

Responses to Webinar Questions

Contributors:

Kathryn Makos, Industrial Hygienist, Smithsonian-Retired

Kerith Koss Schrager, Objects Conservator, Private Practice, Co-Chair AIC Health & Safety Committee

Tara Kennedy, Preservation Services Librarian, Center for Library Preservation & Conservation, Yale University, AIC Health & Safety Committee

Catharine Hawks, Conservator, National Museum of Natural History, Smithsonian

Nora Lockshin, Senior Conservator, Smithsonian Institution Archives

Please see the handouts and bibliography provided with the original presentation for additional information on many of these topics.

<http://www.connectingtocollections.org/arsenic-and-old-lace-controlling-hazardous-collection-materials/>

General Health & Safety/Administration/Equipment

1. How do you find out the legal safety requirements for your area?

Assuming you have no overarching administration (such as a university, government agency, larger corporation, etc.) and/or no safety or risk management personnel on staff, then you start with your federal agency. In the US, this is the Occupational Safety and Health Administration (OSHA) <https://www.osha.gov/about.html>. All states must follow federal regulations, but state and local municipalities may have additional regulations.

Work your way down to find your regional/area offices or state plans. A call into the closest one will *not* get you inspected; they will help answer your question of applicable rules. Of course, the OSHA website itself has all the regulations too. The Onsite Consultation Program (https://www.osha.gov/dcsp/smallbusiness/program_info.html) could help interpret which are applicable to your workplace. Fire safety, protection, flammable liquid storage, etc. might be best handled by your local Fire Marshall. Fire departments and county public health and environmental departments are also very happy to visit and explain the rules and your responsibilities. They would rather do this *before* a fire or hazardous waste spill happens!

- Kathryn Makos

2. Dealing with unresponsive supervisors.

From the OSHA website: "Under federal law, you are entitled to a safe workplace. Your employer must provide a workplace free of known health and safety hazards. If you have concerns, you have the right to speak up about them without fear of retaliation."

Our recommendation is first to remind your supervisor that he/she is responsible legally for your and coworkers' safety. You probably have, and now it's awkward, yes? So go to your human resource/personnel officer. Or the next level manager and voice your concerns in terms of your fear for safety. In that tone, a dialogue will be easier. But remember that under the law you have the right to stop doing any work activity that you feel is dangerous. Read the OSHA site on worker rights, with a Q&A you will find helpful. Last resort, file an anonymous complaint with OSHA; they must inspect promptly. <https://www.osha.gov/workers/index.html>

- Kathryn Makos

3. Where can we obtain the air sampler?

An air sampler could mean the personal exposure sampling device that is worn by the worker and contains a sorbent cassette attached via tubing to the collar area “breathing zone” or a handheld device, like the mercury vapor analyzer that measures mercury concentrations in the air. In either case, you will need to find the services of a health and safety consultant who will have this equipment and, most importantly, understand what the results mean. If you are affiliated with an academic institution or a government agency, they will have health and safety professionals on staff to assist you. If you have an insurance company, it will have a risk management department or workers compensation firm that can help (in insurance company’s best interest to have hazards reduced). If you are a small private historic house or studio, you could contact OSHA’s Non-Compliance On-Site Consultation for free monitoring, control recommendation and training assistance. <https://www.osha.gov/dcsp/smallbusiness/consult.html>. Another option is to hire a consultant firm, which can be found through the American Industrial Hygiene Association (AIHA): <https://www.aiha.org/publications-and-resources/Pages/Consultants-Listing.aspx>

- Kathryn Makos

4. Recommendations for then decontaminating the HEPA vacuum and attachments after using on hazardous items?

The most direct answer is from the manufacturer’s technical representative, as every HEPA vacuum is designed differently regarding whether the filters and bags are pre- or post-fan. This impacts what hazardous particulates you are exposed to as you open the device for filter change and cleaning. Nilfisk, for instance, had designed a filter/bag change-out procedure for post-asbestos decontamination use involving putting the entire vacuum inside an asbestos glove-bag (a flexible containment that encloses an item to allow you to insert plastic arm sleeves into the bag to work safely on the item). This can be adapted for change out of bags and filters collecting any hazardous particulates like arsenicals. Some types though may be much easier to change because of the configuration. So, repeating, call your manufacturer.

If you are consistently using a vacuum for a particular hazard, it is wise to have a dedicated vacuum for that purpose, which is clearly labeled to avoid cross-contaminating through accidental use on, say, storage shelves.

- Kathryn Makos

5. What kind of UV light should we get and where do we find it?

Most conservation labs will use a high intensity long wave (365nm) UV lamp, such as the Blak-Ray UV lamp, because they need a lamp that will fully illuminate larger objects. These tend to be very expensive (\$500+) and are not necessary if you are, for example, just looking to identify uranium glass (see discussion of uranium glass in question #36). Any commercially available UV light (black light) will work as long as it specified that it is actually a UV lamp (look for the wavelength of light emitted in the description or specifications). Lamps can be found through conservation and laboratory supply stores, such as Talas (<http://talasonline.com/lights>), as well as from Amazon and other online retailers.

