontologist, the cleaning of fossils means the removal of the surrounding rock or matrix during the preparation process, as previously discussed. Once the specimens are prepared, they are subject to accumulating dust, just like other museum objects. To minimize dust on specimens:

- house small specimens in closed storage cabinets
- cover open shelving with plastic sheeting

These actions cannot eliminate all dust. Unless you conduct periodic housekeeping, dust and dirt will accumulate. Consult your park's Museum Housekeeping Plan to determine the frequency that fossil specimens should be periodically cleaned. If you do not have a Housekeeping Plan, or if it is out of date, consult your regional/SO curator, the GRD Paleontology Program Coordinator, the Senior Curator of Natural History, and/or a natural history conservator to establish recommended cleaning guidelines.

From time to time, you'll need to gently vacuum and/or use a soft brush to dust certain specimens. Many larger bones may have fragile processes that are easily broken or snapped. As with all other collections, be very careful whenever removing dust from

SECTION II: GEOLOGICAL COLLECTIONS

A. Overview

1. *What information concerning geological collections will I find in this appendix?*

In this section of the appendix you will find:

- a discussion of the characteristics of geological collections
- guidelines and resources to aid in identifying different types of geological specimens
- tools for recognizing deterioration
- information about proper storage environments
- health and safety concerns
- additional sources of information

2. *Why is it important to practice preventive conservation with geological specimens?*

The general impression that "rocks" are inert, strong, and durable is false. Many geological specimens can be:

- fragile
- chemically active
- easily damaged

3. *How do I learn about preventive conservation?*

Read about the agents of deterioration in Section C and the proper storage of specimens in Section D. See Chapter 3: Preservation: Getting Started, and Chapter 4: Museum Collections Environment, for a discussion on the agents of deterioration. Also refer to *Museum Handbook*, Part III (*MH-III*), Chapter 7: Using Museum Collections in Exhibits.

4. *Where can I find the latest information on care of geological specimens?*

Several professional organizations focus on the care of natural history collections, including geological specimens. Such organizations' publications often contain articles on the care of geological specimens. Examples include:

- The Society for the Preservation of Natural History Collections (SPNHC) publishes *Collection Forum*
- The Geological Curators' Group in England publishes a newsletter, *The Coprolite* and a technical series, *The Geological Curator*.

Refer to Section III of this appendix for additional information.

B. Geological Collections

1. *What types of geological specimens are generally found in park collections?*

Since all parks have geology, there's always the potential for geological specimens in a park's collection. Geological collections can include:

- rocks (igneous, sedimentary, and metamorphic)
- mineral specimens (including crystals)
- ores
- cave formations and minerals
- samples of geological formations
- soils
- building stone samples

2. *What is a rock?*

A rock is an aggregate of one or more minerals or a body of undifferentiated mineral matter. Rocks are divided into three different types:

- Igneous Rocks solidified from molten or partly molten material. Examples include:
  - basalt lava flows found at Hawaii Volcanoes, Craters of the Moon, El Malpais, Lava Beds, and Devil's Postpile
  - lava bombs (features associated with lava flows)
  - granite at Yosemite
  - obsidian at Yellowstone
- Sedimentary Rocks result from the consolidation of loose sediment that has accumulated in layers. Sedimentary rocks are divided into:
  - clastic rocks formed by the mechanical breakdown of fragments of older rock, such as sands and shales
  - chemical rock formed by the precipitation of minerals such as gypsum or limestone from solution
  - organic rock formed by the secretions of plants or animals or accumulations of organic matter such as coal or shell fragments called coquina used in the construction of the fort at Castillo de San Marcos

  Examples include sandstones in Glen Canyon, limestones at Guadalupe Mountains, dolomites, shales, clays like bentonite at Bighorn Canyon and Cuyahoga Valley, and coal at New River Gorge.

Some parks have loose sands and sand dunes. Samples of sand may be collected and placed in the park collection such as the gypsum sand at White Sands or silica sands at Great Sand Dunes or Sleeping Bear Dunes.

- Metamorphic Rocks are modifided pre-existing rocks. They undergo metamorphosis in response to marked changes in temperature, pressure, shearing stress, and chemical environment. Examples include:

  – gneiss and schist in the Grand Canyon

  – marble at Oregon Caves, Great Basin, and Mojave

3. *What is a mineral?*

Characteristics of minerals include:

- naturally occurring inorganic element or compound
- orderly internal structure
- characteristic chemical composition
- crystal form
- physical properties

Examples include pyrite (also known as "Fools Gold") from Prince William Forest and borate minerals from Death Valley. Today, over 4,200 different types of minerals are known to science.

4. *What are ores?*

Ores are the natural material from which a mineral of economic value can be extracted at a profit. In general, the term is used to refer to metal-bearing rock. Many parks have historic mines and samples of ores from these mines may be present in the park collection. Copper ores are known from Delaware Water Gap, Keweenaw, and Wrangell-St. Elias. Prince William Forest has a historic pyrite mine.

5. *Why do some collections include cave formations?*

Even though NPS policy is to ensure that all cave minerals and formations are managed in place, many parks with caves will have examples of cave formations (stalactites, stalagmites, cave pearls) or minerals in their collections. Often these specimens were salvaged during trail construction or other similar activities.

