

Chapter 11: Curatorial Health and Safety

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CHAPTER 11: CURATORIAL HEALTH AND SAFETY

A. Overview

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

This chapter has information on occupational health and safety hazards that are unique to the museum work environment. You will find guidance to assist you in ensuring a healthful and safe curatorial environment.

Appendix H has additional information on laws, regulations, policies, and guidelines on the NPS health and safety program.

Review other chapters in this handbook that contain important health and safety information including:

- Chapter 9: Museum Collections Security and Fire Protection, for information on fire safety
- Chapter 7: Museum Collections Storage, for information on structural floor load limits
- Appendix M: Management of Cellulose Nitrate and Cellulose Ester Film, for information on hazards from deteriorating historic film.

2. *What kinds of health and safety hazards will I find in museum collections?*

When you work with museum collections, you may face a wide variety of potential health and safety hazards, including:

- hazardous materials used in collections care:
 - toxic and flammable solvents, such as solvents in waxes or lacquers
 - preservatives, such as alcohol and formalin, used for storing natural history specimens
 - pesticides used to kill or discourage pests
- hazardous objects and conditions in collections
 - pesticide residues from past treatment of collections, such as arsenic
 - objects with inherent vice such as unexploded ordnance or cellulose nitrate film
 - biological hazards such as mold, hantavirus, and insects/arachnids
 - sharp or broken edges on objects

You may also create safety hazards through carelessness in handling collections and supplies (for example, careless lifting and carrying).

You need to know your own susceptibility to allergens and irritants (for example, bee stings or dust) and take appropriate precautions.

You need to acquaint yourself with typical hazards and how you can ensure a healthful and safe curatorial environment.

3. *What is the goal of a health and safety program?*

The ultimate goal of your curatorial health and safety program is to reduce or eliminate occupational illness and injury.

The servicewide policy outlined in Director's Order (DO) #50B, Occupational Safety and Health, outlines a framework for establishing and implementing a Risk Management process that provides for the safety and health of NPS employees and the public. The Reference Manual 50B, Occupational Safety and Health Program, provides more detailed guidance on specific implementation requirements and strategies for the Risk Management Program in the NPS.

Also familiarize yourself with 29 CFR 1910, Occupational Safety and Health Standards for General Industry. You can find the Federal Register on the web at: http://www.access.gpo.gov/su_docs/.

Build your curatorial health and safety program on these guidance documents. Address these goals:

- Recognize and identify the hazards.
- Evaluate the hazards.
- Reduce or eliminate the hazards to the extent possible.

4. *What are the general categories of occupational hazards?*

Learn the four general categories of occupational hazards. All of these categories are present in the museum work place:

- **Chemical Hazards**—including any chemical that can cause a physical or a health hazard. Hazardous chemicals can be in the form of liquids, mists, vapors, dusts, fumes, gases, and solids
- **Physical Hazards**—including radiation, extreme temperature levels, and noise
- **Biological Hazards**—including exposures to bacteria, fungi, viruses, and parasites and allergic reactions to plants, animals, and other substances
- **Ergonomic Hazards**—including problems with the design and selection of a work environment and poor choices in tools and equipment so that excess physical strain and stress occur

Common hazardous materials you should be aware of include: asbestos, biological samples, cellulose nitrate and cellulose acetate, decaying animal matter, disinfectants and other cleaning chemicals, heavy metal-based dyes and paints, laboratory and photographic chemicals, lead-based paints, medications, munitions, oil-filled electrical equipment (such as transformers and large capacitors), pesticides, and some rocks and minerals. The sections in this chapter discuss these materials in more detail.

B. Understanding Health and Safety Issues

1. *What basic occupational health concepts should I understand?*

There are a number of basic concepts you should understand in order to develop a good safety program.

A hazardous substance is any material that can harm the body if it is absorbed in large enough quantities over a period of time. Each hazardous material, or group of materials, has specific toxic effects.

- **Toxicity** is the material's capacity to produce injury to the human body. The higher the toxicity of a substance, the smaller the quantity of this substance needed to cause injury.
- **Chronic health effects** result from a slow accumulation of small amounts of a hazardous substance. The quantities may seem insignificant; however, with daily exposure over a period of years, material can accumulate in the body. Health effects include respiratory problems, cancer, birth defects in offspring, and damage to the heart, liver and kidneys.
- **Acute health effects** result when a worker is accidentally exposed to large quantities of a hazardous substance. A few symptoms are burning eyes, dizziness, and light-headedness.
- **The exposure limit** for a substance is the highest exposure level recommended in a work area when workers are in that area without any special protection. The two most widely used criteria are:
 - **Permissible Exposure Limit (PEL):** The PEL, established by the Occupational Health and Safety Administration (OSHA), is the concentration and time of exposure that cannot be exceeded. This standard is enforceable by federal law. Many substances also have a determined ceiling for concentration and time of exposure.
 - **Threshold Limit Value (TLV):** The TLV is a guideline based on current studies of exposed animals. It is the recommended maximum average concentration of a chemical during a 40-hour week (five 8-hour days). Results of these studies are issued annually by the American Conference of Governmental Industrial Hygienists (ACGIH). It is a recommended level and is not enforceable by law. The TLV is typically more stringent than the PEL.