- Kerith Koss Schragar

Personal Protective Equipment (PPE)

6. Should lab coats that we used while handling items w/arsenic be washed in a dedicated washer? Or any other special instructions for washing?

This is a difficult question to answer in general as it all depends on the extent of contamination. If handling contaminated collections routinely, and you are not concerned with liquid chemical splashes, you may want to invest in inexpensive disposable lab coats. Investing in many coats and having them commercially laundered (with janitorial service uniforms) is another option as long as you disclose to them what hazardous materials might be on them. Or, a dedicated washer on site with double or triple rinse can be useful as long as this doesn’t run counter to any local waste water restrictions (this gets tricky). We do not advise ever using your home washer for contaminated clothing, even if you plan to wash them separately.

- Kathryn Makos

General Chemicals

7. We have a complete Chemical Laboratory filled with original chemicals.

Old chemicals, whether left by a visiting scientist ages ago or part of an historic collection, require the same management plan.

Conduct a complete and detailed inventory of the substance. If there are mixtures, the original formula and ratios must be catalogued. You may need to hire an experienced chemist to help identify contents if records do not exist.

If they are non-collection, then dispose of all as hazardous material waste unless it is unopened, not past its use date (i.e., not in danger of degradation reaction, etc.) and acceptable to be re-used by another scientist. If there is any concern over whether the container is now shock-sensitive, etc. call the Fire Department for safe retrieval and disposal.

Chemical collections must be studied with the same rigor and decisions made as to whether the contents can be safely disposed with the bottle and historic label preserved; or whether the contents are deemed important and if not subject to degradation over time, the chemical containers need to be stored inside secondary containment even on display (artfully so!). Be very careful when handling old glass bottles as many will shatter.

- Kathryn Makos

8. What is the best way to identify which volatiles you might have in your collection?

Unfortunately this is a very general question and without specific details--the answer will also be very general. First, if you actually do not know the identities of volatile chemicals in your collection, you may have little choice other than to hire an experienced chemist to conduct these tests. Or, contact your local county hazardous materials squad for advice on local laboratories that could help you. A local college chemistry department may want to advise as a project for students. It is always recommended that no collector adopt an orphan collection, or accept an acquisition, without full provenance and identification of materials. [See #7 above for more actions]

If you don't feel comfortable developing such a plan, this might be a good time to contract with a health and safety professional. We can help you find one in your area.

Email the AIC H&S Committee at HealthandSafety@conservation-us.org.

- Kathryn Makos

9. What about carbon tetrachloride, which was used in old fire extinguishers? I've heard from our fire dept. that it is a known carcinogen. We've several in our collection, as there was a fire extinguisher company (Red Comet), whose factory was located in Littleton.

Are these the red glass bulb-type of extinguishers? They would hang from the ceiling in brass holders of buildings. When the fire got hot enough, it would cause these glass bulbs to burst and the carbon tetrachloride would put out the fire. It was also used in Halon: so-called "clean" fire suppression systems. The use of carbon tetrachloride was phased out because of its effects on the ozone layer. It is also a suspected carcinogen.

These "Red Comet" type of extinguishers are only a hazard if they are cracked or break open (inhalation, skin, and/or oral exposure). Store them on low shelves in a cool, dry space in well-padded storage boxes.

If you're not comfortable keeping them, you can deaccession the fire extinguishers and the fire department can dispose of them (depending where you live). Take photographs of them so that you at least have photos as a record.

-Tara Kennedy

Paper, Photography & Film

10. Is there any generally used product that would make old documents hazardous?

Generally in recent history? No. Some things to look out for since people have used materials as pest deterrents that might pop up in old documents and books:

- White powdery substances in older books may be flea powders or other powder-based insecticides. Use hand, skin, and eye protection if handling items that you suspect may have come into contact with these materials. An N-95 respirator is also recommended.
- Arsenic was sometimes used in paste (to make it “last longer”) when doing old restoration treatments like silking (literally lining a document with silk).

Some historic pigments contained hazardous elements such as cadmium, arsenic, and mercury. Colored texts or illuminations may contain these pigments.

The biggest “product” that is hazardous in paper-based collections is mold. If working with suspected moldy collections, wear hand, skin, and respiratory protection.

-Tara Kennedy

11. I gave a list of chemicals used to make architectural photo-reproductions to a doctor who specializes in occupational safety and health to identify potentially harmful chemicals and he selected these. He didn't know if touching the plans or inhaling vapors/fumes would be hazardous to collection managers. Any thoughts? Aniline Prints – Chromium or Vanadium Diazo Prints – Phenol or naphthol-base coupler, and possible off-gassing of alkaline vapors (because of ammonia development) or sulfur-based products. Sepia Diazo Prints – Phenol-base coupler, phenol derivative such as resorcinol, and possible off-gassing of alkaline vapors (because of ammonia development) or sulfur-based products. Blueprints – Ferric ammonium citrate and potassium ferricyanide plus water results in ferrocyanide and probably residual ferrous ferrocyanide.

There is a difference in the exposure of the chemical used *while making architectural reproductions* versus exposure to the architectural reproduction item *years after its manufacture* with architectural reproduction chemicals. There are plenty of precautions to take while creating these types of architectural reproductions, but those precautions do not necessarily then spill over into handling the collection items themselves. For example, a lot of the ammonia-based chemicals you mention have a low boiling point, so they would have volatilized off the prints quickly after manufacture.