Most cave formations are composed of calcium carbonate but may be formed by either calcite (more commonly) or aragonite (rarer) crystals. Cave formations composed of aragonite are more fragile and subject to damage. There are a variety of cave minerals. Depending on their chemical composition, they may require special conditions for their preservation.

Cave formations and minerals are in the collections at Mammoth Cave and Carlsbad Caverns. A good reference for helping with the identification of cave formations and minerals is *Cave Minerals of the World* by Carol Hill and Paolo Forti (1997).

6. *Why do some collections contain quarried stone?*

Some parks like Harpers Ferry and Acadia have historic stone quarries that were used in building construction. Examples of the rock types from these quarries may be placed in the park collection. Other parks, such as Alibates Flint Quarries, may have prehistoric quarries where chert or flint was mined by Native Americans or the catlinite quarry at Pipestone. Reference samples of this rock material may be placed in park collections.

7. *How do I identify the different types of specimens?*

You may need a geologist or mineralogist to help you identify a particular mineral, but the standard reference for mineral identification is: *Dana's New Mineralogy: The System of Mineralogy of James Dwight Dana and Edward Salisbury Dana* by Richard V. Gaines et. al. (1997).

C. Factors That Contribute to Specimen Deterioration

1. *What agents of deterioration affect geological specimens?*

Deterioration can result from:

- Physical damage resulting from improper storage or handling
- Chemical changes, depending on the chemical composition of the specimen and the environment in which it is stored.

2. *How can I identify active deterioration?*

Look for:

- physical changes in the specimen, such as changes in size or shape
- “growth” of new minerals on the surface
- spalling
- breakage
- powdery residues
- change in color
- change in translucency
- swelling
- uncharacteristic odors

> *Also, look for darkening, embrittlement, and shrinkage of old coatings and adhesives. These can be very damaging to geological collections.*

3. *How can I protect my specimens from deterioration?*

The best approach is to maintain:

- proper storage
- climate control systems
- an active environmental and Integrated Pest Management (IPM) monitoring program

Begin at the microenvironmental level and work outward. If you have a limited budget, you may have to start small. First, invest in archival-quality enclosures and trays. If you have additional funding available, perhaps you can purchase new storage cabinets. The perfect scenario, if funding is appropriate is:

- a heating and cooling system that maintains appropriate environmental conditions facility-wide
- proper storage cabinets
- archival-quality enclosures and trays

No matter what your park can afford, be sure to take the time to maintain accurate records of your museum facilities' environments, including:

- temperature
- relative humidity
- visible and UV light
- IPM

4. *What is the best relative humidity and temperature for my specimens?*

Maintain a stable storage environment:

- temperature of 59° - 77°F
- relative humidity at 45-55%

Relative humidity may not be a critical factor in the storage of most geological specimens. However, some anhydrous (water-free) minerals will absorb moisture from the atmosphere. Store these specimens in a cabinet or room that is maintained in a low humidity environment. You may need to place trays or packages of silica gel or some other desiccant in the cabinet to help reduce humidity levels. Conduct regular monitoring. Remember to regularly check and recondition or replace the silica gel, as needed. For additional information, see *COG*s 1/8 "Using Silica Gel in Microenvironments" and 2/15 "Cobalt Indicating Silica Gel Health and Safety Update."

5. *Should I be concerned about atmospheric pollution?*

Yes. Both gaseous and particulate pollutants can accelerate deterioration, especially if they are acidic or caustic. Many minerals, including calcium carbonate, are highly susceptible to reactions with acids. Particulates can lodge on surfaces and surface coatings, which you'll need to clean off (this is never a risk-free procedure [see below]).

In addition, some geological specimens are themselves sources of gaseous pollutants:

- mercury vapor is readily liberated from cinnabar
- a number of uranium-series minerals release radon
- asbestos-containing minerals may break down enough to release inhalable particles

> *Monitor all specimens known to contain hazardous substances. Seek expert advice. Remember that such items may require separate storage (or transfer to a more appropriate facility).*

6. *Does cleaning contribute to deterioration?*

Yes. Both custodial (room-level) cleaning and specimen (preparation-level) cleaning can expose the specimen to rough handling and caustic materials. Maintenance chemicals that can cause severe damage to specimens include: chlorine bleach, ammonia, other cleaning agents, waxes, and related materials. Whenever possible, utilize nontoxic cleaning alternatives (see *COG* 2/21 "Safer Cleaning Alternatives for the Museum and Visitor Center"). Carelessness and improper techniques can cause damage through vibration and impact.

Remember that specimen cleaning is an irreversible process in many instances. Cleaning can cause loss of:

- matrix
- parts of the actual specimen
- associated trace material

Don't clean a specimen just to keep up a routine. Ask yourself if cleaning really is necessary. If not, don't do it.

7. *Are there any other deterioration concerns?*

Some sulphate-based cave minerals such as selenite (calcium sulphate) and epsomite (magnesium sulphate) readily absorb water from the atmosphere and can disintegrate. To prevent deterioration, any mineral that can potentially absorb water must be stored in a low humidity environment. For additional information, see Holmberg (2000) and Jerz (2000), noted in the bibliography.

