CHAPTER 24 – COLLECTION-BASED HAZARDS

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A. INTRODUCTION

1. Collections, as defined by SD 600, Collections Management, include objects, natural specimens, artifacts, and other items that are acquired, preserved, and maintained for public exhibition, education, and study.

2. Collections may contain a wide range of chemical, biological, and physical hazards, which are either inherent to the nature or construction of the item itself, or acquired as a result of post-collection preparation, treatment, alteration or degradation.

3. Museums, art galleries, and cultural sites are responsible to both their staff and the visiting public for providing a safe, healthy, and enjoyable work and educational experience. Management that prescribes to and practices a pro-active safety culture realizes that collections with uncontrolled safety risks are inaccessible for research or display.

4. SI policy is to protect staff, users of the collections, and the public, from adverse exposure to collection hazards by:

    a. identifying hazards within its collections,

    b. minimizing the health and safety risks from use of the collections through remediation and safe work practices,

    c. notifying collection users of known or suspected hazards and safe work procedures to control risks,

    d. disclosing hazardous materials information in outgoing shipments and requiring hazard information on incoming shipments from senders, and

    e. controlling risks to visitors in public programs and exhibits.

5. This Chapter applies to all SI-owned, leased or operated facilities that store, display or otherwise handle collections. It sets forth safe work practices which conform to applicable regulatory and professional consensus standards included in this *SI Safety Manual,* and as guidance for the collection management plan requirements of "*SD 600 - Collections Management Implementation Manual."*

B. ROLES AND RESPONSIBILITIES

The safety of collections and the persons handling them is part of an overall collections management policy. Ensuring that collection access is not restricted due to unsafe conditions is a facility safety and collection care joint responsibility.

1. Safety Coordinators shall:

    a. Identify, with the assistance of supervisors, collection-related work tasks or work areas (including public programs and exhibits) under their control that may require exposure evaluation and control per requirements of this Chapter.

    b. Ensure that all employees assigned to work with collections or exhibits, and other authorized users of collections (e.g., visiting researchers including those with short-term appointments or interagency agreements, volunteers, interns and docents), are provided hazard awareness and safe work practice information, and are identified to the Office of Safety, Health and Environmental Management (OSHEM) for exposure and safety risk assessments, as part of the Job Hazard Analysis (JHA) process.

    c. Assist supervisors, with consultation from OSHEM, in establishing, implementing and periodically re-evaluating work practice and exposure control programs to reduce collection-based health and safety risks, in accordance with the provisions of this Chapter.

    d. Ensure that risks to staff and the visiting public from public program activities and displays are properly controlled.

2. Supervisors shall:

    a. Identify, with the assistance of the Safety Coordinator, collection-related work tasks or work areas (including public programs and exhibits) under their control that may require exposure evaluation and control per requirements of this Chapter.

    b. Ensure that OSHEM-recommended engineering, work practice, personal protective equipment and other control measures are implemented to reduce collection-based health and safety risks.

    c. Ensure that all employees working on or around collections with identified hazards receive hazard communication training as required by this Chapter.

    d. Report employee illnesses or other symptoms possibly associated with collection work to OSHEM.

3. Employees shall:

   a. Abide by the work practices and personal protective equipment requirements of this Chapter.

   b. Inform supervisors of any illnesses or other symptoms believed to be associated with collection work.

4. Staff, Registrars, and Offices Responsible for Shipping Collections shall ensure that collection objects being received by or shipped from the facility are accompanied by appropriate hazard warning information per requirements of this Chapter.

5 Office of Safety, Health and Environmental Management (OSHEM) shall provide technical assistance to Safety Coordinators and supervisors including: evaluating collection-based activities, storage environments, and public displays for health exposure risks, general safety and fire safety hazards, and recommending controls to reduce or eliminate exposure risks.

C. HAZARD IDENTIFICATION and RISK ASSESSMENT

Supervisors will be able to best eliminate or significantly reduce risks from collection hazards, including hazards from current preparation and treatment work, by first developing a Job Hazard Analysis (JHA) or a Laboratory Safety Plan. The JHA is a tool that focuses on job tasks as a way to identify hazards that are necessary to the workplace but, uncontrolled, could cause injury. It also establishes control measures and related training. Consult your Safety Coordinator and Chapter 4, "Safety Risk Management Program", of this *Manual* for more assistance.

1. Identifying Hazardous Materials or Conditions. The presence of hazardous materials or hazardous conditions associated with collection objects and specimens (including public programs, exhibits and educational/hands-on learning centers) are to be determined to the extent possible. Identification may be accomplished through:

   a. knowledge of **inherent properties and materials,** their **toxicity, flammability or combustibility, and physical restrictions.** Consult Attachment 1 and Section L, "References and Resources", of this Chapter for additional guidance. Examples include:

      - Hazardous plants or mineral specimens,
      - Constituents such as aniline dyes, chrome patinas or lead pigments.

- Radioactive materials such as certain fossils, uranium pigment (e.g., Fiestaware), radium paint (e.g., cockpit dials or watch faces)
- Asbestos-containing art plaster in stuccos, taxidermy mounts
- Extremely flammable cellulose nitrate films/negatives
- Alcohol preservatives, gunpowder, degraded medicinals
- Sharp weaponry, heavy artwork, fragility/breakability leading to trauma or cuts
- Lead-containing (e.g., linotypes, printing presses); lead-painted art frames or industrial/historic artifacts.

b. knowledge of **zoonotic/biological hazards** associated with the care of living collections and living study specimens, field collection of living specimens, and handling postmortem specimens. These hazards and controls are addressed in Chapter 44, "Zoonoses Control", of this *Manual*.

c. knowledge of past and current collection **preservation methods, conservation treatments, post-collection preparation, pesticide treatment**, and any associated Safety Data Sheets.

d. review of **archival records**, original collector's notes, interviews with current staff conservators, curators or preparators.

e. **analytical testing**, including use of instrumentation such as x-ray fluorescence, radiation surveys, environmental analyses of objects and specimens (methods acceptable to collections and conservation staff).

2. Identifying Residual Hazards in the Storage Environment and Cases.

a. Hazards on/within collections (which also may potentially contaminate the storage bins, cases or flooring of the storage room) must be identified, including:

- Particulate residues of past preservative/pesticide treatments (e.g.,arsenical or mercuric salts, DDT, DDVP [vapona], sulfur compounds).
- Vapors from organic treatment chemicals or natural object degradation that may accumulate within closed cases and also be absorbed into/vaporize from porous or wooden case interiors.
- Recrystalization and re-vaporization (after treatment application) of pesticides, such as naphthalene and para-dichlorobenzene.

b. Storage area or case structural composition may include hazards, particularly if the material is in poor or damaged condition, such as:

- Asbestos-containing materials (ACM) in objects which may crumble/degrade and contaminate cases.

- Unprotected ACM in building insulation (e.g., ducts, pipes, ceilings) that settles on surfaces.
- Lead-based painted cabinets which, if powdering or flaking, can contaminate floors and personnel with lead dust.
- Arsenic-treated felt gaskets on older wooden core cases.

3. Hazards in Exhibits and Public Programs are addressed in greater detail in Section H of this Chapter.

   a. The presence of hazardous materials or conditions within exhibit displays or program activities, that could affect staff or the public, must also be identified and controlled.

   b. Exhibits slated for demolition or renovation are to be tested for the presence of hazardous materials (e.g., asbestos, lead paint, residual heavy metal pesticides) and appropriate SI construction specifications for abatement and disposal are to be included in the project design.

4. Technical assistance and analytical measures for identification can be obtained through your facility Safety Coordinator and OSHEM. Additional sources of guidance are listed in Section L, "References and Resources," of this Chapter.

5. Identification data is to be maintained with the object or specimen per the collecting unit's established documentation system.

6. Exposure Risk Assessment. Once a hazard is identified within a collection, employee health and safety risks shall be determined through occupational exposure surveys conducted by OSHEM, in accordance with provisions of the SI Safety Manual including Chapter 4, "Safety Risk Management Program" and Chapter 39, "Exposure Assessment and Medical Surveillance". Consult your Safety Coordinator and OSHEM to arrange for these surveys.

   a. These surveys may include physical, chemical, or biological evaluations depending on the type of contact and exposure, and will focus on the potential for injury, trauma or illness. The most stringent and best practices standards will be applied.

   b. Many contaminants (e.g., arsenic, asbestos, formaldehyde), are specifically regulated by OSHA, and require exposure monitoring to be performed during work tasks that pose a risk from these materials (e.g., asbestiform mineral sectioning, handling arsenic-treated study skins).

   c. Staff handling radioactive collections shall be evaluated for inclusion in the personal dosimetry program.

Hazard vs. Risk: Important Distinction to Understand

A material's hazard is a basic property of nature or construction

Example 1: formaldehyde fixatives (high hazard, carcinogen)
Example 2: cellulose nitrate (highly reactive) film base
Example 3: heavy, sharp-edged sculpture

Risk, however, is the degree to which that hazard is able to affect your body's systems (illness, trauma).

The hazard may be difficult to change, but your safety or health risk from that hazard can be controlled.

Example 1: formaldehyde used in a hood poses low exposure risk;
Example 2: cellulose nitrate flammability controlled with specialized storage containers and measures.
Example 3: use of material handling equipment, instead of manual lifting, reduces risk of muscle strain or impact trauma to body.

D. RISK CONTROLS

1. Permanent remediation measures assist in the long-term preservation of the collection, and enhance its accessibility for research. Collections management is to work with their safety coordinator and OSHEM to:

   a. prioritize the severity of collection-based safety risks.

   b. determine a feasible plan for eliminating or significantly reducing each risk to within acceptable limits. This plan would include seeking management support for resources and funding, such as grants through the National Collections Program.

   c. implement feasible interim safe work practice controls to reduce risks until permanent remediation can be achieved.