Phenolic compounds are different than straight-up phenol, which is naturally occurring as a solid and synthetically manufactured as a liquid. Most of the effects from those are dermal injury in its pure state. The phenolic residues in the paper will actually do more harm to the paper than to the person handling it.

Sulfuric acid is a strong acid that is used in the manufacture of Prussian Blue (potassium ferricyanide), the blue in blueprint, but it is the precipitate that is used as the colorant, not the acid itself. Blueprints are created utilizing the photosensitivity of Prussian Blue, and not by using sulfuric acid.

A good thing to remember: seriousness of exposure to a chemical is concentration multiplied by the amount of time of exposure. These chemicals will be in minute concentrations years after manufacture and exposure to the drawings is minimal. If you are still concerned, wear protective gloves (check out AIC Health & Safety Committee's Chemical Protection Guide as well as the selection guide by the manufacturer of the brand of gloves that you purchase):

http://www.conservation-wiki.com/w/images/7/76/H%26S_PPE_Chemical_Selection_Guide_2_Page.pdf

-Tara Kennedy

12. Would deteriorating microfilm/microfiche be considered a hazard?

Microfilm/fiche bases are composed of either cellulose acetate or polyester. Polyester is a stable plastic and should not decompose. Cellulose acetate is an unstable plastic and can deteriorate in unstable environmental conditions. When breaking down, it gives off acetic acid and a vinegar smell and is often referred to as “vinegar syndrome.” In large concentrations, it can be an eye and mucous membrane irritant. If you are experiencing any irritation, wear eye protection (unvented goggles) and a respirator that protects you against acids and solvents. While acetic acid vapor is the most common degradation product, propionic or butyric acid vapors may be found as well.

It is always worth mentioning in a discussion about the degradation of film materials that nitrate films are major safety concern. Microfilm/fiche is not made of cellulose nitrate because cellulose nitrate was phased out as a film material before microfilm/fiche was produced. Be advised that degrading nitrate film is a very serious hazard due to the flammability of cellulose nitrate and because the gaseous by-products are strong acids and oxidizing agents. Consult ANSI/NFPA 40 Storage and Handling of Cellulose Nitrate Motion Picture Film.

For a comprehensive discussion of film supports including checklists on handling, storage and degradation: Nishimura D., “Film Supports: Negatives, transparencies, microforms and motion picture film” in *Storage of Natural History Collections: A Preventive Conservation Approach*, C. Rose, C.A. Hawks, H.H. Genoways (eds), SPNHC 1995, pp 365-94.

-Tara Kennedy & Kathryn Makos

Preserved Specimens (Formaldehyde & Alcohol)

13. If you switch your specimens from formaldehyde to alcohol, is there a limit as to how much you can have on the premises?

Yes. Your local Fire Marshall needs to be consulted for the prevailing NFPA standards regulating storage design for fluid-preserved collections. Ethanol and isopropanol are flammable liquids, addressed in NFPA Flammable and Combustible Liquids Code. This is an extensive topic, covering the need for tightly sealed containers, special cabinetry, rooms of set-volumes of liquid and fire-rated construction, fire detection and prevention devices, spill containment or run-off prevention, gravity or powered ventilation, perforated shelving to allow water or fire suppression liquids to pass through the full length of shelves, and much more depending on the amount of flammable liquid collections you need to store. All jurisdictions may have a different interpretation so, again, your best resources is your local fire department for on-site advice.

- Kathryn Makos

Pesticides, Naphthalene, Arsenic & Taxidermy

For general taxidermy information:

See previous C2CC webinar for larger discussion on the care and handling of taxidermy collections:

<http://www.connectingtocollections.org/troublesome-trophies-and-fragile-feathered-friends-introduction-to-the-care-of-historic-taxidermy/>

Marte, F. et al. 2006. Arsenic in taxidermy collections: history, detection and management. *Collection Forum* 21(1-2):143-150.

14. I will be digitizing a large number of fur coats and other fur accessories and I am wondering if there are any specific risks associated with them like there is with beaver top hats treated with Hg or taxidermy laced with arsenic and heavy metals.

Fully and partially tanned skins are less likely to exhibit significant pest infestations due to the toxic nature of the chemical preparations; they may still be susceptible to mold growth if storage is in high humidity environs. However, storage treatments post-tanning may very likely include “mothballs/flakes” (naphthalene or paradichlorobenzene), if these coats/garments were part of a household collection, or toxic particulates like arsenic, lead or bromides if treated prophylactically by a collector or customs agents or cross-contaminated by other specimens in storage. While sampling data at the Smithsonian suggests that certain treatments like mercuric salts may be tightly bound in the fur/skin proteins, it is still a potential risk to handle without precautions, especially if you do not know the treatment histories of the coats and accessories. Therefore, personnel handling the object for digitizing, curation, mount-making, installation, etc. should assume possible contamination and follow the traditional safe work practices: wear nitrile gloves, disposable Tyvek lab coats or similar clothing protection & change often; properly dispose of any padding, storage or covering materials; maintain clean work surfaces (cover with disposable paper or HEPA vacuum cleaning). X-ray Fluorescence (XRF) or spot tests may help you identify certain heavy metals (see more information in answer to #15).