The NPS uses 50% of the PEL limit as an action level. If the concentration of a contaminant in a workspace is at or above 50% of the PEL, you must take action to monitor the exposure level and reduce the exposure.

2. *How will I know that I am being exposed to hazardous materials?*

Many hazardous materials have good initial warning properties that signal exposure to a potential injury:

- odor
- burning eyes
- skin, nose and throat irritation
- breathing difficulty

However, after a time, olfactory fatigue may set in, and you will no longer be able to smell the contaminant. Other hazardous materials, especially particulates, give little or no warning. These materials can cause harm when they are present in quantities too small to be detected by odor or other unpleasant indications.

You must identify all hazardous materials in the workplace.

Identifying all hazardous materials in the workplace allows you to identify ways to block and limit exposure.

3. *How does the body absorb substances?*

There are three ways your body absorbs substances:

- ***Skin Contact:*** Healthy, undamaged skin often provides an effective barrier against the absorption of many hazardous substances. Some substances, however, will dissolve or destroy the skin's protective layer. Punctures, scrapes, and cuts increase the risk of absorption. Once a substance is absorbed through the skin, it can cause systemic damage. Be aware of any burning, pain, redness, or irritation when using substances.
- ***Inhalation:*** Hazardous substances are very often airborne (for example, dusts, mists, fumes, vapors, gases). When you inhale these materials, they are absorbed into the blood stream and distributed to all parts of your body. Some materials will damage your lungs; others will pass through into your blood stream. Be aware of common warning signs, such as coughing, a burning sensation, heaviness in the chest, and wheezing or breathing difficulty.
- ***Ingestion:*** You may unknowingly absorb small quantities of a toxic substance into your gastrointestinal system from food or drink or from contaminated hands.

4. *How do I evaluate the degree of a health hazard?*

The factors that determine the degree of a health hazard from a given substance are:

- toxicity of a substance
- amount of a substance
- duration (length and frequency) of exposure

- protective measures used (for example, ventilation, respirators, gloves)
- susceptibility (your health condition at the time of exposure)
- environmental conditions at time of exposure (Temperature, airflow, and humidity affect the dispersion of a hazardous substance, its availability for absorption, and the amount and speed of absorption.)

By looking at each of these factors, you can decide how to limit the hazard to yourself and others in the workplace. For example, you may choose to use a less toxic substance. You might limit how long each day you use the substance. You could choose to wear gloves and protect yourself from direct skin exposure. Looking at each of these factors gives you a number of ways to minimize the hazard.

You should also understand the concept of the breathing zone. The breathing zone is the area around your nose and mouth. Many curatorial tasks are done near the breathing zone, including numbering objects, pulling objects from storage shelves, and dusting. When identifying concentrations of airborne contaminants in a workspace, it is important to determine concentrations in the breathing zone, not just in the general airspace.

Because exposure may occur in more than one way (for example, both ingestion and inhalation of a particulate such as arsenic), biological monitoring may be appropriate. Biological monitoring measures individual absorption by all routes of entry and may include testing of:

- exhaled breath
- urine
- blood

Contact your park safety officer to develop a plan for airborne exposure monitoring and/or biological monitoring if you are concerned about your exposures to hazardous materials.

5. *What is the Job Hazard Analysis?*

The Job Hazard Analysis (JHA) is a written document that evaluates hazards in your workspace (office, storage space, work area, laboratory and research spaces). The purpose of the JHA is to prevent or reduce the risk of job-related injuries and fatalities. The JHA is a tool you use to examine and evaluate activities in the curatorial workplace and to decide on corrective actions to take to prevent accidents. A JHA should be completed for all jobs that:

- have an associated history of injury, illness, or death
- require the use of personal protective equipment (PPE)
- involve activities that are clearly dangerous

Obvious hazards in the curatorial workspace include:

- exposure to toxic chemicals, such as pesticides, preservatives, and solvents
- exposure to dangerous microorganisms, such as hantavirus
- exposure to hazardous materials in collections (for example, nitrate film, radioactive specimens)
- falls from ladders or step stools
- injuries from power tools when constructing storage racks
- injuries from lifting and carrying objects

There may be other hazards specific to your park or its collections.