2. Remediation through hazard removal, enclosure, or other permanent controls shall be planned and conducted, if feasible or allowable, with respect to preserving the integrity of the collection in accordance with good conservation and collection care practices. Examples could include:

a. Drain and properly dispose of battery acids, or chemical/pharmaceutical liquids, while retaining the historic containers, to reduce the risks of chemical leaks or violent reactions from degraded chemicals.

b. Enclose fragile, sharp, inherently poisonous/toxic, or pesticide treated specimens or mounts in well sealed containers, under acrylic drawer tops, or in vitrines for public handling or display.

c. Rapid processing of incoming collections/specimens to remove potentially contaminated shipping and packing materials, and to reduce cross-contamination of work area or other objects/specimens.

d. Lead shielding or distancing between radioactive objects and persons.

e. Digitization of photographs, paper and books. Consult with SI Digitization Program Office.

f. Scavengers, vapor-impermeable enclosures, and sealants (e.g., scavenger papers, Marvelseal® bags, clear stabilization compounds) on or around collection items.

3. Safe Work Practices for collections and their material handling, management, research, restoration or conservation shall be developed for the specific needs of the collection or program.

   a. Safe work practices will include a declaration of the pertinent hazards and the employee exposure monitoring results associated with the collection unit and tasks, engineering controls (ventilation) to reduce health hazard exposures, dust and vapor suppression techniques, personal protective equipment, and good housekeeping.

   b. Safe work practices can be developed as a simple safe operating procedure, or using the JHA format in Chapter 4, "Safety Risk Management Program" of this Manual, or they may already be a part of a Lab Safety Plan, if applicable (see Chapter 26, "Laboratory Lab Plans, of this Manual).

4. Pesticide Application Requirements. Current pesticide application must comply with the regulatory and SI requirements of Chapter 31, "Pesticide Management" of this *Manual*. A standard operation procedure for applications is to be approved by the facility Safety Coordinator prior to work.

   a. Where multiple pesticides or treatments are available, the one least harmful to the environment and to human and animal health shall be attempted first. If that treatment is found to be ineffective, the more harmful/toxic methods available may be used with safety procedures and

other restrictions per Chapter 31 to ensure maximum health risk reduction to within acceptable occupational exposure limits.

b. No pesticide shall be used that is listed by the following agencies as confirmed by sufficient evidence to be a human carcinogen, or suspected or reasonably anticipated to be a human carcinogen, unless the applicator can provide peer-reviewed and published scientific documentation establishing that the pesticide is the only known effective treatment against the identified pests:

   i. International Agency for Research on Cancer, World Health Organization.
   ii. National Toxicology Program, U.S. Department of Health and Human Services. Report on Carcinogens (current edition).
   iii. American Conference of Governmental Industrial Hygienists.
   iv. U.S. Occupational Safety and Health Administration.

5. Engineering Controls/Local Exhaust Ventilation, such as laboratory fume hoods or capture exhaust hoods (e.g., slot hoods, downdraft tables, and "trunk" hoods), shall be used whenever possible when conserving, sectioning, treating, or examining a hazardous collection object/specimen. Design and installation of hoods shall be in accordance with Chapter 27, "Ventilation for Health-Hazard Control", of this *Manual.*

6. General ventilation for collection work and storage areas is to be designed and maintained in accordance with SI/OFEO Design Guidelines, the guidelines of the SI/National Collections Program Collections Space Committee, and applicable indoor air quality standards per Chapter 27 of this *Manual.*

7. Hot Work (i.e., use of torches and other flame producing equipment for operations such as bracket and mount making) is to be conducted in accordance with Chapter 14, "Hot Work Management and Permit System", of this *Manual*. Hot work activities may only occur in areas with a valid daily or fixed area hot work permit which ensures the proper fire safety precautions are in place.

8. Fall protection. If collection care (e.g., condition surveys) or conservation activities (e.g., large sculpture cleaning/restoration) requires performing work at heights of 4 feet or higher, fall protection devices (e.g., scaffolding, guardrails, bucket lifts, personal equipment) may be required, per Chapter 10, "Fall Protection", of this *Manual*.

9. Material handling (either manual or powered) of heavy or over-sized objects requires special training to prevent accidents and injuries and proper

equipment for balanced and properly-sized loads (e.g., forklifts, hand trucks, dollies), per Chapter 13, "Materials Handling and Storage" of this *Manual*.

10. Dust minimization work methods are to be used when sectioning, cleaning, conserving, and transporting objects/specimens with residual particulates and fibers. Examples include:

    - diamond saw cutting fluids,
    - sectioning of hazardous minerals/ores under a laboratory fume hood,
    - High-Efficiency Particulate Air [HEPA]-filtered vacuum cleaners,
    - closed containers or coverings for short-distance transport of objects/specimens from storage to work area,
    - non-vigorous handling.

11. Cleaning of Storage and Work Areas. Consistent housekeeping consists of good conservation and safety care, as it reduces pests, detritus and hazardous residues. Hazards on or within collections are also likely to contaminate the storage bins, cases or flooring of the storage room.

    a. Cross-contamination must be prevented by segregating hazardous collections from non-hazardous, as feasible. Cabinets, drawers and shipment boxes/materials that have housed contaminated items shall not be re-used for housing other items unless properly cleaned of residual particulates and the action documented.

    b. Work and storage surfaces in contact with contaminated or hazardous objects/specimens shall be non-porous, easily cleanable material. These surfaces shall be cleaned periodically using decontamination methods effective for the type of residue or spill (e.g., HEPA-vacuum or wet methods for particulates; solvent cleaners for organic liquids). HEPA filters should be changed periodically (depending upon use).

    c. Water-trap vacuum cleaner collections water cannot be disposed down the sewer (i.e., in violation of local clean water regulations) and may require disposal as regulated waste (per Section G of this Chapter), particularly if the effluent contains heavy metals or other hazardous materials collected. Contact your facility Hazardous Waste Coordinator, or OSHEM, for guidance.

    d. Vacuum cleaner waste bags and filters from cleaning these areas, particularly those areas containing lead paint chip residue from cases, may require disposal need to be disposed of as regulated waste (per Section G of this Chapter). Contact your facility Hazardous Waste Coordinator, or OSHEM, for guidance.

12. Personal Protective Equipment (PPE). After identification of collection related hazards has been completed, the Safety Coordinator shall assist the supervisor in making PPE product and selection recommendations, per the decision logic guidance in Chapter 17, "Personal Protective Equipment", of this *Manual*.

    a. The use of respirators is to be considered on a case-by-case basis based on the results of the hazard analysis and employee exposure monitoring. Refer to Chapter 18, "Respiratory Protection," of this *Manual*, for information on respirators.

    b. Protective barrier gloves (e.g., nitrile or vinyl) are to be worn by staff, and offered to visiting researchers, when handling potentially contaminated collections, containers or storage surfaces.

    c. These gloves are to be disposed after use to prevent contamination from the used glove itself. In most cases, used gloves can be disposed as regular trash once removed inside out. Activities generating larger supplies of contaminated gloves (e.g., collection packing and moving) may require disposal as regulated waste (per Section G of this Chapter). Contact your facility Hazardous Waste Coordinator for guidance.

    d. Protective clothing (e.g., lab coats) is to be worn whenever collection-handling activities may result in clothing being contaminated by hazardous materials (e.g., moving over-sized objects or intensive cleaning). Due to possible contamination of laboratory coats with chemicals, staff members are not to wear laboratory coats outside of their workspace. Laboratory coats shall not be taken home and laundered with personal clothing items.

    e. Provisions are to be made by the collecting unit to launder lab coats on-site in a dedicated uniform washer and dryer, or through an industrial uniform launderer. When using the services of a commercial laundry equipped to accept contaminated clothing, the firm shall be informed of the possible contaminants. An example of a contaminant warning: "CAUTION: Clothing may be contaminated with (inorganic arsenic) (lead) (mold) (chemicals). Do not remove dust by blowing or shaking.

13. Personal hygiene practices are to be used by all personnel who handle hazardous collections. These practices are best-practice conservation care, as well.

    a. Carefully remove gloves so as to prevent skin contamination. One technique: With palms facing up, grasp the outside of one glove with the other and pull to roll and remove so it is inside out (presumably clean on the inside). Grasp the clean inside of that glove to remove the other glove in the same way so it rolls off inside out. Dispose of gloves appropriately.

b. Wash hands, arms, face and neck after removing work gloves and/or leaving work area for a different task.

c. While wearing contaminated gloves, or while at collections work area, do not eat, drink, smoke, or apply cosmetics. Avoid touching your eyes, nose, or mouth, or adjusting eyeglasses after touching potentially contaminated surfaces. When in doubt, wash exposed skin frequently.

d. Do not eat, store, or prepare food or beverages in an area containing hazardous materials.

E. FIRE PROTECTION CONCERNS. The storage and use of certain collections pose specialized fire protection concerns that are addressed in greater detail in the Chapters listed below.

1. Collections shall be stored in separate, dedicated areas, enclosed with fire-rated construction that is provided with appropriate automatic fire detection and suppression systems. Specific fire protection and prevention requirements for these areas are addressed in Chapter 36, "Fire Protection", and Chapter 38, "Fire Prevention", of this *Manual,* and Chapter 7 of the *SI Fire Protection and Life Safety Design Manual.*

2. Collections/Artifacts that may present an explosion or self-ignition hazard (e.g., munitions) shall be reported to the safety coordinator and stored in locations approved by OSHEM. Wherever possible, artifacts presenting an explosion hazard shall be made safe prior to storage. Weapons and munitions must be inspected by a qualified explosives ordnance expert to insure munitions have been declared inert. Other types of artifacts presenting similar hazards must be evaluated by OSHEM and the owner on a case-by-case basis to determine the stability of the object, assess the risks, and determine adequate risk mitigation measures. For further guidance see Chapter 36, "Fire Protection", of this *Manual*.