-Catharine Hawks with Kathryn Makos

15. What if you are not certain if there is arsenic on the feathers in your textile collections? Would a Bruker XRF be the best way to identify the presence of arsenic prior to potential treatment?

A portable, handheld XRF is certainly the quickest way to identify arsenic on your collections. However, there is the obvious expense that can be prohibitive for many collections. For collections that do not have their own XRF, you may be able to contact Bruker or another company for a demonstration or a short term loan, or contact a local university, forensics lab, etc. and see if they will help you—the portability of the units as well as the interesting nature of museum work, may make this an enticing project for them.

Another method to detect arsenic is spot testing using commercially available test strips or arsenic test kits, such as the QUANTOFIX Arsenic Test Kit: <http://www.mn-net.com/tabid/10305/default.aspx>

These require that you do a surface wipe of the object (usually with a moistened cotton swab). The swab is then soaked in vial of water and the addition of potassium hydroxide, zinc, and concentrated hydrochloric acid creates a reaction with arsenic (if present) to form arsine gas, which turns the indicator paper brown. Because the reaction produces arsine gas it should be conducted wearing proper personal protective equipment (PPE) and in a well-ventilated area such as a fume hood.

If you have access to a chemical laboratory, the tests can be conducted with the chemicals themselves using test strips that can be purchased without the reagents found in the QUANTOFIX arsenic test kit.

Paper test strips only:

<http://www.sigmaaldrich.com/catalog/search/ProductDetail/FLUKA/83544>

http://www.ctlscientific.com/cgi/display.cgi?item_num=90762

A description of performing the tests can be found in the references below. These references describe the procedure for using user-provided chemicals with commercially purchased test strips. The same procedure is followed for using the QUANTOFIX kit but substituting the manufacturer’s instructions for adding the supplied reagents to your test vials:

- (1) <https://ellencarrlee.wordpress.com/2009/01/14/catharine-hawks-on-arsenic-testing/>
- (2) Nancy Odegaard, Scott Carroll, Werner S. Zimmt. 2005. *Material Characterization Tests for Objects of Art and Archaeology* (Second Edition). Archetype Publications.

Remember that pesticides may have been applied selectively or irregularly—so multiple areas of an object should be tested when using both XRF and the test strips. These tests will only indicate that arsenic is present (not the form). Therefore, arsenic containing pigments would also create a positive. It’s important to have both positive and negative controls when conducting your spot testing.

- Kerith Koss Schragar

16. Is there any good solution for the textiles, treated with naphthalene?

(see answer to #17)

17. Please speak more about "mothballs" camphor and naphthalene based, since they are everywhere in the Himalayan monasteries I work in, especially in closed storage trunks.

We are assuming "mothballs" are either paradichlorobenzene-PDB, naphthalene, or a mixture of the two (both have serious toxicity issues). It is impossible to tell the difference without testing. They have different melting points, so that is one of the simplest ways to determine which one is present. Camphor is a terpenoid that has long been used as a pest repellent. It is toxic to people, as are almost all plant-derived aromatics. Obviously the first item would be the physical removal of all remaining crystals. Next, airing out of textiles or other materials, ideally under a lab fume hood but outdoors on a breezy, moderately warm day would help, under a small tent or some other means to protect against light damage. The textiles should be examined carefully to be sure no pests are present prior to rehousing. If they are to remain in the wooden storage trunks, it can be assumed that the trunks should also be aired well – naphthalene, PDB, and camphor will all be absorbed by the wood. The airing is unlikely to completely clear any of these from either the textiles or the wood, so it may be prudent to look into the use of scavengers (e.g., activated charcoal, MicroChamber board) and to repeat the airing annually for a few years. To protect against pest ingress, it may also be worthwhile to look at ways to ensure that pests cannot enter the trunks. Something as simple as plumbers' tape (Teflon tape available at hardware stores or sold as Relic Wrap by conservation suppliers) might work, depending upon the configuration of the trunks. Any additional sealing of the trunks would reinforce the need for periodic airing and/or use of scavengers.

-Catharine Hawks with Kathryn Makos

18. We are dealing with a lot of old taxidermy - what issues should we be thinking about?

Mold, hazardous preservatives and pesticides, insect frass and feather allergens are only a few of the concerns. Your first clues will be collectors and post-collection treatment records. There are many published articles on this.

Odegaard, N., D.R. Smith, L. V. Boyer, and J. Anderson. 2006. Use of handheld XRF for the study of pesticide residues on museum objects. *Collection Forum* 20(1-2):42-48.

Sirois, P. J. 2010. Detecting pesticide residues on museum objects in Canadian collections--a summary of surveys spanning a twenty year period. *Collection Forum* 24 (1-2):28-45.

Pool, M.A. 2004. Health and Safety Technical Resources on Pesticides for the Conservator. American Institute for Conservation. Washington DC. 8 pp.

- Kathryn Makos

19. There are two deer heads on the wall of our storage room that are not ours. Although, the actual objects/artifacts and art are not in there we do store our exhibition displays in there. Could this be a potential issue?