D. Handling and Storage of Geological Collections

1. *What do I need to know about handling specimens?*

Weight
Depending on the size of the specimen, weight can be a major factor. You may need to access heavily loaded cabinet drawers. Be sure not to overload drawers; consult the manufacturer's recommended weight loads and do not exceed them. Always use extreme caution; due to its weight, if a specimen

shifts it may cause the drawer to tip.

Transport

Never carry specimens to a table or other area. Use a wheeled, sturdy cart with a padded surface to transport specimens between storage cabinets and exhibit or research areas.

Handling

Protect the specimen. Practice limited handling. Specimens should spend as little time outside storage cabinets or exhibit cases as possible. Only handle specimens on or over a work surface.

Gloves

Contrary to standard handling practice with other museum collections, DO NOT wear cotton gloves when handling geology specimens. The specimen may be slippery, and you could easily drop it. Use your clean, bare hands to assure a good grip.

Lab Coats and Other Protective Outerwear

Wear a labcoat or other type of protective outer garment when handling collections. This will help to minimize deposits of particulates and dirt on your clothing. Wearing a labcoat also helps to protect the specimen from damage due to contact with badges, jewelry, and belt buckles. Another option is to wear a Tyvek® "jumpsuit," sold in paint stores.

2. *How should I store specimens?*

Use standard geology cabinets for most specimens (see *Tools of the Trade* for additional information). As with other collection items, you can store small specimens in trays, cavity-packed in polyethylene foam. This is a good idea for items that may require more frequent access and transport for research purposes.

For larger specimens, you'll probably need to use open shelf storage. Very large specimens such as pieces of building stone or larger ore samples may require their own pallet for support. To move these specimens, you'll need a pallet jack.

Since a specimen may spend well over 95% of time in storage, proper storage systems are a wise long-term investment. As with all collections, inappropriate storage materials put the specimen at risk. Always use acid-free, inert storage materials and housings. Cabinetry should be of steel construction, with high gloss, epoxy powder coatings.

3. *What additional protection do geological specimens need in storage?*

- In general, don't leave a specimen on a bare surface exposed to the open lab conditions.
- Make sure that specimens (particularly large ones) are not supporting their weight on appendages, attachments, or other weak areas.
- Pad surfaces with inert closed-cell polyethylene foam (such as Volara® or Plastizote®).
- Use closed storage wherever possible.
- For large specimens, use custom-made reinforced fiberglass jackets (the same principle as cavity packing, but on a much larger scale).

This facilitates open shelf storage.

- Place smaller specimens in specimen trays.

Protection from high and/or fluctuating temperature and relative humidity are important for all specimens. Other threats include:

- UV exposure
- water
- fire
- theft and vandalism
- related factors

E. Health and Safety Issues

1. *What health and safety issues are related to geological specimens?*

Some minerals may contain elements that are toxic. The most common ones are:

- Aluminum
- Antimony
- Arsenic
- Beryllium
- Bismuth
- Bromine
- Cadmium
- Lead
- Mercury
- Selenium
- Thallium
- Uranium

Handle all of these minerals with care.

Many parks have historic mines that extracted minerals that may be considered hazardous to human health. Some examples include:

- Cinnabar, which is a mercury sulfide (HgS) mineral.

- Arsenopyrite (FeAsS), which includes arsenic.
- Asbestos, which is a variety of fibrous, nonflammable minerals with flexibility and high tensile strength. Asbestos includes minerals such as chrysotile, amphibole, and crocidolite.

Specimens of these economically important minerals related to historical mining in the parks may be present in park collections and used in park exhibits.

2. *How can I best protect the health of staff and researchers using potentially toxic collections?*

Make sure that a mineral has been properly identified and that you are aware of its chemical composition. If a mineral does contain potentially toxic elements, always wear neoprene gloves when handling it. Be sure to wash your hands after you finish handling any other minerals with bare hands, as a precaution. As with all collections, never allow food or drink around mineral specimens.

> *Always wear neoprene gloves when handling minerals that contain potentially toxic elements.*

3. *What other safety concerns should I consider?*

Take into account the following:

Heavy Metals
Heavy metals cause problems by displacing or replacing related minerals that are required for essential body functions. For example, cadmium can replace zinc, and lead displaces calcium. When this happens, cadmium or lead is stored in the bones or other tissues and becomes difficult to remove from the body. At the same time, the important functions of the minerals that are replaced cannot be carried out.

Toxic Gases
Some minerals may release gases or vapors. In a closed specimen cabinet, this can generate high concentrations of toxic gases. These can include:

- acidic vapors (thought to be primarily carboxylic acid vapors)
- mercury vapor
- sulfur dioxide
- hydrogen sulfide, the gas that tarnishes silver

Label all cabinets housing such minerals with the appropriate National Fire Protection Association (NFPA) Hazard Warning Symbol. This will ensure that all personnel (staff, visitors, and emergency workers) are aware of these potential hazards.

Note: See Chapter 11: Curatorial Health and Safety, Figure 11:4 on page 11:45, for an example of the NFPA Hazard Warning Symbol System.