3. Collections containing or housed in flammable or combustible liquids or gases.

   a. Collections containing fuel or gases (e.g., match and lighter collections, vehicles that contain fuel) shall have every attempt made to eliminate the fuel prior to storage. In cases where the fuel or gas cannot be removed, such artifacts shall be stored in locations approved by OSHEM and in accordance with Chapter 38, "Fire Prevention", of this *Manual*.

   b. When combustible or flammable liquids cannot be removed (e.g., natural history specimens preserved in alcohol) or are an integral part of the

object itself, the collections shall be stored in protected areas approved by OSHEM and in accordance with Chapter 38, Fire Prevention. of this *Manual,* and Chapter 7 of the *SI Fire Protection and Life Safety Design Manual.* These may include, but are not limited to flammable liquid warehouse areas, flammable liquid cut-off rooms, flammable liquid storage lockers, and approved flammable liquid cabinets.

4. Storage of cellulose nitrate motion picture film and other cellulose nitrate based materials shall be reported to OSHEM and the SI Archives prior to commencement of storage. Storage and handling of this material shall be in accordance with NFPA 40, "Standard for the Storage and Handling of Cellulose Nitrate Film," the requirements of Chapter 36, "Fire Protection" and Chapter 38, Fire Prevention of this *Manual,* and SD 502, "Cellulose Nitrate Still and Motion Picture Film."

F. HAZARD WARNINGS AND DISCLOSURE STATEMENTS (INCLUDING SHIPPING and RECEIVING)

1. Warnings to Staff and Visiting Researchers. Written notification of known or suspected hazards within a particular collection, and the adopted safe work practices, are to be provided to all collection users, in accordance with the requirements of Chapter 25, "Chemical Hazard Communication".

2. Labels and Storage Area Signage. Hazardous materials in collections must be labeled as hazardous materials, either per object or in a manner sufficient to alert users and emergency responders prior to contact (e.g., postings on storage rooms doors or shelves and cabinets). Examples include:

   a. New acquisitions should include a notation in the accession and catalog records, collections information system record, and (as appropriate) on the storage case.

   b. Larger-scale collections could have a hazard awareness sign posted on entrance doors, and/or at the end of storage rows.

   c. Collections containing radioactive materials, especially those subject to licensing by the Nuclear Regulatory Commission, may require special labeling; the unit is to consult Chapter 32, "Ionizing Radiation", of this *Manual* for further guidance.

3. SI Inter-office and Intra-facility Loans for Study or Display Disclosures. Collections shared with other SI units for study or display must be accompanied with hazard information to allow the receiving units to properly control their risks.

4. Shipping and Receiving Disclosures (internal and external to the SI).

   a. Collection objects and specimens shipped from the field to a facility, shipped (e.g., loaned) to another facility, surplused, deaccessioned, or otherwise transferred (e.g., pursuant to the Native American Graves Protection and Repatriation Act 43 CFR 10), shall be accompanied by documentation that discloses known or suspected hazardous materials that may be present within the object or specimen, or its shipment fluid.

   b. Shipping and receipt of any collection with radioactive components must comply with shipping documentation requirements of Chapter 32, "Ionizing Radiation", of this *Manual*, including those relative to disclosure, hazard warnings, recommendations for managing the risk and applicable maintenance precautions.

   c. Packaging, shipping documentation, and shipping methods shall be compliant with U.S. Department of Transportation (DOT) and International Air Transport Association (IATA) regulations.

   d. The facility point of contact or shipping office shall not accept any radioactive object or potentially hazardous collection that is not accompanied by this hazard disclosure information.

5. Hazard Identification from Senders of Collections.

   a. The SI collecting unit shall ensure that senders of collections (e.g., incoming loans, incoming fieldwork or items for acquisition consideration) provide hazard disclosure documents PRIOR to shipment or arrival at the SI. Supervisors must communicate hazards and precautions to their staff prior to arrival of the item.

   b. Pre-planning for receipt of collections should include a determination (e.g., from the sender, from the local consulate office) of the past pesticide or customs fumigations of the item, to prevent inadvertent receipt of a potentially toxic shipping crate and/or object. For instance, research on a foreign customs fumigation method, such as methyl bromide, may require assistance from the local consulate.

6. Receipt and Shipment of Collections with Radioactive Components.

   a. The facility point of contact (POC) for ***receipt*** of any incoming collections, must ensure that the objects are accompanied by appropriate documentation, relative to disclosure, hazard warnings, recommendations for managing the risk and applicable maintenance precautions, per Chapter 32, "Ionizing Radiation", of this *Manual*. This also applies to intra-SI shipments.

b. The facility POC responsible for ***shipping*** an object to another facility (including another SI facility) must ensure that the transfer is authorized and accompanied by appropriate documentation, relative to disclosure, hazard warnings, recommendations for managing the risk and applicable maintenance precautions, per Chapter 32, "Ionizing Radiation", of this *Manual*.

G. WASTE DISPOSAL

1. All hazardous or potentially contaminated collections and/or storage materials slated for disposal, or any spill or leak from hazardous collections, or contaminated wash water (include water trap vacuum liquid), may require disposal in accordance with the Resource Conservation and Recovery Act (RCRA). Supervisors shall contact the facility Hazardous Waste Coordinator and/or OSHEM for testing, guidance and disposal assistance through the SI hazardous waste contractor as required.
2. Disposal of miscellaneous work materials (e.g., contaminated gloves, interleaving papers, swabs or other conservation materials) or potentially contaminated storage materials and drawers, may also be regulated waste, as determined by either of the following two allowable methods:

   a. Results of a Toxicity Characteristic Leaching Procedure (TCLP) test on a representative grouping of the material, or

   b. A decision may be based upon prior knowledge of the waste stream from past representative TCLP test results or documented history (e.g., manufacturer data).

   In instances where SI collection units have received past TCLP test results for miscellaneous material, the unit is to contact the facility Hazardous Waste Coordinator for those results and/or OSHEM for technical advice.

3. If radioactive or biological waste is generated in the collecting unit, supervisors are to contact their facility Safety Coordinator or Radiation Safety Coordinator for special disposal instructions.

4. Refer to Chapter 29, "Hazardous Waste Management", of this *Manual* for further information.

5. Refer to Attachment 2 of this Chapter for special instructions on disposal of "Collections Storage Cases with Hazardous Material Components".

H. EXHIBITS AND PUBLIC PROGRAMS

1. Staff, docents and the visiting public shall be protected from exposure to specimens or objects known to, or suspected of, containing hazardous materials. Any potentially hazardous items must be displayed inside cases or in a manner that the public is protected against contact. Examples include:

    a. no mounting of specimens or objects that were prepared with toxic chemicals on walls or over walkways.

    b. enclosing items in well-sealed vitrines or other containers.

    c. separating the public from radioactive aeronautics dials, minerals, fossils, cloisonné jewelry, glassware, or Fiestaware by distance and/or shielding.

    d. applying coating or consolidant to hazardous equipment or objects that will be handled in public displays.

2. Treated objects that pose a skin contact or absorption hazard shall not be touched or handled, except by trained docents or staff wearing gloves or other appropriate skin protection. Safe work practices will be established and followed, using the applicable guidelines listed throughout this Chapter, particularly in Section D.

3. Use of flammable liquid collections and specimens or objects stored in flammable liquids is generally not permitted in public spaces. Where no viable alternative is available, collections with limited quantities of flammable liquids may be allowed when certain safety parameters are met and approved by OSHEM. Information that must be provided to OSHEM for evaluation includes: chemical name and Safety Data Sheet of liquid to be used for display; total quantity of liquid to be displayed; and number, size, type, volume, location and mounting of each container, as well as the design of display cases housing the containers.

4. Exhibits slated for demolition or renovation shall be tested for the presence of hazardous materials (e.g., structural asbestos or lead-based paint; asbestos art plasters, metal pesticides on objects or scenery, lead or cadmium paints); appropriate Smithsonian Institution abatement and construction safety specifications shall be included in the project design.

I. TRAINING

1. All collection users (employees, visiting researchers including those with appointments or interagency agreements, volunteers, interns, or contractors) assigned to collection work must be advised of known or suspected hazards within a particular collection, and are expected to follow the specified safe work practices.

    a. At a minimum, short-term visitors under direct supervision of SI staff are to receive this notification as part of their basic safety and emergency procedure orientation to the facility and collection under study.

    b. In general, collection staff working with objects and specimens subject to this Chapter shall receive an overview of collection-based hazards and specific safe work practices as part of job-specific safety training and Chemical Hazard Communication training, in accordance with, respectively, Chapter 6, "Training", and Chapter 25, "Chemical Hazard Communication", of this *Manual*.

    c. Contractors shall receive hazard communication information and directions as part of their contract specifications.

2. Any individual that prepares a package or shipment for transportation which includes hazardous materials is required to have training to meet the requirements of DOT 49 CFR 172 Subpart H. This includes individuals that pack, mark, label, transport or offer for transport by a commercial vendor, packages or shipments that contain hazardous materials. Contact your Safety Coordinator for course scheduling.

2. Training resources and slide programs can be found on the OSHEM web page: http://ofeo.si.edu/safety_health/Training/training_catalog.asp. On-site training classes can also be provided by OSHEM, by contacting your safety coordinator for scheduling.

J. DISASTER PREPAREDNESS, RESPONSE and RECOVERY

1. Collecting units are responsible for identifying collections under their control that would pose a danger to staff, first responders, and the public in case of a disaster and include these hazards and response provisions in the facility's Disaster Preparedness and Emergency Response Plan.

2. Collecting units should ensure that they are included in their facility's disaster preparedness and emergency response planning process, and that their

special needs are clearly communicated to the facility Emergency Command Center.

3. In consultation with the SI Office of Protection Services, collecting units should ensure that their staff is provided with appropriate salvage and recovery training (e.g., the American Institute for Conservation Cultural Emergency Response Team).

4. Guidance on best practices in improving collection emergency planning, preparedness, and response is provided by the Smithsonian Collections Emergency Management Working Group, chaired by the National Collections Program and the Office of Protection Services. https://collab.si.edu/sites/OUSFA/NCP-SCAC/CEM/default.aspx

K. RECORDS AND REPORTS

1. Documentation of substance or physical collection hazards, hazardous material inventories, and workplace surveys related to this Chapter shall be maintained for at least 30 years, in accordance with 29 CFR 1910.1020, "Access to employee exposure and medical records," by the facility (Safety Coordinator and collection management supervisor) for current and future reference.