You'll need to identify how the deer heads were prepared. Hopefully the owner has some collector prep history records. If by a recent taxidermist, then contact and find out taxidermy methods and materials. Usually "modern" taxidermy does not use heavy metals or other easily flaking particulates. But if these are older and assumed to be prepared for museum longevity, then seek collector information. If not available, assume heavy metal pesticide usage that will settle on floors and surfaces in your storage room. Consider building a shelf with a lip below each mount and HEPA vacuuming often.

Best: Consider bagging them if you don't really care about their appearance in a storage room!

- Kathryn Makos

Mercury and Mercury-Containing Objects

The three different forms of mercury have different exposure risks and health hazard. They are: elemental/liquid mercury (e.g., the kind found in historic mirrors and scientific equipment); organic mercury compounds (e.g., methyl mercury--the kind found in fish) and inorganic mercury compounds (e.g. mercuric sulfide commonly known as the mineral cinnabar or mercuric chloride used as a pesticide). For example, after exposure to liquid mercury, less than 1% of the total amount is absorbed through ingestion or dermal contact, while 80% of inhaled mercury vapor released from elemental mercury is absorbed by the respiratory tract and retained in the kidneys and brain. Methyl mercury, by comparison, is more hazardous via ingestion. For a discussion on the health effects of the different types of mercury see: <https://www3.epa.gov/airtoxics/hlthef/mercury.html>

In some cases there may be a visible indicator that a mercury-containing object or specimen is releasing mercury (such as mercury droplets), but the more hazardous mercury vapor has no sensory indicator that it is present (color, smell, etc.) and may be present even if liquid mercury droplets are not. Mercury and mercury compounds slowly volatilize at room temperature and at increasing rates with higher temperatures, so it is important to keep mercury-containing objects in cool and well-ventilated areas. Even if the vaporization is slow, the vapor can build up in enclosed spaces. This constant generation or sublimation means that even adjacent specimens may become contaminated when housed in cabinets with mercury-treated specimens or mercury-containing objects. Mercury vapor is also readily adsorbed by wood (or onto metal) used in some cabinets, and could be released from these surfaces even after the removal of contaminated object.

20. Mercury Mirror information—What year did mercury stop being used in mirrors?

A tin-mercury amalgam was the primary means for creating the reflective surface on glass mirrors from the 16th-19th centuries. In 1886, the mercury process of mirror production was prohibited, but that is generally not considered a firm cutoff date since there were likely stocks of mirrors that had already been produced and mirrors were being reused. The mirroring technique using the deposition of silver was developed in the 1830s. However, the resulting surface was unstable and the technique was not truly perfected until the early 20th century. It is safest to assume that anything before the early 20th century is a mercury-containing mirror. Glass mirrors from the 16th, 17th and 18th centuries will be mercury mirrors. However, because tin-mercury mirrors degrade and/or break and the historic value can oftentimes be associated with the frames, the looking glass may have been replaced, so the date of a mirror may not actually reflect the date of the glass.

More information on identifying mirrors and the health and safety hazards of tin-mercury mirrors can be found in Koss Schragger, K. 2013. "Tin-Mercury Amalgam Mirrors." *AIC News*, 38(1): 12-16 and on the AIC wiki: http://www.conservation-wiki.com/wiki/Tin-Mercury_Amalgam_Mirrors

-Kerith Koss Schragger

21. We have had two mercury spills - a thermometer and a dental amalgam holder.

[Adapted from Koss Schragger, K. 2013. "Tin-Mercury Amalgam Mirrors." *AIC News*, 38(1): 12-16]

Small liquid mercury spills, like the amount found in a thermometer, can be safely handled yourself using appropriate precautions. A general procedure can be found on the EPA website. <https://www.epa.gov/mercury/what-do-if-mercury-thermometer-breaks>

Mercury vapor is the major health concern and liquid mercury droplets are easily dispersed, so it's important not to agitate spills.

Ventilate contaminated areas and wear protective equipment. Never use a broom or vacuum to collect liquid mercury, unless it is a specially designed mercury recovery vacuum. Commercial mercury spill kits, sponges and powders that sequester and contain the liquid should be used for collection. Sprays, powders and papers are also produced for controlling mercury vapor levels. Follow manufacturer instructions on how these should be used.

If spill kits are not available, gently collect beads of mercury into sealed containers using disposable materials. Never pour liquid mercury down the drain. Dispose of clothing and any absorbent materials that have come in contact with mercury and do not launder contaminated material in a washing machine. Be particularly aware of tracking liquid mercury on shoes. All contaminated items should be placed in sealed containers, clearly labeled and disposed of according to state, local, and institutional regulations.

Many civic and government agencies offer collection and exchange programs for mercury and mercury-containing devices as part of an ongoing awareness to provide proper disposal for hazardous materials. For information about these programs, contact local officials to find out when and where a collection will be held. Commercial companies can be contracted to collect hazardous waste and there are also mail-in mercury disposal programs for businesses. Be aware that there may be additional hazards to consider along with spilled mercury, such as the broken glass from the thermometer.