Also, be sure to note the presence of these minerals in relevant emergency planning documents (such as your Museum Emergency Operations Plan [MEOP]) and brief all first responders on their presence and locations.

Mineral Dust

Inhaling mineral dust may be more of a hazard than handling the specimen. The amount of dust depends on how friable the specimen is and how it is handled. For example, handling may release asbestos fibers. Although mineral dust may not be a primary problem in museum collections, at times it may be important to use a good quality respirator when handling specimens, especially if they are being cut or trimmed.

Note: Before you can use a respirator, you must first undergo a medical evaluation, formal training, and fit testing. For additional information concerning respirator use, see *COG* 2/13.

4. *Could some specimens be radioactive?*

Yes. Many parks contain radioactive minerals or ores. Some examples of common radioactive minerals include:

- Autunite (hydrated calcium uranium phosphate)
- Brannerite (uranium titanate)
- Carnotite (potassium uranium vanadate)
- Monazite (a mixed rare earth and thorium phosphate)
- Thorianite (thorium dioxide)
- Uraninite (uranium dioxide)

The vast majority of the radioactive content in minerals or ores is either uranium-238 or thorium-232, although other radioactive elements may be present. Uranium minerals are found in Blue Ridge Parkway, and many western parks such as Canyonlands have abandoned uranium mines, so it is possible that uranium minerals will be present in park collections.

5. *What terms should I know that are relative to radioactivity?*

Radioactivity is the spontaneous release of particles and energy by the nucleus of an unstable atom. This is part of a natural decay process in which an unstable element is transformed into a stable element, such as uranium-238 becoming lead-206. There may be a number of intermediate stages or daughter elements.

Radiation in the common sense refers to *ionizing radiation*: a term for invisible particles or waves with enough energy to strip electrons from atoms, causing chemical changes. The three basic types of natural radiation are alpha, beta, and gamma. There are also X-rays and neutrons.

An alpha particle is composed of two protons and two neutrons-essentially it's a helium nucleus, an ionized helium atom (a helium atom devoid of its electrons and having a net charge of +2). Alpha particles are comparatively large and cannot penetrate much more than a sheet of paper or a few inches of air. However, they are extremely potent ionizing agents because they interact with plenty of matter in their [short] path.

A beta particle (actually a "beta-minus" particle, since it has a charge of -1) is a stray electron originating from an atom's nucleus as the result of neutron breakdown. "Beta-plus" particles are positrons or "positive electrons," something seldom encountered in nature. Beta radiation can be stopped by a few centimeters of wood, plastic, or glass. A few millimeters of aluminum will also stop most beta particles.

Note: Do not use lead or other highly dense materials to shield from beta radiation. Certain types of shielding can actually be worse than none. Lead and other dense metals (including tungsten) can emit X-rays when exposed to beta particles such as those thrown out by the natural decay products of U-238 and Th-232. This phenomenon is called *bremsstrahlung*. If the lead is thick enough, the X-rays won't get out the other side of it. Nevertheless, if you're going to use shielding for a mineral display, it's best to make it out of wood or acrylic (Plexiglas®).

Gamma radiation is composed of high-energy photons (invisible light; electromagnetic waves). It has no charge, but its high energy means that it can cause ionization. Fortunately, gamma rays move so fast and have such energy that they often pass right through matter without interacting at all.

6. *How can I determine if specimens are radioactive?*

It's vital to correctly identify a mineral's composition. If you have a specimen that you suspect is radioactive, confirm its identification with a trained mineralogist. Most university geology departments include a mineralogist on the faculty. The crystal structure, color, and other physical properties may permit a quick identification. If a Geiger counter or scintillator is available, you can use it to detect the presence of radioactive particles. If you do not have access to a Geiger counter or a mineralogist, use the procedure to detect radioactivity in specimens proposed by Blount (1990):

> Place the specimen on a small piece of unexposed black-and-white photographic film in a lightproof sleeve and then have it developed to check for fogging.

7. *What is radon?*

Radon is a naturally occurring radioactive gas that is colorless, odorless, tasteless, and chemically inert. It is found in soils, rock, and water throughout the U.S. Because radon occurs throughout the nation, it's possible that specimens in your collection emit radon. Radon has a half-life of only 3.5 days, but when a radon-emitting sample is stored in a closed specimen cabinet, radon levels may come to equilibrium over time. The actual amount of radon will depend on the number, volume and chemical composition of the radioactive mineral specimens stored in the cabinet.

30 CFR, Part 57, Subpart D regulates occupational levels of alpha and gamma radiation in underground uranium mines. Occupational yearly exposure per individual shall not exceed 4 WLM (working level month) alpha or 5 REM (Roentgen Equivalent Man = the amount of ionizing radiation that when absorbed by a person is equivalent to one roentgen or x-ray or gamma radiation) gamma. While these levels may not exist in most park collections, they do provide a standard by which staff safety can be measured. Generally the EPA typically recommends 10% of occupational limits for the general public.

If you have concerns regarding occupational exposure to radioactive specimens in your park's collection, consult with an industrial hygienist, NIOSH, and/or the U.S. Public Health Service specialist duty-stationed in your park or region.