2. Identification data is to be maintained with the object or specimen per the collecting unit's established documentation system.

3. Documentation of hazard warnings and disclosures included with shipments is to be maintained indefinitely by the facility shipping office with its established shipping records documentation system.

4. Employee exposure measurements and surveys, as well as employee medical monitoring, shall be maintained by OSHEM, and the respective supervisors, for the duration of the employee's SI employment plus 30 years, in accordance with 29 CFR 1910.1020, "Access to employee exposure and medical records," and Chapter 39, "Exposure Assessment and Medical Surveillance", of this *Manual*.

5. Training records shall be maintained for the duration of their SI employment, per requirements of Chapter 25, "Chemical Hazard Communication".

L. REFERENCES and RESOURCES

1. Hawks and Makos Collections Hazard Guidance Document. [Att 1 of Chapter]

2. Goldberg, L. 1996. A history of pest control measures in the anthropology collections, National Museum of Natural History, Smithsonian Institution. JAIC 35 (1996):74-75

3. Health and Safety for Museum Professionals. Edited by C. Hawks, M. McCann, K. Makos, L. Goldberg, D. Hinkamp, D. Ertel, Jr, and P. Silence. Society for the Preservation of Natural History Collections. 2011. 647 pp. [Copies available in OSHEM and through your Safety Coordinator]

4. Smithsonian Institution National Collections Program web and Sharepoint sites, particularly for Collection Storage and Preservation Environment Summit reports and resources.

5. American Institute for Conservation (AIC) of Historic and Artistic Works, Resource Center: Health and Safety Committee and Disaster Response and Recovery.

6. Society for the Preservation of Natural History Collections.

7. Heritage Preservation, The National Institute for Conservation, Heritage Emergency National Task Force. Information on Major Disasters in conjunction with FEMA.

8. NCPPT: National Center for Preservation Technology and Training (part of National Park Services): Disasters (including “Health and Safety in Disaster Preparedness”).

9. National Park Service, Museum Management Programs: Conserve-o-Gram series and other publications and manuals on chronology of pesticide usage and collection-work practices.

10. Contaminated Collections: Preservation, Access, and Use. Proceedings of a symposium held at the National Conservation Training Center (NCTC), Shepherdstown, West Virginia. April 6-9, 2001. Collection Forum, Volume 17 (1&2)

11. Conservation and Art Material Encyclopedia Online (CAMEO), a database of chemical, physical, visual, and analytical information on over 10,000 historic and contemporary materials used in the conservation, preservation and production of

artistic, architectural, and archaeological items. Developed by the Conservation and Collections Management Division at the Museum of Fine Arts, Boston.

12. Database of Hazardous Materials (NOAA CAMEO Chemicals), interactive website for response information for thousands of hazardous materials, including fire and explosion hazards, dangerous reactivity, health hazards, firefighting techniques, cleanup procedures, protective clothing, and chemical properties. National Oceanic and Atmospheric Administration (NOAA).

13. Canadian Conservation Institute. Publications, fact sheets, studies on environmental stressors, mould outbreak and abatement, temperature/humidity parameters, anoxic and other pest treatments.

14. Native American Graves Protection and Repatriation Act (NAGPRA) 43 CFR 10

15. SD 502, “Cellulose Nitrate Still and Motion Picture Film”.

16. NFPA 40, Standard for Storage and Handling of Cellulose Nitrate Film.

17. SI Fire Protection and Life Safety Design Manual.

18. OFEO Smithsonian Codes, Standards and Guidelines.

19. OFEO Smithsonian Facility Design Standards

20. ASHRAE Handbook-HVAC Applications. Chapter 23 “Museums, Galleries, Archives, and Libraries”. 2011. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Standards for collection storage indoor air quality. [Consult OSHEM for copy]

Attachment 1

COLLECTION HAZARDS GUIDANCE DOCUMENT with LITERATURE CITATIONS

The attached tables and citations are excerpts from the following presentation, published in CIPP 2001 Postprints, AIC Web Site (http://aic.stanford.edu):

HIDDEN HAZARDS: THE DARK SIDE OF COLLECTIONS
Catharine Hawks and Kathryn Makos
CIPP Health & Safety Session
2001 AIC Annual Meeting; Dallas, Texas, 2 June, 2:00-2:30 pm

List of Tables

The authors welcome additions to the tables based on the experience of museum professionals in various specialty fields. Please let us know if you have suggestions or comments.

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Attachment 1

Table 1. Collections-based Hazards - Archives/Libraries (Books, Documents, Maps/blueprints, Audiovisual materials in various formats, Material preserved as evidence from various investigations or court proceedings, Memorabilia)

INHERENT (pre-collection)	ACQUIRED (post-collection)
Residues of past animal/insect/fungal infestations Residues of past forensic examinations of evidence (*e.g.*, aniline dyes, silver nitrate, hydrofluoric acid, osmium/ruthenium tetroxide, hydrogen sulfide/nitric acid, antimony and antimony trisulfide, finely divided carbon, lead salts, mercury compounds, residues from cyanoacrylate fuming) Biological contaminants on evidence (*e.g.*, Hepatitis C from dried blood) Cyanide, mercury, or arsenic in some printers' inks Dyes and other colorants used in bookbindings, particularly aniline dyes and green dyes made with arsenic salts Ferrocyanide compounds in blueprints Cellulose nitrate in imitation leather bookbindings *See Photography (below) for other potential hazards in archives/library collections*	Residues of past animal/insect/fungal infestations Residues of continued forensic examinations of evidence Deterioration of bindings, releasing particulates containing dyes and other colorants used in bookbindings, particularly aniline dyes and green dyes made with arsenic salts Deterioration of blueprints to release ferrocyanide compounds Deterioration of cellulose nitrate in imitation leather bookbindings to release acidic compounds Soot and other particulate accumulations from fires, pollution, old building systems Asbestos from decrepitating structural insulation in storage or exhibit areas or from deterioration of old fireproof file cabinets Powdered lead/cadmium/PCB paint from old building finishes *See Photography (below) for other potential hazards in archives/library collections*

Table 2. Collections-based Hazards – Biosciences (Botanical specimens, Invertebrate specimens, Vertebrate specimens, Historic dioramas)

INHERENT (pre-collection)	ACQUIRED (post-collection)
Poisonous plants and seeds Hanta virus and other zoonotics from recent field acquisitions Insect/fungal residues on salvaged specimens Pathogens preserved in cryogenic specimens Poisonous venoms in recently acquired specimens Radioactivity and pollutants in shells of mollusks collected from contaminated water Potential pathogens in fecal material (scats) Pest control chemicals, plaster containing asbestos, and lead earliners in taxidermy mounts prepared by commercial taxidermists Pest control chemicals and other unidentified materials in specimens acquired from donors or in orphaned collections	Residues of animal/insect/fungal infestations Residues from pesticide/fungicide treatments during specimen preparation (skins; stuffing materials in rugs/mounts/study skins; skeletal material; scutes; egg shells; some mollusk shells; scats; plant specimens and sheets; some entomology specimens, and specimen labels) Residues from post-preparation pesticide/fungicide treatments of specimens, historic dioramas, labels Mercury vapor from herbarium pressing papers, sheets and labels treated with mercury salts during or after preparation Secondary contamination of cabinets and untreated specimens and sheets/labels by mercury vapor from treated specimens (vapor hazard) Fixatives such as arsenic, mercury, chromium salts, and formaldehyde used in specimen preparation Vapor from poorly sealed jars containing specimens preserved in fluids (alcohols, and formaldehyde and other fixatives) Asbestos reinforced plaster incorporated into taxidermy mount body forms and dioramas Deterioration of celluloid used in taxidermy mounts for modeling of soft tissues and in diorama foliage, to yield acidic or toxic products (celluloid may have been stabilized with lead white) Lead labels on specimens and lead ear liners in taxidermy mounts Chromium-tanned skins (blue-green)

	Residues on skeletal material from improperly neutralized enzyme cleaning Soot and other particulate accumulations from fires, pollution, old building systems Asbestos from decrepitating structural insulation in storage or exhibit areas Powdered lead/cadmium/PCB paint from old building finishes Powdered lead/cadmium paint from storage or exhibit case finishes Potential for explosion of ampoules improperly removed from cryogenic storage Deterioration of microscope slide mounting media to yield powdery or crystalline residues

Attachment 1

Table 3. Collections-based Hazards - Decorative Arts (Ceramics, Glassware, Jewelry, Metalware

INHERENT (pre-collection)	ACQUIRED (post-collection)
Celluloid objects (ivory substitutes)	Decrepitation of pigments to form toxic dusts
Uranium glazes/pigments in Fiesta-ware,	Powdery deposits from decomposition of glass that contains toxic pigments or other toxic material
Vaseline glass, and enameled jewelry	
Mercury in pigments	Cyanide liberated by water-washing of silver or gold plated objects with cyanide bound into finish
Mercury or cadmium alloys used in base metals	
Silver or gold plated objects with cyanide bound into finish	Cyanide deposits on metal fittings of furniture fumigated with HCN
Naturally occurring radiation from some ceramic clays	Mercury vapor from any mercury pigment or alloy
Lead and cadmium used in glazes	Radioactivity (radon gas or radiation) from objects containing radioactive material
Asbestos in some ceramic slips	Radioactive dusts from the surface of objects that contain radioactive material or from the radioactive material itself
Components of artificial patinas, such as chromium salts	Powdered lead/cadmium paint from storage or exhibit case finishes
Pigments or other additives to glass and enamels (arsenic, cadmium, cobalt, lead)	Powdered lead/cadmium/PCB paint from old building finishes
Lead cames in stained glass	Soot and other particulate accumulations from fires, pollution, old building systems
Lead carbonate and/or celluloid in synthetic mother of pearl	Asbestos from decrepitating structural insulation in storage or exhibit areas
Radioactive (luminous) dials in clocks/watches	
Poisonous seeds, as eyes in some figurines, in jewelry and rosaries, or in 19th–early 20th century craft items (castor or tiger bean, apricot stone, chinaberry, jumbie bean, rosary pea)	