For spills larger than a thermometer, ventilate the area and restrict access. Call your local health department as soon as possible. If it is after-hours, please call your local fire department. If you have questions about potential health effects, you can call your physician, or your local poison control center at (800) 222-1222.

Any time one pound (about two tablespoons) or more of mercury is released to the environment, it is mandatory to call the National Response Center (NRC). The NRC hotline operates 24 hours a day, 7 days a week. Call (800) 424-8802.

See more information on larger spills here: <https://www.epa.gov/mercury/what-do-if-you-spill-more-mercury-amount-thermometer>

-Kerith Koss Schragger

22. Can you go over the mercury droppings on cinnabar, why is this happening?

This is a naturally occurring phenomenon of cinnabar due to the chemical makeup and structure and happens particularly along fresh break edges and/or with higher temperatures. Cinnabar is the primary ore for the recovery of elemental mercury because mercury is easily collected by grinding and roasting the cinnabar and collecting and condensing the vapor. The droplets are generally small and well-adhered to the surface, but should still be considered a health and safety hazard. Cinnabar also releases mercury vapor. See health and safety warnings for mercury above.

-Kerith Koss Schragger

Botanicals

23. The information pertinent to herbaria in this slide - something about sulfuric salts and mercuric chloride

[From Hawks, C., K. Makos, D. Bell, P. Wambach, and G. Burroughs. 2004. An inexpensive method to test for mercury vapor in herbarium collections. *Taxon* 53(3):783-790.]

Mercuric chloride (HgCl_2) solutions had been used as pesticide and/or fungicide treatments for botanical specimens at least since the 18th century. Mercuric chloride in alcohol or water solutions was used to immerse or spray specimens, pressing papers, and mounting sheets.

Use of mercuric chloride is associated with the gray-black stains seen on many herbarium sheets. Stains have been found to contain mercuric sulfide (metacinnabar, probably from reaction with sulfur in the mounting paper) and a mercury sulfide/mercury oxide ($2\text{HgO}\cdot\text{HgS}$, possibly from reactions with paper and air) as well as unreacted mercuric chloride. The metallic sheen of some stains suggests that *elemental* mercury may also be present. Stains may be a reliable indication of the presence of mercury in some form (fungal stains may be distinguished from mercury stains by microscopy), but absence of stain is not a reliable indication that mercury compounds are absent. Unreacted mercuric chloride is colorless.

See more information on health and safety hazards of mercury in the “Mercury and Mercury-Containing Objects” section above.

- Kathryn Makos

Medicinals

24. Looking for recommendations for locked storage cabinets that are effective for housing old medicines.

Research what is in current hospital standard use for regulated drugs, but they might not be visually appropriate for museum display. Alternately, install museum security screws on cases and smash-proof display clear fronts would be a goal.

-Nora Lockshin

25. Picric acid. It was used as an antiseptic in old first aid kits in the 20's and 30's. As it dries out and crystalizes, it becomes a very unstable explosive. I'm a volunteer historian at a Girl Scout council. Our old first aid kits are mostly empty, but other councils have called the Fire department about these, who usually sends the bomb-squad.

Agreed. It is best to err on side of caution by calling your fire department/hazardous materials team to remove these old WWI and II first aid kits with picric acid pads.

- Kathryn Makos

26. Is there a way to test unidentified historic medicines for hazards?

Aside from contextual research (e.g. typical kit contents for the time period and what is labeled vs what isn't), we would recommend a hazmat company to sample and run a Toxicity Characteristic Leaching Procedure (TCLP) test, work with a local university forensics teaching lab, or assume all has toxicity and handle accordingly. In addition, consult local university with a medical teaching department or Registrars and Health and Safety Staff at the National Museum of Health and Medicine.

-Nora Lockshin with Kathryn Makos

27. If you have pharmaceutical vials of belladonna & digitalis, what is preferred? Dispose of poison and keep packaging? Or..?

With any highly hazardous medicinals, pharmaceuticals, or chemicals in collections, there are very few compelling research reasons to keep the contents. And if the contents are under any risk of degradation, reaction, evaporation and shock-sensitivity, you must safely dispose. The container and historic labeling, etc. may be all that is needed for your purposes of study and display.

- Kathryn Makos

"However, the care in handling and rinsing to retain a legally empty bottle takes a certain amount of training and liquid hazmat disposal as well. I would work with a local hazmat company to create a partnered protocol for a historic collection if they wanted to keep the bottle. The USDA/ local & state police only handle drug turn-ins once per year, on National Prescription Drug Take-Back Day, which is usually in April/May.

<https://www.dea.gov/divisions/hq/2016/hq050616.shtml>. One could plan toward that."

-Nora Lockshin

28. We have collections of old pharmaceuticals and medicines from old drug stores. Some are in bottles others in boxes or bags. We also have old photo chemicals from photo studio. They are all stored in plastic bags inside boxes and have the boxes set aside in one area. We would like to get rid of them but both public and private haz mat business are way too expensive. Is there any other source to dispose of these? Since they are bagged, boxed, stored away from other collections and labeled, is it ok to just leave them alone if we can't afford to dispose of them?