8. *How should I protect staff and the public from radioactive specimens?*

Never be careless around radioactive materials. Follow these general rules:

- Minimize all contact with radioactive specimens.
- Protect everyone from breathing in radon or inhaling or ingesting other radioactive particles.
  - Do not crush, saw, or grind radioactive minerals so as to cause their dust to enter the air, especially indoors.
  - As with all museum specimens, never smoke, drink, or eat while handling radioactive minerals.

  Note: Inhalation of radon or breathing in or ingesting radioactive minerals or their dust is the most likely method of radiation exposure.
- Wear latex or nitrile gloves whenever handling radioactive specimens.
- Always wash your hands after handling radioactive minerals.
- Work to minimize deposits of radioactive particulates on staff:
  - Always wear a labcoat or other protective outer wear.
- Store all radioactive specimens appropriately. Post proper labels and signage (see Figure U.3. above). Make sure that everyone knows the nature of the materials that they might be handling. Be sure to provide everyone accessing these collections with guidance on handling, precautions, and procedures.
- You may need to store radioactive specimens in a special cabinet with a venting systems (see Figure U.3.). Refer to *Conserve O Gram* 2/5 "Fossil Vertebrates as Radon Sources: Health Update" for additional information.
- If possible, store radioactive specimens in a separate, secured room that is vented to the outdoors.

Additional Important Safety Notes:

The general rules stated above are NOT adequate for specimens emitting high levels of radiation. Consult an industrial hygienist or the National Institute for Occupational Safety and Health (NIOSH) for assistance developing appropriate control measures.

Contact NIOSH by telephone at: (800) 356-4674 or on the web at: <http://www.cdc.gov/niosh/homepage.html>.

NIOSH also conducts Health Hazard Evaluations (HHE). A HHE is the study of a workplace to see if workers are exposed to hazardous materials or harmful conditions. To request a HHE, or for more information, see the HHE Program website at: <http://www.cdc.gov/niosh/hhe/default.html>.

Requests for a HHE must be in writing. The HHE Program website includes an on-line HHE Request Form.

For additional information concerning a HHE relative to geological and paleontological collections, refer to:

> Jiggens, Timothy, E., John J. Cardarelli, and Steven H. Arhrenholz. *NIOSH Health Hazard Evaluation Report: Hagerman Fossil Beds National Monument, National Park Service, U.S. Department of the Interior, Hagerman, Idaho*, HETA 96-0264-2713. Cincinnati: National Institute for Occupational Safety and Health, 1998. Available on the web at: <http://www.cdc.gov/niosh/hhe/reports/pdfs/1996-0264-2713.pdf>.

Remember:

- There is an inverse square relationship between the level of exposure to radiation from a mineral and the distance you are from it. Radiation levels drop off dramatically the farther you are from the specimen.

- If you're going to use shielding for a radioactive mineral on exhibit, it's best to make it out of wood and/or acrylic (Plexiglas®).

> *Always store specimens appropriately and use proper labels and signage that identifies ALL hazardous materials*

9. *Are there any other human health risks associated with geological specimens?*

Some specimens of rocks or minerals are large and difficult to move. You may want to store such specimens on pallets and use a pallet jack or forklift to move them. Always follow proper safety precautions. Use appropriate techniques and equipment.

F. Security Concerns

1. *Are some types of specimens at increased risk of theft and/or vandalism?*

Gold nuggets and silver specimens have commercial value; store them in a safe. Other minerals may be vulnerable, including:

- certain rare and valuable mineral specimens
- minerals with good crystal structure
- some minerals of gemstone quality
- small specimens, which are easier for a thief to pick up and steal

2. *How should I best protect specimens at risk?*

You may wish to have a professional mineral appraiser examine your collections. An appraiser can provide an indication of the market value of specimens. Appraisals can help you to decide which specimens may require increased levels of security.

As noted above, some specimens should not be stored with other items. Rather, they require their own secure storage areas. Specimens that may require separate storage include radioactive specimens and those that produce gases.

For additional information concerning museum security, refer to Chapter 9: Museum Collections Security and Fire Protection.

G. Exhibiting Geological Specimens

1. *What should I consider when planning an exhibit?*

Geology exhibits usually focus on two broad interpretive themes:

- Processes. The specimens illustrate a process such as erosion or volcanic activity.
- Objects. The exhibit focuses on the specimens themselves, such as examples of different rock types or mineral ores.

Do not select specimens for exhibit until the exhibit planning team has developed interpretive themes. As the Exhibit Plan progresses, the planning team can then decide how each specimen can best illustrate the story being told.

> *Always consider the durability of a specimen and its value when deciding how to exhibit it (either as a touch specimen or in an exhibit case).*

2. *Are there any particular concerns for exhibiting geological specimens?*

Many geological specimens are relatively inert; they don't require any special conditions. Often, because of their durability, geological specimens are used as touch exhibits. Make sure that specimens selected for use as touch specimens do not contain any toxic or radioactive substances. Place fragile specimens (such as some smaller crystals) inside an exhibit case. Massive crystals such as quartz may be suitable for a touch exhibit.

3. *Are there any specific situations that I should avoid when exhibiting geological specimens?*

Do not assume that all objects classified as geological specimens are the same. Know the properties of each specimen and how these different properties can affect the potential for damage. This includes damage from environmental conditions, improper display, or inappropriate handling.