Table 4. Collections-based Hazards - Ethnography/Archaeology

Organic and inorganic artifacts from various burial environments, Human and animal remains (various types of preservation including mummification), Baskets, Ceramics, Ceremonial costumes and elements, Utensils, Weapons

INHERENT (pre-collection)	ACQUIRED (post-collection)
Residues of insect/animal/fungal infestations	Residues of insect/animal/fungal infestations
Asbestos in pottery slips	Residues from fungicide/pesticide treatments
Lead glazes on ceramics	Soot and other particulate accumulations from fires, pollution, old building systems
Radioactive materials in ceramic bodies or glazes	Asbestos from decrepitating structural insulation in storage or exhibit areas
Toxic pigments (in glass beads, on ceramics, etc.), especially those in powdery states on archeological materials	Powdered lead/cadmium paints from storage and exhibit case finishes
Smoke tanned skin (aldehyde tan)	Powdered lead/cadmium/PCB paints from building finishes
Contamination of archeological materials by environmental pollutants (organic and inorganic mercury, arsenic, organic pesticides, untreated sewage, agricultural waste)	Decrepitation of ceramic wares containing toxic materials to form dusts that pose inhalation hazards
Plant/animal/mineral poisons used by a culture or applied to objects by a culture	Corrosion of metal objects, especially lead, to yield highly toxic, loosely adhered corrosion products
Toxic plants in ethnobotanical collections or used in creating jewelry or other ornaments, especially poisonous seeds, (castor or tiger bean, apricot stone, chinaberry, jumbie bean, rosary pea)	
Black powder, loaded guns, live ammunition	
Pathogens in naturally mummified human remains	
Exothermic reactions in iron removed from wet sites (sufficient to cause burns)	
Anthrax, bacteria, ectoparasites on unprocessed animal fibers	
Lead objects (bale seals, coins, bullets, cames, type, toy soldiers)	

Attachment 1

Table 5. Collections-based Hazards - Fine Arts (Drawings, Paintings, Prints, Sculpture)

INHERENT (pre-collection)	ACQUIRED (post-collection)
Lampblack and coal tar dyes	Residues of animal/insect/fungal infestations
Cadmium compounds used as phosphors in neon sculptures and mercury added to neon gas to create blue color	Residues from pesticide or fungicidal treatments
Pigments containing lead, cadmium, chromium, cobalt (particularly cobalt violet or cobalt arsenate), manganese, arsenic and mercury; and especially pigment dusts from pastels	HCN and/or HCl from heating or cutting plastics
Silicates and asbestiform contaminants in sculpture, especially soapstone and serpentine, and in art plasters	Mercury vapor from mercury pigments
Artists' canvas impregnated with mercury salts as a fungicide	Soot and other particulate accumulations from fires, pollution, old building systems
Lead in solder or other components of sculpture	Asbestos from decrepitating structural insulation in storage or exhibit areas
	Powdered lead/cadmium/PCB paint from old building finishes
	Powdered lead/cadmium paint from old storage and exhibit case finishes

Table 6. Collections-based Hazards - Furniture

INHERENT (pre-collection)	ACQUIRED (post-collection)
Preservatives such as pentachlorophenol**,** creosote, and chromated copper arsenicals in wood used to make furniture Mercury amalgams in mirror backings Horsehair and feather stuffing materials (allergens) Tropical hardwoods Residues from animal/insect/fungal infestations Formaldehyde in plywood and composition board Celluloid in imitation leather upholstery and possibly in inlays (may be stabilized with lead white) Silver or gold plated inlays or furniture hardware with cyanide bound into finish *See Textiles (below) for hazards related to fabric components*	Carcinogenic dusts from hardwoods (oak, beech, birch, maple, walnut) Respiratory illness from dusts from exotic woods (teak, red cedar, redwood, some African woods) Allergenic responses to biohazards (fungi, bacteria, endotoxins) from any wood Toxic dusts from drilling/sawing preservative treated woods Mercury vapor from amalgams Residues from animal/insect/fungal infestations Pesticide/fungicide treatment residues, including treatment of upholstery stuffings, and cyanide deposits on metal fittings of furniture fumigated with HCN Soot and other particulate accumulations from fires, pollution, old building systems Asbestos from decrepitating structural insulation in storage or exhibit areas Powdered lead/cadmium/PDB paint from old building finishes Degradation of PVC in modern pieces, resulting in release of toxic plasticizers Deterioration of celluloid to yield acidic or toxic products

Table 7. Collections-based Hazards - Geoscience Collections (Minerals, Natural and synthetic gemstones, Core and soil samples, Ore/product samples from mining/metallurgy)

INHERENT (pre-collection)	ACQUIRED (post-collection)
Toxic minerals that pose dust, vapor, direct handling hazards, (note that silicates, whose dusts are inhalation hazards, are not listed unless there is another toxic mineral present) *e.g.*: *antimony* (native element, boulangerite, bournite, bournonite, cerrantite, cerrusite, jamesonite, kermesite, polybasite, pyragyrite, scorodite, senarmonite, stephanite, stibiconite, stibnite, tetrahedrite) *arsenic* (native element, adamite, annabergite, arsenopyrite, arsenolite, claudetite, cobaltite, conichalcite, enargite, erythrite, finnemanite, georgiadesite, glaucodot, heliophyllite, koettigite, legrandite, loellingite, mimetite, miccolite, nickeline, olivenite, orpiment, pharmacooite, proustite, realgar, schultenite, skutterudite, tennantite) *asbestiform minerals* (amphibole, amosite, actinolite, anthrophyllite, chrysotile, crocidolite, tremolite) *berylium* (behoite, bertrandite, beryl, bromellite, crysoberyl, euclase, gadolinite, milarite, phenakite) *bismuth* (native element, bismuthinite) *cadmium* (greenockite, hawleyite, monteponite,) *cobalt* (bieberite, cobaltite, erythrite, glaucodot, skutterudite, sphercocbaltite) *chromium* (chromite, crocoite, eskolaite, phoenicochoroite, uvarovite) *copper sulfates* (brochantite, chalcanthite) *iron sulfides* (arsenopyrite, marcasite, pyrite) *lead* (native element, angelsite, boleite,	Decrepitation and mechanical damage that release dusts to pose inhalation and handling hazards Oxidation of iron sulfides to yield acidic products Mercury vapor from mercury minerals Mercury vapor contamination of other materials (storage cabinets, other specimens, and organic materials such as paper labels) Radon or ionizing radiation emitted by radioactive specimens over time and especially, dusts from or on radioactive specimens Soot and other particulate accumulations from fires, pollution, old building systems Asbestos from decrepitating structural insulation in storage or exhibit areas Powdered lead/cadmium/PCB paint from old building finishes Powdered lead/cadmium paint from old storage and exhibit cases

boulangerite, bournite, bournonite, cerussite, curite, descloizite, finnemanite, fiedlerite, galena, georgiadesite, heliophyllite, jamesonite, kasolite, linarite, mimetite, pentfieldite, phoenicochroite, phosgenite, pyromorphite, schultenite, vanadinite, wulfenite) *manganese* (babingtonite, bixbyite, eosphorite, ferberite, franklinite, hausmannite, hauerite, heubnerite, johanssenite, phosphophyllite, purpurite, pyrolusite, rhodocrosite, rhodonite, romanechite, psilomelane) *mercury* (native element, calomel, cinnabar, montroydite) *molybdenum* (molybdenite, wulfenite) *nickel* (native element, bunsenite, nickeline, niccolite, nitrobarite, retgersite) *selenium* (native element, selenolite) *thallium* (carlinite, pierrotite, routherite) *tellurium* (avicennite, paratellurite) *thorium* (monazite) *uranium* (autunite, bequerelite, betafite, carnotite, curite, descloizite, kasolite, samarskite, thorianite, torbernite, uraninite, uranite) *vanadium* (carnotite, karelianite, shcherbinaite, anadinite, volborthite) *There are over 200 other radioactive mineral species. Some mineral specimens also exhibit radioactivity as a function of ion substitution or the presence of radioactive materials in the matrix surrounding the specimens.* • Soil/core samples from atomic and hydrogen bomb sites • Soil/sore samples from nuclear power station sites • Soil/core samples from nuclear accident sites • Soil/rock/core samples from areas with naturally occurring radioactive species	

Table 8. Collections-based Hazards - Historic Buildings (Architectural Objects, Structures, Fragments of structures)

INHERENT (pre-collection)	ACQUIRED (post-collection)
Asbestos insulation on ceilings, boilers, pipes, and wires, and in roofing materials, sidings, and floor tiles Asbestos reinforced decorative plasters Lead, cadmium and other toxic pigments in paints Mercury compounds in interior paints Lead pipes and solder Arsenic or cyanide in old wallpaper or wall paper pastes Mercury amalgams on mirrors and mercury in some lighting materials Residues of animal/insect/fungal infestations Structural instability Soot and other particulate pollutants from external environment or old building systems Pesticide/fungicide treatment residues, including residues of termite treatments of wood Old wiring (fire hazard) Chromium salts in artificial patinas on some decorative metals PCBs in some transformers and in some interior and exterior paints Celluloid in imitation leather wallpapers Radioactive materials in old smoke detectors and lightning rods	Residues of animal/insect/fungal infestations Residues from pesticide treatments Structural instability (sometimes from excessive floor loading or from heavy visitor traffic) Decrepitation of building materials such as paints containing lead/cadmium/PCB, and asbestos-containing materials Soot and other particulate accumulations from fires, pollution, old building systems Use of old electrical systems (fire hazard) Leaks from old transformers or other equipment Deterioration of celluloid to yield acidic compounds Mercury vapor from amalgams Ionizing radiation and dusts on or from radioactive materials