The answer is "it depends." Each chemical has its own distinct properties that may or may not be an immediate problem. Is it flammable? Combustible? Strong oxidizer? Is what you're storing next to it make it more likely to be a problem? If these are things you don't need, it is best to dispose of them properly.

My understanding (at least in the state of CT) is that communities often have days where you can dispose of these types of chemicals for reasonable prices, especially if it is organized by your city, town, county, etc. These may be restricted to residential use. You may be able to talk to your municipal waste disposal agency and get them to help you with disposal at a reduced rate if you tell them your situation. Check the EPA web site for laws in your state:

<https://www.epa.gov/hwgenerators/links-hazardous-waste-programs-and-us-state-environmental-agencies>

If you need money to dispose of these materials, fundraise! Now is the time to educate people about the hazards of different chemicals and what it could potentially do to the museum/ cultural institution. You could also try partnering with a local business or institution that has hazardous waste disposal methods in place. If we're talking about a small amount of chemicals, they may be happy to help you out for free tickets to your next event, for example.

-Tara Kennedy

Ammunition & Weapons

29. Handling gun powder?

If we are talking about a smokeless gun powder:

Gunpowder should be stored in a cool, dry space. What you want to avoid is spontaneous combustion: in the case of gun powder, even oxygen is not necessary as there is enough oxygen in the gunpowder to ignite. So all you need is a spark or a hot plate to ignite it.

This PDF from the Sporting Arms and Ammunition Manufacturers' Institute (SAAMI) provides some great information about safe storage: http://saami.org/specifications_and_information/publications/download/SAAMI_ITEM_200-Smokeless_Powder.pdf

-Tara Kennedy

30. What risk and/or options do I have with the following: 2 rounds (.45 caliber, .50 caliber) US issued intact ammunition from the WWII era. Are these ok "as is" or should I take some sort of action?

The hazard in the ammunition is the smokeless powder inside of the bullet. Store these items in a cool, dry place, wrapped in layers of acid-free paper. The key element to avoid is heat, which can ignite the gunpowder inside of the bullet, even without additional oxygen.

-Tara Kennedy

Fuel & Oil

31. I recently came across a soil sample impregnated by kerosene; you could smell the kerosene the moment you opened the collections box. Calling my supervisor, I was told "it hasn't exploded yet, I doubt it will" and told to catalogue and return the box to the shelf. I am still concerned about this box.

Personally, I would be concerned about the box AND the supervisor's attitude! In some diplomatic manner, insist that the local Fire Department be called to consult. They will be very happy to do so rather than respond to a fire.

In the meantime, the box should be stored in a well-ventilated area to avoid the buildup of potentially ignitable fumes. The area and boxes should also be clearly labelled to warn of the potential hazards. You may also want to consider something like VaporSorb, which will absorb the fumes. These pouches will eventually become saturated and need to be "refreshed" on a regular basis according to the manufacturer's instructions.

<http://noodor.com/p/vapor-vapors-fumes-remove-gas-removal-filter-trap.html>

- Kathryn Makos & Kerith Koss Schragger

32. We have a collection of oil and lubricant cans for vehicles, a chunk of them still have chemicals in them. Do you have any suggestions on how to store them or to have them drained and cleaned?

Your best resource may be the local commercial automotive repair shop, if the contents are vehicle oils and lubricants. They will have the best way to clean and remove, and properly dispose of the waste oil, while returning you the cleaned collection container.

- Kathryn Makos

Asbestos & Lead

Specific certification and/or training may be required to handle or dispose of both lead and asbestos. If you suspect that an object, exhibit material or building facility contains these materials, you should have them tested before proceeding and check with federal, state and city regulations about abatement and disposal. Your employer is responsible for providing any necessary training for handling hazardous materials.

33. Specifically how old do these plaster-based paintings need to be to have asbestos in them?

Widespread industrial asbestos mining began in the mid-1800s, with large scale commercial applications well under way by 1920. So unfortunately art plaster may need testing by someone trained in the sampling and identification of asbestos, especially since this type of plaster may not be banned. Indeed there are many asbestos products EPA has not been able to ban due to court action: <https://www.epa.gov/asbestos/us-federal-bans-asbestos>

Also, asbestos containing materials go beyond those just found within commercial preparations. UCLA researchers have identified asbestos in Byzantine plaster dating to the 1100s:

<http://www.thehistoryblog.com/archives/date/2014/page/28>

- Kathryn Makos & Kerith Koss Schragger

34. Do asbestos minerals in a collection pose a risk if left undisturbed?

Assuming this is a question about a Mineral Science collection. The broader concern is how to safely store, section, handle any inherently toxic mineral (especially those that easily powder or become friable). Asbestiform minerals are just one example and you need to ask: how can I mitigate particulate settling or handling that makes particulates/fibers airborne? Even left undisturbed in a cabinet, most minerals will powder and those drawers will need to be cleaned (HEPA vacuum/wet wipe). Some collection managers will bag these, or better, install a Plexiglas top on the drawer. Storage areas should be clearly labeled to alert users of hazards within cabinets and drawers. Observation or sectioning needs to be done under a lab hood, with the work area cleaned with a HEPA vacuum afterward, for instance.