4. *What should I know about cleaning geological specimens?*

The care and cleaning of specimens on exhibit is similar to that of other objects. Dry dusting and vacuuming may be appropriate for larger specimens but not for smaller fragile specimens. A damp cloth may be appropriate for some rock types but not water-soluble minerals like certain types of salts.

Practice preventive conservation. A proper exhibit case design can prevent dust accumulation. This approach is preferable to cleaning specimens after they become dusty. Know the composition of the specimen and its degree of durability prior to any decision on how it should be cleaned.

H. Conservation of Specimens

1. *When should I contact a conservator?*

Contact a geological conservator if you notice any signs that the specimen is reacting to environmental conditions such as:

- new crystal growth
- deterioration of labels or storage materials

A trained geological conservator may be able to provide simple corrective steps that will address the immediate problem or determine if more serious treatment is warranted. For example, if there is active deterioration of the specimen, the conservator may be able to determine if it is the result of environmental conditions in storage or other causes. Proper diagnosis of the problem is critical in order to correct the situation.

2. *Should park staff repair damaged and/or incomplete specimens?*

Do not attempt any specimen repairs yourself. The various glues and adhesives in common use can cause long-term damage to the specimen. If the specimen is intended solely for exhibit, you may be able to have a conservator repair it. However, it's vital to ensure that specimens used in research are not chemically contaminated. Do not use any adhesives (or any other chemical additives) on such specimens.

> *Remember: Many specimens were initially prepared according to the original project's research design and/or the specimen's intended use. Be sure that any proposed treatments (including preventive conservation) will not alter or compromise the specimen's relevance to such research or hinder future investigation*

3. *What types of repairs can a conservator undertake?*

A conservator can:

- recommend what can (and cannot) be done for the specimen
- advise you if conservation work is necessary
- do advanced cleaning and stabilization. Such work may be beyond even the resources of a park that has its own laboratory and trained staff.
- undertake delicate repairs and infills of specimens. Note: Infills, reconstructions and replacement of missing parts may be acceptable for exhibition and interpretive uses. Any such repairs should be:
  - easily distinguishable from the original specimen
  - inert
  - reversible

Exhibiting repaired specimens also may require you to alter or revise related interpretive elements. Each specimen creates its own set of concerns and issues.

4. *What type of damage is beyond repair by a conservator?*

A conservator <u>cannot</u> undo irreversible damage. Such examples include:

- fading caused by UV exposure
- breaks

> *Breaks are irreversible. They do not "go away" when the specimen is glued back together.*

5. *Should protective coatings be applied to specimens?*

As a general rule, protective coatings are not currently applied to geological specimens. Older specimens may have been coated with a variety of poor-quality substances, including shellac, waxes, oils, films, and spray-on polymers.

6. *What about cleaning specimens?*

Many larger, hardier specimens (like rocks and ores) can withstand occasional cleaning. In some cases, trained park staff can clean specimens. Appropriate methods, techniques, cleaning supplies, and equipment vary with the chemical composition of the specimen. For example:

- Don't use water to clean certain minerals, such as salt minerals like halite (sodium chloride) or gypsum (calcium sulfate) because they are soluble in water.
- Specimens with small delicate crystals may require procedures to remove dust and dirt.
- Ultrasonic cleaners can be used to clean some small crystal specimens. The technique used depends on the minerals (Hansen, 1984).

Before starting, be sure to consult your park's Museum Housekeeping Plan. It will help you determine:

- which specimens you can safely clean
- which specimens should only be cleaned by a conservator (or some other specially trained individual)
- the frequency that specimens should be cleaned
- appropriate method, techniques, supplies, and equipment.

If you do not have a Housekeeping Plan, or if it's out of date, consult your regional/SO curator, the NPS Geological Resources Division, and/or a natural history conservator to establish recommended cleaning guidelines.

SECTION III. REFERENCES

A. National Park Service Resources

- Geologic Resources Division, Paleontology Program
  P.O. Box 25287
  Denver, Colorado 80225-0287
  www2.nature.nps.gov/geology/paleontology

- Senior Curator of Natural History, Park Museum Management Program
  1201 Oakridge Drive, Suite 150
  Fort Collins, Colorado 80525
  (970) 267-2167

- Your regional/SO curator

B. Professional Organizations

The Society of Vertebrate Paleontology has a preparators' group and a special session at their annual meetings to discuss fossil preparation and related topics. Contact the society at:

Society of Vertebrate Paleontology
60 Revere Drive
Suite 500
Northbrook, IL 60062
www.vertpaleo.org

The Society for the Preservation of Natural History Collections (SPNHC), represents the interests of natural history collections and the people associated with the management and care of these collections. Publications include *Collection Forum* and *SPNHC Newsletter*. SPNHC's annual meetings include formal presentations and workshops. Contact SPNHC at:

Society for the Preservation of Natural History Collections
PO Box 797
Washington, DC 20044
www.spnhc.org

The Paleontological Society is an international association dedicated to the science of paleontology. The organization publishes the *Journal of Paleontology*, *Paleobiology*, *The Paleontological Society Memoirs*, *Short Course Notes*, and various other special publications. The society holds an annual meeting, as well as regional meetings. Contact the society at:

The Paleontological Society
PO Box 7075
Lawrence, KS 66044
(785) 843-1235 ext. 297
www.paleosoc.org

The Paleobotanical Section of the Botanical Society of America is an organization of individuals concerned with fossil plants. The section publishes the *Bibliography of American Paleobotany*, as well as other materials and special publications. The Paleobotanical Section holds workshops and conferences at the annual meeting of the Botanical Society of America. For additional information, refer to their website at: < www.dartmouth.edu/ ~ daghlian/paleo > .