Table 9. Collections-based Hazards - History/Military/Science/Technology/Transportation
(Aircraft, Ammunition, Farming equipment, Fire-fighting equipment, Equestrian equipment including tack, Household appliances and housewares, Industrial products, Musical instruments, Scientific equipment, Sporting goods, including hunting and trapping equipment, Tools and supplies from various trades, Toys, Weapons

INHERENT (pre-collection)	ACQUIRED (post-collection)
Carbon tetrachloride in glass balls as 19th-early 20th century fire extinguishers	Residues of insect/animal/fungal infestations
Battery acids in transportation collections	Residues from pesticide treatments
Mercury cathodes in Castner-Kellner electrolytic cells	Soot and other particulate accumulations from fires, pollution, old building systems
Mercury oxide pigments in marine paints	Glass balls containing CCl4 may break or degrade, releasing the carcinogenic chemical, or may explode, releasing phosgene gas
Asbestos containing insulations and fabrics	Asbestos from decrepitating insulation or other components in objects, including household appliances, or from various types of insulation in museums housing the objects
Black powder, loaded guns, live ammunition (cartridges, grenades, mortar shells), including WWII Japanese grenades containing picric acid	Powdered lead/cadmium/PCB/paints from old building finishes
Residues of animal/insect/fungal infestations	Decrepitation of object finishes with toxic pigments
Radioactive dials, sealed sources and other components of scientific and technical equipment, and some aircraft and vehicles, eyeglass lenses, static generators, and lightning rods	Deterioration of chemicals and pharmaceuticals to reactive or explosive compounds, including picric acid
PCBs and other hazardous chemicals in transformers, capacitors, and other electrical/physics collections	Mercury vapor from any mercury containing component of an object
Mercury felts in static generators in lighthouses and scientific equipment	Deterioration of celluloid, resulting in acidic residue and gases, and continued flammability
Unidentified chemicals and chemical solutions that leave explosive residues when dehydrated (e.g. picric acid)	Deterioration of PVCs resulting in release of toxic plasticizers
Celluloid objects or components (flammable)	Explosion of old tinned cans of deteriorating foodstuffs, releasing bacterial contaminants
Cadmium sulfide coatings on photovoltaic cells	

Coins, weights, bullets, and seals made of lead Lead solder in a variety of objects Toy soldiers and other toys made of lead Poisonous seeds or enamels containing uranium and/or toxic pigments, used in eyes for dolls Poisonous seeds used in maracas and rattles Tanks of compressed gases Poisoned baits in old animal traps Edged weapons	

Table 10. Collections-based Hazards - Medicine (Dental. Human, Veterinary)/ Human Anatomy

Specimens fixed/preserved in various fluids or cryogenically, Pharmaceuticals/chemicals, Corrosion casts and models Surgical/dental tools, Medical equipment
Mummified remains or other human or animal remains in dry forms

INHERENT (pre-collection)	ACQUIRED (post-collection)
Arsenic compounds, mercuric chloride, chromium salts, formaldehyde and other toxic materials used as fixatives in anatomical preparations Some chemicals used in microscope slide preparations Metallic mercury and a variety of toxic pigments used in anatomical models (including corrosion casts–models made by corroding unwanted tissue and then fixing and coloring the desired parts) Mercury in thermometers and other equipment and mercury spilled in medical kits Mercury vapor lamps Radioactive components in x-radiography equipment and other instrumentation Radioactivity from porcelain false teeth and eyeglass lenses Pathogens in specimens preserved as natural mummies, preserved cryogenically or in fluids, and remaining on old surgical/dental tools or in old glassware Residues of animal/insect/mold infestations Toxic compounds or potentially explosive residues in old pharmaceuticals, dental therapeutics, and old chemical stocks, especially picric acid residues and old bottles of ether	Degradation of old chemicals/pharmaceuticals and conversion to toxic/explosive compounds Residues of insect/animal/fungal infestations Residues from pesticide treatments Soot and other particulate accumulations from fires, pollutions, old building systems Mercury vapor from any mercury component or residue Asbestos from decrepitating structural insulation in storage or exhibit areas Powdered lead/cadmium/PDB paint from old building finishes Powdered lead/cadmium paint from storage or exhibit case finishes Vapor from poorly sealed jars containing specimens preserved in fluids Deterioration of slide mounting media for form powdery or crystalline deposits Ionizing radiation or dusts from or on radioactive objects

Table 11. Collections-based Hazards - Paleobiology (Vertebrate fossils**,** Invertebrate fossils Paleobotanical specimens, Casts, Jacketed fossils**)**

INHERENT (pre-collection)	ACQUIRED (post-collection)
Radioactive specimens, especially vertebrate fossils from several formations in the western US Specimens containing iron sulfides in microcrystalline form Residues of animal/insect infestations, especially in fossils received in plaster jackets Toxic minerals in the matrices surrounding specimens	Structural instability in old mounted fossils, especially vertebrate fossils Oxidation of iron sulfides to acidic products as a function of poor museum environments Acid residues on specimens as a result of improperly neutralized acid digestion treatments to remove matrices Infestations of animals/insects in jacketed fossils Radon and ionizing radiation from radioactive specimens and radioactive dusts from or on decrepitating radioactive specimens Silicate and other toxic dusts from decrepitation or mechanical damage to specimens Asbestiform plasters as infills in some specimens Degrading cyanoacrylate adhesives used on specimens Deteriorating water glass (sodium metasilicate) used as adhesive/fills Asbestos from decrepitating structural insulation in storage or exhibit areas Powdered lead/cadmium/PDB paint from old building finishes Soot and other particulate accumulations from fires, pollution, old building systems

Table 12. Collections-based Hazards – Photography (Film-based media, Photographic prints, Photography equipment, Chemicals used in photographic processes)

INHERENT (pre-collection)	ACQUIRED (post-collection)
Residues of fungal infestations Nitrocellulose film Cellulose acetate films Image materials (ferric ferrocyanide/ferrous ferricyanide, platinum salts, cellulose nitrate in collodion, pigments and aniline dyes) Materials used in toning (hydrochloric acid, hydrogen sulfide, platinum sulfur dioxide, selenium compounds, uranium nitrate) Old chemical stocks including toners (see above), developers (hydroquinone, monomethyl para-aminophenol sulfate, potassium bromide, sodium hydroxide, sodium sulfite, sodium thiocyanate,) stop baths/fixers/hardeners (acetic acid, formaldeyde solutions, potassium chromium sulfate), hypo eliminators (hydrogen peroxide), intensifiers/reducers (ammonia, dichromates, HCl. mercuric chloride, mercuric iodide, potassium cyanide, potassium ferricyanide, potassium permanganate, silver nitrate, sodium cyanide) Mercury salts used in some early photographic printing processes	Release of highly toxic hydrogen selenide gas during restoration of selenium toned photographs Deterioration of old chemicals to highly reactive or explosive materials Spontaneous combustion of decomposing nitrate film Deterioration of nitrate or acetate films with release of volatiles (acetic acid, acetone, n-butanol, butyric acid, cyclohexane, methylene chloride, nitrogen dioxide, propionic acid, 1,1,1,-trichloroethane) Soot and other particulate accumulations from fires, pollution, old building systems Mold spores from fungal infestations Mercury vapor from mercury compounds

Table 13. Collections-based Hazards – Textiles (Fibers and fabrics - natural organic, mineral, metal, synthetic; Upholstery, Costume, Decorative items, Ceremonial vestments)

INHERENT (pre-collection)	ACQUIRED (post-collection)
Residues of animal/insect/fungal infestations Dyes and other colorants, particularly aniline dyes and green dyes made with copper arsenate Synthetic mother of pearl made with lead carbonate and/or celluloid Formaldehyde in polyesters and permanent-press fabrics Mercury treatments in felt production Feathers and animal hair in some clothing items or accessories (allergens) Chromium tanned footwear Antimony, arsenic, chromium, lead, or ferric ferrocyanide (Prussian blue) used to weight silk	Evolution of formaldehyde vapor from heating polyester or permanent press fabrics (as in pressing) Mercury vapor evolution from mercury treated material Decrepitation of synthetic mother of pearl Dyestuff transfer during cleaning processes Evolution of HCN from action of ultraviolet radiation on weighted silk Toxic dusts from fabrics dyed with arsenicals Residues of animal/insect/fungal infestations Soot and other particulate accumulations from fires, pollution, old building systems Powdered lead/cambium paint from old storage or exhibit cases Powdered lead/cadmium/PDB paint from old building finishes Asbestos from decrepitating structural insulation in storage or exhibit areas

Tables1-13 compiled from: Alwis *et al*. 1999, Bachman 1981, Blount 1993, Brady and Clauser 1991, Briggs *et al*. 1983, Brown 1997, Caneva *et al*. 1991, Carman and Carman 1989, Caufield 1989, Cosgrove *et al*. 1992, Croat 1978, Czerwinska and Kowalik 1979, Daniels 1987a, Daniels 1987b, Deucher *et al*. 2000, Dicus 2000, Down 1989, Eastman Kodak Company 1985, Faller and Price 1992, Fenn 1989, Gage *et al.* 1995, Gernsheim 1981, Grant 1980, Green and Daniels 1987, Hawks and Bell 1999, Hawks and Makos 2000, Hawks and VonEndt 1990, Hey 1980/81, Hildebrand 1968, Howie 1984, Howie 1986a, Howie 1986b, Howie 1992, Hoy and Catling 1981, International Agency for Research on Cancer 1995, Irwin *et al*. 1972, Jiggens *et al*. 1998, Keller 1981, Kondratas 1991, Lambert 1994, Lampe and McCann 1985, Landi 1992, Leene, 1972, Lindsey 1987, Lloyd and Mullany 1994, Long 1909, Makos 1998, Makos and Dietrich 1995, Martin and Zalk 1997, Mayer 1991, McCann 1992, McNeil 1996, Miller 1991, Mills *et al*. 1995, Moe 1998, Mottana *et al.* 1978, Nishimura 1995, Pabst 1987, Pritchard and Kruse 1982, Puffer 1980, Purewal 1999, Rader and Ison 1999, Ramatowski 2001, Reilly 1986, Rixon 1976, Rogers *et al.* 1989, Rossol 1994, Rossol 2000, Rowell 1953, Rutzky *et al*. 1995, Shaw and Rossol 1991, Simione 1995, Simmons 1995, Smurz 2001, Spafford-Ricci and Graham 2000, Thorp 1990, Upton 1993, Waller *et al*. 2000, Walters 1925, Watkinson and Leigh 1978, Williams 1994, Williams 1999, Williams and Hawks 1987, Windholz *et al*. 1983, and the experience of the authors and their colleagues.