- Kathryn Makos

35. Any thoughts on lead contamination of benchmark weights when the inner plastic linings break down? We have recently discovered bags turning blackish and realized the linings are degrading. Do we discard them all and replace with non-lead? (A significant number of weights museum-wide). They must contaminate other non-lead weight stockinet covers. We are currently working with University Health and Safety but wondered if anyone else has come up against this?

The best solution when dealing with any hazardous material such as lead is to replace them. Your University Health and Safety department should have methods to quickly identify if there is any surface contamination occurring (such as XRF or surface wipes) and should be able to advise on the proper disposal. For anyone who does not have these resources, lead indicator papers are commercially available and you should contact your institution and/or municipal waste disposal departments on how to properly dispose of lead. You may also want to contact the manufacturer to see if this is a common problem and perhaps they may be able to discuss replacement and disposal options with you, since their product is now a health hazard. To save money you or a volunteer can make replacement weight bags using sand and the pre-washed textile of your choice, but, of course, they won't have the weight of a similar sized bag filled with lead.

-Kerith Koss Schragner

Radioactivity

It should be noted that collection care workers often have unique exposure scenarios with radioactive objects that should be considered and may not be addressed in general exposure recommendations. Conservators, for example, may be dealing with radioactive dusts or particles created during the treatment of these objects or spend longer amounts of time handling or leaning over them. In these cases, proper handling protocols, like personal protective equipment, will reduce the risk. Some museums will store or exhibit radioactive materials in special cases. Placing a large number of objects in one place will concentrate the radiation emission and increase risk of exposure to both people and objects.

For more details on the health and safety hazards specifically related to the handling of collection objects, see:

- (1) Strahan, Donna. 2010. "Uranium in Glass, Glazes, and Enamels." *Health & Safety for Museum Professionals* (p. 456)
- (2) Norquest, Sharon, Kile, Amelia and Peters, David. "Working with a Collection of Radioactive Aircraft Instruments" in the Objects Specialty Group Postprints from the 2015 AIC Annual Meeting.

36. Is there an easy/inexpensive way to identify radioactivity in objects?

Normally, radiation is determined using a Geiger counter with a Geiger-Mueller tube or probe or a scintillation counter. Since most of us don't have those lying around, you might try using a badge dosimeter. Put it in proximity of the suspected object and then send the badge away for analysis. If you work at a university with a Health and Safety department, you might be able to get this service at little to no cost.

Another option is to see if a nearby institution has a Geiger counter where you could take your object to be analyzed. For example, the Mutter Museum – a museum in Philadelphia dedicated to medical oddities – has its own Geiger counter. Universities and colleges may also have a Geiger counter that you could ask to use.

Radioactive objects will also expose film and photographic paper (if it's possible to find those things anymore). Place the object in question onto the photographic paper and wait. This is a qualitative test only: it will tell you it's radioactive, but not *how* radioactive.

If we're talking about uranium glass or Fiesta ware, this tidbit might put you at ease:

Because the pretty green uranium glass is rather ubiquitous, the USNRC has done a radiation exposure assessment for the glassware. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1717/nureg-1717.pdf>

If a glass is simply sitting on a shelf in your house, your annual radiation dose is 0.2 millirem. If you drink regularly from the glass, the exposure goes up to 2 millirem. Overall, pretty low.

In 2001, Donna Strahan, a conservator at the Metropolitan Museum of Art and a lecturer at the University of Delaware did a study of over 400 glass, enamel and ceramic objects from museum and private collections that use uranium as a colorant. http://www.jstor.org/stable/1506809?seq=1#page_scan_tab_contents Her conclusion: "Little health risk from uranium-containing objects was found unless many objects were stored in a small area or if acidic or alkaline foods were stored in them and consumed in quantity."

In 2002, a nuclear scientist named Eric Norman, now at the University of California, Berkeley, studied the all the various brightly colored Fiesta ware china for radiation and only found the orange dishes and the yellow teapot to be detectably hot. <http://escholarship.org/uc/item/5mb3p5fw> Even so, "none of the observed radioactivity levels are very high and should not be cause for alarm," Norman writes in this report. "Nevertheless, I would not want to routinely eat salad off the orange plate or drink tea from the yellow teapot," he adds.

<http://cenblog.org/artful-science/2012/06/05/radioactive-artifacts/>

-Tara Kennedy

Unknown Hazards

37. We have several empty Edison battery jars in our collection with some unknown substance in the bottom.

Suggestions for cleaning?

These are Thomas Edison battery jars? If so, the substances inside may have historic value. Edison battery jars should each have identifying numbers on them, so you need to first contact the Edison National Historic Park (NPS) for information on the substance and consultation as to whether the substance should be removed or retained, and their recommended safe method. The NPS has conducted published reports on the hazardous collection materials on this site. "Unknown" substances, especially those that might be old, can be very hazardous to remove on your own. Contact a licensed hazardous materials firm for assistance.

- Catharine Hawks with Kathryn Makos

**For more information about AIC Health & Safety Committee resources,
please visit our website and wiki:**

www.conservation-us.org/healthandsafety

http://www.conservation-wiki.com/wiki/Health_Safety

Contact the Health & Safety Committee via email:

HealthandSafety@conservation-us.org