The Mineralogical Society of America promotes scientific research, teaching, and educating the public concerning mineralogy. The Society publishes *American Mineralogist*, *Reviews in Mineralogy and Geochemistry*, monographs, a newsletter, and books. It holds courses, lectureships, symposia, and meetings. The organization also gives grants and awards. For further information, contact the society at:

Mineralogical Society of America
1015 18th Street, NW, Suite 601
Washington, DC 20036
(202) 775-4344
www.minsocam.org

The Geological Curator's Group in England was established in 1974 to improve the status of geology in museums and raise the standard of geological curation. Their goals are to advise, inform, and create a forum for discussion for all aspects of the care of geological collections as an irreplaceable part of our scientific and cultural heritage.

The Geological Curator's Group is affiliated to the Geological Society of London. For further information, refer to the Group's website at: <http://www.hmag.gla.ac.uk/gcg > .

C. Glossary

Body fossil: the preserved remains of any anatomical part of a plant or animal.

Carbonization: the accumulation of residual carbon from a plant or animal by changes in the organic matter and decomposition products.

Consolidant: any type of material, often a plastic or shellac, used to hardened and strengthen a specimen. Applied by either specimen immersion or surface application.

Fossil: any remains, trace or imprint of a plant or animal that has been preserved in the earth's crust since some past geological time.

Mineral: a naturally occurring inorganic element or compound having an orderly internal structure and characteristic chemical composition, crystal form, and physical properties.

Ore: the natural material from which a mineral or minerals of economic value can be extracted at reasonable profit. Usually applied to metalliferous material.

Permineralization: a process of fossilization whereby the original hard parts of a plant or an animal have additional material deposited in their pore space.

Pyrite disease: humidity-driven oxidation of pyrite (iron sulfide) that affects the microcrystalline or framboidal forms that change the iron sulfide to iron sulfate.

Replacement: a process of fossilization involving the substitution of inorganic material for the original organic constituents of an organism.

Rock: an aggregate of one or more minerals or a body of undifferentiated mineral matter. Rocks are divided into three different types: igneous, sedimentary and metamorphic.

a. Igneous Rock: rocks or minerals that solidified from molten or partly molten material.

b. Sedimentary Rock: a rock resulting from the consolidation of loose sediment that has accumulated in layers. Sedimentary rocks are divided into:

- clastic rocks formed by the mechanical breakdown of fragments of older rock such as sands and shales
- chemical rocks formed by the precipitation of minerals such as gypsum or limestone from solution
- organic rocks formed by the secretions of plants or animals or accumulations of organic matter such as coal.

c. Metamorphic Rock: any rock derived from pre-existing rocks by mineralogical, chemical and/or structural changes, essentially in the solid state, in response to marked changes in temperature, pressure, shearing stress, and chemical environment.

Trace fossil: a sedimentary structure resulting from the life activity of an animal such as a track, trail, burrow, tube, boring or tunnel, or marks on other fossils indicating feeding or chewing activities or the preserved feces of an animal.

D. Web Resources

The National Institute for Occupational Safety and Health (NIOSH)
http://www.cdc.gov/niosh

NIOSH Health Hazard Evaluation (HHE) Program
http://www.cdc.gov/niosh/hhe

Quality Condition Score for Paleontology/Geology collections
http://fenscore.man.ac.uk/Formspage1.htm
http://fenscore.man.ac.uk/FORMF3.htm.

Fossil Plant Preservation
http://www.ucmp.berkeley.edu/IB181/VPL/Pres/Pres2.html
http://www.korrnet.org/kgms/feb-01/feb01-8.htm

Radioactive Minerals
http://www.crscientific.com/radiation.html

Mineral Dust
http://www.minsocam.org/MSA/RIM/Rim28.html

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National Park Service
Paleontological Specimens
Preparation/Conservation Record

Catalog Number JODA 8499 Accession Number 248 Field Number DF8001

Taxon: *Stylemys Sp*.

Description: Cranium and shell fragments

1. Permanent Location: Collection Storage, Cabinet 56, Drawer 3

2. Field Observations: when collected it was not recognized as a turtle skull immediately because it was in about 13 pieces and caked with loose sediment.