Table 14. Preliminary list of materials used as pesticides/fungicides in museum collections

alcohol	formaldehyde
aldrin	heptachlor
argon	hydrogen cyanide
arsenic salts	hydrogen phosphide
bendiocarb (Ficam)	iodofenphos (o,o-dimethyl o-(2,5-dichloro-4-iodophenyl) phosphorothioate)
benzene hexachlorides (*e.g*., Lindane)	lauryl pentachlorophenate (Durotox, Mystox)
borax	malathion
boric acid	menthol
camphor	mercuric chloride
carbaryl	methyl bromide
carbolic acid (phenol)	methyl bromide/ethylene dibromide
carbon dioxide	methyoxychloride
carbon disulfide	naphthalene
carbon polysulfide	nitrogen
carbon tetrachloride	orthodichlorobenzene
carbon tetrachloride/ethylene dichloride	othrophenylphenol
chlordane	paradichlorobenzene
chloropicrin	pentachlorophenol
chlorpyrifos (Dursban)	phosphine
creosote	propoxur (Baygon)
diatomaceous earth	pyrethrins (synthetic)
Diazinon	salicylic acid
dichlorodiphenyltrichoroethane (DDT)	silica gel
dichlorvos (Vapona, DDVP)	sodium aluminum fluorosilicate (Larvex)
dimethyl dichlorovinyl phosphate resin strips (No-Pest Strips, DDVP)	sodium arsenite (Sibur)
dieldrin	sodium fluorosilicate
Edolan U	spices and aromatic oils
endrin aldehyde	sulfuryl fluoride
Endosulfan II	strychnine
ethylene dibromide	thymol
ethylene oxide	tobacco/nicotine
fenitrothion (methyl nitrophenyl phosphorothioic acid ester)	1,2,4-trichlorobenzene

Table 14 compiled from: Ballard and Baer 1986, Brokerhof 1989, Carpenter 1985, Cranstone 1985, Croat 1978, Dawson and Strang 1992, Derrick *et al*. 1990, Funk and Sherfey 1975, Glastrup 1987, Goldberg 1996, Hawks *in press*, Hawks and Von Endt 1990, Hawks and Williams 1986, Howe et al. 1999, Johnson 1999, Makos and Dietrich 1995, McGiffin 1985, Muir *et al*. 1981, Museum of New Mexico 1997, Myers 1965, Peltz and Rossol 1983, Pryor 1982, Renshaw-Beauchamp 1978, Rossol and Jessup 1996, Seifer *et al*. 2000, Selwitz and Maekewa 1998, Sirois 1988, Sirois and Taylor 1988. Story 1985, Tilbrooke 1978, Vetter and Bauer 1978, Vingelsgaard and Schmidt 1986, Whitmore 1965, Williams et al. 1986, Winks and Champ 1977, Zycherman and Schrock 1988.

Table 15. Preliminary list of materials that may have left persistent residues after use on museum collections

arsenic salts (including sodium arsenite) – fixatives; particulate residues
bendiocarb – particulate residue (loses efficacy in a matter of months)
benzene hexachlorides (Lindane) – residues in objects and possibly particulate residues
borax – particulate residue
camphor – may offgas very slowly from materials over time
chlordane – recrystallizes on objects
chloropicrin – unchanged chloropicrin residues
chlorpyrifos – particulate residue; sufficiently volatile to redeposit on other surfaces
creosote (from coal tar) – long-term retention in wood
diatomaceous earth – particulate residue
dichlorodiphenyltrichoroethane (DDT and isomers) – particulate residue
dimethyl dichlorovinyl phosphate resin strips – liquid acids as decomposition products
Edolan U – mothproofer designed to give long-term protection
ethylene oxide – forms ethylene chlorohydrin residues that may persist for long periods in objects
formaldehyde – fixative for organic material
hydrogen cyanide – residues on metal surfaces
lauryl pentachlorophenate – designed for prophylactic use it presumably lasts for many years
mercuric chloride – fixative; unreacted salts offgas mercury vapor, can convert to mercury sulfide, mercury oxide, and possibly colloidal mercury
methoxychloride – residues in objects and possibly particulate residues
methyl bromide – numerous reaction products with proteinaceous materials and gas may be retained in objects for long periods
naphthalene – recrystallizes on objects; may continue to offgas vapor for many years
orthodichlorobenzene - recrystallizes on objects; may continue to offgas vapor from objects for many years
paradichlorobenzene - recrystallizes on objects; may continue to offgas vapor from objects for many years
pentachlorophenol – designed for long-term retention in wood
silica gel – particulate residue
s*odium aluminum fluorosilicate* – particulate residue
sodium fluorosilicate – particulate residue
spices and aromatic oils – particulate residue (spices); slow evolution of vapor (aromatic oils)
sulfuryl fluoride – slow release of vapor over time (especially in storage cabinets)
strychnine – particulate residue
thymol – slow release of vapor over time
tobacco – particulate residues

Table 15 compiled from: Bachmann 1981, Briggs *et al*. 1983, Dawson and Strang 1992, Funk and Sherfey 1975, Green and Daniels 1987, Glastrup 1987, Howe *et al* 1999, Peltz and Rossol 1983, Hawks and Bell 1999, Pryor 1982, Purewal 1999, Rader and Ison 1999, Seifer *et al* 2000, Sirois 1988, Sirois and Taylor 1988, Tilbrooke 1978, Vingelsgaard and Schmidt 1986, Waller *et al*. 2000, Whitmore 1965, Williams *et al*. 1986, Windholz *et al*. 1983, Zycherman and Schrock 1988.

Table 16. Sample list of suspect asbestos-containing materials

The following list intended as a general guide to show which types of materials may contain asbestos. It is not all-inclusive (USEPA, 2000). Use this list as clues to determining if asbestos may have been used in collections storage area construction, or in collection objects themselves. The two most common occurrences of asbestos materials in collections or exhibits are in scientific collections (physics, electrical, mineral sciences) and in art plasters (sculpture, diorama settings, casts, taxidermy modeling or forms).

CATEGORY	PRODUCTS	
Surfacing Materials [a]	Heating and Electrical Ducts Decorative Plaster (dioramas, casts, sculpture, taxidermy) Acoustical Plaster	Spray-Applied Insulation Blown-in Insulation Vinyl Wall Coverings Textured Paints/Coatings
Thermal System Insulation (TSI) [b]	Cement Pipes HVAC Duct Insulation Boiler Insulation	Breaching Insulation Pipe Insulation (corrugated air-cell, block, etc.)
Textiles [c]	Ductwork Flexible Fabric Connections Cord, Rope, Yarn Electric Wiring Insulation Electrical Cloth Roofing Felt Thermal Paper Products	Packings, valves, flanges High Temperature Gaskets Laboratory Gloves Fire Blankets Fire Curtains (theater, welding)
Miscellaneous/Other	Elevator Brake Shoes Cement Wallboard Cement Siding Asphalt Floor Tile Vinyl Floor Tile & Mastics Vinyl Sheet Flooring Cooling Towers Flooring Backing Construction Mastics Electrical Panel Partitions Ceiling Tiles & Mastics, Lay-in Panels Transite board (in many household appliances) Vehicle engine firewalls	Chalkboards Shingles (roofing, siding, clapboard) Base Flashing Spackling, patching, taping, or joint Compounds Fire Doors Caulking/Putties Laboratory Hoods/Table Tops Adhesives Wallboard Elevator Equipment Panels Artificial ashes & embers Crayons

[a] Defined by OSHA as “material that is sprayed, troweled-on, or otherwise applied to surfaces (OSHA, 1998).

[b] Defined by OSHA as “asbestos-containing materials applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain (OSHA, 1998).

[c] May also be surfacing , TSI, or other; separated here to highlight potential collection objects.

Table 17. Highly reactive and peroxide-forming materials

HIGHLY REACTIVE, SHOCK AND HEAT SENSITIVE MATERIALS
(Furr 2000)

Ammonium perchlorate	1-Chloro-2,4-dintrobenzene	Ethyl nitrate
Ammonium permanganate	Cumene hydroperoxide	Hydroxylamine
Anhydrous perchloric acid	Diacetyl peroxide	Peroxyacetic acid
Butyl hydroperoxide	Dibenzoyl peroxide	Picric acid
Butyl perbenzoate	Dilsopropyl peroxydicarbonate	Trinitrobenzene
t-Butyl peroxyacetate	Dinitrobenzene (ortho)	Trinitrotoluene
t-Butyl peroxypivalate	Ethyl methyl ketone peroxide	

TYPES OF COMPOUNDS KNOWN TO AUTO-OXIDIZE TO FORM PEROXIDES
(National Research Council, 1995)

- Aldehydes
- Ethers, especially cyclic ethers and those containing primary and secondary alkyl groups
- Compounds containing benzylic hydrogens
- Compounds containing allylic hydrogens including most alkenes; vinyl and vinylidenes
- Compounds containing a tertiary C-H group

CLASSES OF CHEMICALS THAT CAN FORM PEROXIDES UPON AGING
(National Research Council, 1995)

Unsaturated materials may polymerize violently due to peroxide initiation:

Acrylic acid	Methyl methacrylate	Vinyl chloride
Acrylonitrile	Styrene	Vinyl pyridine
Butadiene	Tetrafluoroethylene	Vinylidene chloride
Chlorobutadiene (chloroprene)	Vinyl acetate	
Chlorotrifluoroethylene	Vinyl acetylene	

Following are peroxide hazards upon concentration (distillation/evaporation)

Acetal	Dicyclopentadiene	Methyl acetylene
Cumene	Diethylene glycol dimethyl ether	Methyl cyclopentane
Cyclohexene	Diethyl ether	Methyl-I-butyl ketone
Cyclooctene	Dioxane	Tetrahydrofuran
Cyclopentene	Ethylene glycol dimethyl ether	Tetrahydronaphthalene
Diacetylene	Furan	Vinyl ethers

Peroxides derived from the following may explode without concentration

Organic:	Inorganic:
Divinyl ether Divinyl acetylene Isopropyl ether Vinylidene chloride	Potassium metal Potassium amide Sodium amide

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COLLECTION STORAGE CASES WITH HAZARDOUS MATERIAL COMPONENTS

PURPOSE: This document establishes policy and guidelines for proper disclosure, transfer and disposal of collections storage cases with hazardous material components.