3. Condition on Receipt: In several pieces and in need of a good wash to reveal the broken surfaces.

4. Development Notes: Prep by Matt Smith

2000		
11th Sept	15 min	Started exploring the matrix on the occipital portion of the cranium, removing loose bits and probing and cleaning obvious foramina. Vinac
12th Sept	7 hours	Continued with occipital portion of cranium. Cleaned out right otic capsule. Portion that I had attached before with a drop of vinac loosened and dropped off I cleaned both surfaces and reattached. Removed matrix from ventral surfaces and the right quadrate. The posterior portion of the skull has suffered some wear and tear pre-burial. The occipital condyl is missing as is bone from the area just behind the right otic capsule. The squamate bone I believe? Also the posterior portions of the parietals and supraoccipital. Just started work on the left post-orbital, jugal, and quadratojugal (pojq) portion of the skull. Vinac
13th Sept	5 hours	Worked mainly on pojq today. Started by cleaning off as much of the exterior surface as possible to ascertain if the fractures would allow me to clean out the interior surfaces or just what. Also worked on left otic capsule and discovered that even more of the squamatic bone is missing on this side. Also, it appears that the articular surface of the quadrate has been damaged. The fracturing of the qj is quite extensive and I don't believe it will allow me to clean out the interior surfaces as I had hoped. Vinac
14th Sept	5:45 hours	Continued cleaning out the left otic capsule today and discovered the stapes is present and intact!! Also the large mass of matrix on the dorsal surface of the prootic and the opisthotic was easily removed revealing the suture where the squamosal would have been. The whole area was easily freed of matrix leaving the posterior portion largely exposed. I have decided to limit the amount of matrix in

		the left postorbital area by confining it to a series of arches to provide strength. There are also impressions of missing bone on these arches that I thought may be worth preserving. Worked a bit on the right orbit. Vinac
15th Sept	7:15	Continued on the right orbit and external surface of the fore part of the skull. I made a supportive jacket for the edge of the maxilla and premaxilla and started to expose the knife like edge of these bones. This was done mainly with a pin-vise to avoid damage. I then started to work down onto the premaxilla at the end of the day. Vinac
16th Sept	2 hours	Worked on premaxillae and maxillae. Vinac.
18th Sept	4:15 hours	Continued on palate working backwards exposing crenellations on maxillae. Injected thick vinac into break in left maxilla. This should hold it if I am careful enough. The matrix is hard and then becomes strangely soft about 1/8 to 1/16 of an inch away from the bone. Vinac.
19th Sept	3:45 hours	Continuing on palate. I am now starting to dip into the internal nares and vomerine area. Exposed an area on the posterior most portion of maxilla or perhaps the pterygoid. It was an extremely thin lip of bone and wanted to shatter. I had to preserve it with paleobond because the vinac was too soft and would soften every time I applied more vinac or 'washed the fossil with acetone. The vomer seems to form a knife like ridge that extends all the way back to the pterygoids from the premaxilla area.
20th Sept	2:45 hours	I have removed the supportive jacket because the danger to the maxillae is over and I need more mobility to reach the areas around the vomer and the orbits. I removed the matrix all along the vomer with a needle and the thing is a amazingly thin ridge of bone over most of its length. I have started to try and work behind the jugal and post orbital of the right orbit and clean that area out entirely. It seems stable enough to do this. Vinac.
21st Sept	5 hours	Worked on right orbital and post orbital areas. It has been exceedingly difficult because of the angles involved in getting under the cheekbones. Also the huge foramen in-between the eyes was a challenge be cause of the ridges of bone along the ventral surface. The anterior portion of one of these ridges began to shatter an I stabilized it with paleobond. Also there is a slight wing of bone that I had to leave some matrix on in the posterior portion of the temporal area. This wing broke off and I reattached it with paleobond. It is too fine and the matrix is too well adhered to attempt to remove it. the corresponding area on the posterior portion of the cranium is broken away and so it looks like it is just hanging out in space but in reality that would not have been the case. Washed the shell fragments and tried to look for further skull fits but found none. Vinac.
22nd Sept	1:40 hours	Did some final picking and probing. Tried to remove as much of the dirt and such as possible that was caked on by too much vinac. Then I tacked it all together in order to store it. I also tacked together two portions of the shell that fitted together. By 'tacked' I mean a drop of thick vinac here and there that will easily come apart with the application of acetone.

Figure U.5. Example Preparation Record #1 (continued)

Preparation/Conservation Record
National Park Service
Hagerman Fossil Beds NM
Paleontological Specimens

Catalog #: ________________ **Accession #:**________ **Field #:**_______

Preparator's Name:______________________________ **Date to begin work:**_________

Specimen (Family, Genus, Species):____

Element:____

Permanent Location:____

Field Observations:____

Condition Upon Receipt:____

Development Notes:____

____

____

____

____

Consolidants: _______B15 _______B72 _______PVA _______Glyptal ______B76

_______B98 _________PaleoBond Other:____

Adhesives:___B76 _______B98 _______B15 _______DUCO _______PVA

_______Cyanoacrylate _______PaleoBond Other:__________________________________

Stabilizers and Fillers: ______Plaster _______Carbowax _______Plastic

_______Mache Other:____

Casting/Molding Notes:____

____

Attachments (photos, drawings, etc):____

Comments:____

____

____

____

Date Complete:_____________ **Total Hours (see reverse side):**_____________

Figure U.6. Example Preparation Record #2

Date	Hours Worked (round to nearest quarter hour)	Date	Hours Worked

Preparation/Conservation Record

Page 2

Figure U.6. Example Preparation Record #2 (continued)