BACKGROUND

Collection storage cases throughout at Smithsonian Institution (SI) are frequently transferred to non-Smithsonian organizations, or slated for disposal. Many storage cases were constructed of hazardous materials, or contaminated with substances from the objects or specimens stored within them. Of most concern are:

- Lead containing paint
- Pesticide treated gaskets (e.g., arsenic or mercury-treated felts strips on unit doors)
- Treatment, preservative or pesticide residues (e.g., heavy metal particulates, persistent organic crystallizations such as naphthalene)

Before cases can be properly disposed or transferred (e.g., gift, surplus, deaccession), full written disclosure regarding the presence of known or suspected hazardous materials must be provided to the end user/recipient. This documentation must accompany the cases upon transfer from the SI. Disclosure meets requirements of the SI Hazard Communication and Hazardous Waste Management policies, and federal regulations established by the Occupational Safety and Health Administration (OSHA) and the U.S. Environmental Protection Agency (USEPA). The General Services Administration, which is a major outlet for federal agency surplus items, or other federal or private sector organizations accepting cases, may have more stringent requirements on documentation, requiring that they be contacted directly prior to transfer/disposal actions. Depending on the nature of the transfer, the case is to be abated to reduce the hazard risk, and OSHEM is to be consulted on the appropriate methods and regulations.

These guidelines establish methods for hazard identification and disclosure, requirements for abatement to reduce risks, and conditions under which cases with unabated hazards cannot be transferred.

HAZARD IDENTIFICATION AND DISCLOSURE

Lead Containing Paint

The Hazard: Lead containing paints on cases and their drawers or shelves can pose an inhalation or ingestion hazard to adults (from paint dust or fume as a result of sanding, cutting or welding) and to children (for example, if cases with flaking paint are used in a children's hands-on area). The presence of lead paint must be disclosed so users can make informed decisions about necessary safety precautions to be taken.

Standards**:** OSHA lead standards apply to work tasks involving any detectable concentration of lead. USEPA further distinguishes the concentration quantity defined as "lead-based paint".

- OSHA standards on Lead, require that workers be protected from exposure to lead from activities involving materials, paint, objects containing ANY detectable concentration of lead (lead-containing). Therefore, lead surveys must identify any lead-containing paint, and include both detectable concentrations as well as measurements noted as being below the analytical limit of detection.

- USEPA and local jurisdictions, further define "Lead-based paint", for the purpose of regulatory abatement action, as paint or other surface coatings that contain lead equal to or greater than 1.0 milligram per square centimeter of surface area (typically analyzed by X-ray fluorescence-XRF), 0.5 percent by weight or 5,000 parts per million by weight (typically analyzed as a lead paint bulk chip sample).

Sampling Methods: Sampling methods and calibration of instruments used to identify lead, codified by the USEPA in 40CFR745.227, must be performed in accordance with the U.S. Department of Housing and Urban Development (HUD) "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing" Chapter 7: Lead-Based Paint Inspection (1997 Revision) using one or both of the following methods. NOTE: Both the case coating and the drawers must be sampled, as drawer fronts are often painted.

a) An X-ray fluorescence (XRF) spectrum analyzer, with units of measure in milligrams per square centimeter [NOT parts per million (PPM)], or
b) Bulk paint chip sampling, performed in accordance with HUD methodology and analyzed by an accredited laboratory participating in the EPA's National Lead Laboratory Accreditation Program, with units of measurement as percent lead by sample weight or parts per million by sample weight.
c) **NOTE: XRF measurements CANNOT be used for hazardous waste determinations!** See the last section of this guideline for the allowable methods for determining hazardous waste.

Reporting Requirements: Reports must be provided to OSHEM for technical review prior to case transfer or disposal actions. Reports must include:

- Name of analyst and documented training on the use of the XRF and/or bulk sampling methods. For SI staff proficient in the use of XRF technology, training documentation must include, as a minimum, the XRF manufacturer's instrument training. For OSHEM staff, training must also include USEPA certification as a Lead Inspector. Environmental contractors must be certified as a Lead Inspector/ Risk Assessor and licensed by the appropriate jurisdiction having authority.

- Lead concentrations detected by XRF per case, in milligrams per square centimeter of surface area, and the referenced detection limit of the XRF instrument.

- Manufacturer information on the XRF instrument, calibration protocols and confirmation that measurements were taken in accordance with HUD specifications as referenced in the SI Safety Manual Chapter 23, "Lead-Containing Materials".

Arsenic, Mercury or Other Pesticide Treated Gaskets

The Hazard: Historic records indicate that many collection case gaskets, particularly those in cases used by NMNH and NMAH, were manufactured or treated specifically with arsenic for pest management. Arsenic is a potent toxicant that is a known human carcinogen through both the inhalation and oral exposure routes. Mercury has also been detected in past sampling of gaskets in various museum collection cases. Elemental and inorganic mercury compounds can be absorbed through the skin, ingested accidentally if on the hands or face, or inhaled in vapor form, and contribute to systemic toxicity. ***Therefore, all felt gasketing must be presumed to contain hazardous materials, unless manufacturer data or analytical data proves otherwise.***

Standards: Other than lead, there are no directly applicable federal standards relating measurable surface concentrations of heavy metals to health impact.

Sampling Methods: Determination of the presence (i.e., results at or above detection) or absence of arsenic, mercury or other pesticides can be accomplished by a number of accredited methodologies including:

a) XRF instrumentation, properly calibrated, maintained and used in accordance with manufacturer's instructions and training;
b) Wipe or bulk sampling of gasket material in accordance with NIOSH methodology and AIHA-accredited laboratory analysis (consult OSHEM).

Reporting Requirements: Reports must be provided to OSHEM for technical review prior to case transfer or disposal actions. Reports must include:

- For XRF:
  - Name of analyst and documented training on the use of the XRF and/or bulk sampling methods. For SI staff proficient in the use of XRF technology, training documentation is to include, as a minimum, XRF manufacturer's instrument training.
  - Metal or chemical agent concentrations detected per case and the referenced detection limit of the XRF instrument.
  - Manufacturer information on the XRF instrument and calibration protocols.

- For wipes or bulks:
  - Name of analyst,
  - Sampling methodology,
  - Concentrations reported by analyte and per case,
  - Accredited laboratory and its full analytical report.

Chemicals Used for Past Fumigation or Treatment

Disclosure must be made by the collecting units regarding chemicals, particularly the volatile organics, used to fumigate the cases or otherwise treat the collections (e.g., Vikane, PDB, naphthalene). An assessment is then to made by OSHEM and the facility as to whether any such contaminants may still be present on the case and the potential hazard(s) that might be posed upon transfer.

RECOMMENDATIONS FOR ABATEMENT AND LABELING

Lead Containing Paint

1. Case coatings should be in good (not flaking) condition prior to transfer. Coating in poor condition should be stabilized with a lead paint encapsulant and over-layers of lead-free paint.
2. Units with lead-based paint must not be transferred to children's museums or hands-on learning centers where children may be in contact with lead coated surfaces.
3. Prior SI experience has shown that physical removal of painted metal jacketing from old wooden cases is prohibitively expensive, requiring licensed abatement contractors, and is not recommended.

Gaskets

1. Prior to any transfer, hazardous gaskets first should be removed using safe work protocols established by OSHEM and the facility Safety Coordinator, the underlying surface sealed and new (nonhazardous) gaskets adhered prior to transfer.
2. New gaskets, to fit any required thickness or shape, are easily procured through standard case vendors (such as Viking Metal) currently servicing the SI.

Cleaning and Abatement of Residual Chemicals and Insect Detritus Inside Cases

1. Per due diligence, and prior to transfer, cases and drawers shall be cleaned of all visible dust and debris with a HEPA-filtered vacuum, to remove any live insect stages and/or particulate contamination from past chemical treatments of the cases or their stored objects/specimens.
2. After cleaning, the facility, in consultation with OSHEM, is to determine whether any residual contamination still poses a hazard and if further abatement is needed.

Disclosure Documentation and Labels

Collection cases must be accompanied by written documentation including hazard identification reports and, as feasible, individually labeled with the known or suspected hazard. Consult MSC, NMNH, or NMAH safety office for examples of labeling used on their case transfers. Examples: "Caution Paint Contains Lead" or "Danger Gaskets contain Arsenic, Carcinogen Risk".

HAZARDOUS WASTE DISPOSAL (SEE SI SAFETY MANUAL CHAPTER 29 FOR MORE DETAILS)

If the facility intends to dispose of collection storage cases which have known or suspected hazardous materials, a determination must first be made as to whether the cases constitute hazardous waste. One of the following two allowable methods shall be used:

1. The cases may undergo a Toxicity Characteristic Leaching Procedure (TCLP) test, or
2. A decision may be based upon knowledge of the waste stream from past representative TCLP test results or documented history (e.g., manufacturer data of paint and materials).

The facility hazardous waste coordinator and/or OSHEM must be contacted to arrange for this testing, which must be done by a qualified person through a certified analytical laboratory. All surfaces, including the drawers and superficial gasketing, must be included in a representative TCLP sample. ***XRF measurements (as used for lead paint or metal sampling) ARE NOT THE SAME as a TCLP test and CANNOT be used for hazardous waste determinations!***