You can obtain more information about the JHA from:

- Department of Interior Manual (DM), Part 485, Chapter 14
- Reference Manual 50B, Occupational Safety and Health Program, Section 13, available on the web at: <http://www.nps.gov/riskmgmt/>
- OSHA 3071, 1998 (Revised), *Job Hazard Analysis*, an informational booklet that provides a generic overview to conducting a JHA (Available through OSHA on the web at: <http://www.osha.gov/>.)
- OSHA *Self Inspection Checklists*, 1997, checklists that use a question and answer format to guide the user in examining conditions and evaluating hazards, including sections on evaluating a safety and health program and using personal protective equipment (Available through OSHA on the web at: <http://www.osha.gov/>.)

Your park or regional safety officer can also provide specific guidance on conducting a JHA.

C. Controlling Exposure to Hazardous Substances

1. *How do I control exposure to hazardous substances in the workplace?*

When evaluating ways to control exposure in the workspace consider:

- limiting the use of hazardous materials
- installing proper ventilation (including fume hoods, when necessary)
- wearing appropriate personal protective equipment
- practicing good housekeeping and personal hygiene

- storing, handling, and labeling hazardous materials appropriately
- disposing of hazardous materials properly

2. *How do I limit the use of hazardous material?*

Where possible, use a less hazardous material, or use a different method. For example, substitute water-based paints and inks for solvent-based paints and ink. Substitute an IPM monitoring program for use of traditional museum pesticides such as paradichlorobenzene or Vapona. Nitrate negatives can be duplicated and copies provided for research use.

Limit the time of exposure to hazardous substances. Break up tasks that require exposure to hazardous substances into short blocks of time over a number of days.

Close all containers of chemicals when they are not in use. For example, keep the top on the lacquer that you use for numbering objects.

Provide waste receptacles with lids for disposal of toxic materials (especially solvents that will evaporate).

3. *What kinds of ventilation systems are available?*

There are two basic types of ventilation systems:

General or dilution ventilation is designed to keep you comfortable by heating, cooling, and controlling the air's moisture content. The HVAC system for your workspace is a general ventilation system. **Don't** rely on general ventilation to control moderate to high toxicity materials, or reduce concentrations from a "spot source" in your breathing zone.

Local exhaust ventilation captures the hazardous substance where it is generated and carries it away from your breathing zone. It is very effective in removing substances of moderate to high toxicity by using a system of fume or exhaust hoods, ducts, air cleaners, and fans. You should have local exhaust ventilation if you regularly work with hazardous materials. This is the preferred method for removal of air contaminants.

If only low concentrations of hazardous materials are used in your workspace, portable ventilators may be a practical solution. Portable fume or air scrubbers draw air through a charcoal absorption filter with a fan. The filtered air is then released back into your workspace. This is a less expensive alternative, but you must change the filter regularly for these ventilators to remain effective.

Ventilation: A Practical Guide by Clark and others (1984) provides detailed guidance on ventilation systems, including the criteria for designing an exhaust hood system. See Figure 11.1 for the advantages and disadvantages of different types of ventilation. Work with your regional risk manager and park safety manager, the regional/SO curator, and the park's maintenance staff to evaluate the need to improve ventilation in the curatorial workspace.

Ventilation is the key engineering control for protecting staff from the effects of hazardous substances. You should make proper ventilation a high priority when evaluating a curatorial workspace.

4. *How do I install proper ventilation?*

You must work with a ventilation engineer to ensure proper ventilation if a fume hood is installed. For proper ventilation:

- Make sure air in the workspace flows **away** from the breathing zone of each worker to a non-occupied area of the building or to the exterior.
- Pull contaminated air out of the workspace with an exhaust fan. If you try to use a fan to blow air out of a workspace, you will only disperse the contaminant within the workspace.
- Locate the ventilation system's exhaust opening close to the source of the contaminant. Move work to the exhaust area.
- Promote maximum effectiveness of the exhaust system by preventing cross-drafts from interrupting the direct outward flow of air.
- Be sure that the air exhausted from the workspace is replaced. This avoids negative pressure that reduces the ability of the exhaust system to remove contaminants. An engineer will know how quickly air is replaced in the space.
- Ensure that exhaust outlets are not near air intake valves that would pull the contaminant back into the workplace. Work with a ventilation engineer to be sure that outlets are placed properly.
- Avoid polluting the surrounding area with the contaminated exhausts. The level of environmental pollution from exhausts depends on the toxicity and concentration of the substance being vented. These levels must be evaluated by a ventilation engineer.
- Consult local or state environmental regulations on what materials can be directly exhausted. Some materials may require scrubbers in filters under Clean Air Act regulations.

5. *When should I wear Personal Protective Equipment (PPE)?*

Use Personal Protective Equipment (PPE) only when other management controls (for example, ventilation, adoption of an alternative procedure or substance, time limitations on exposure) are not possible. ***Never consider PPE as your primary source of protection.***

PPE includes:

- respiratory devices
- eye and face protection devices
- protective clothing

There is no personal protective equipment designed for universal use. The type of PPE you wear depends on the specific hazardous substances you are using. Material Safety Data Sheets (MSDS) (see Section C) provide specific information about appropriate types of PPE to be used with a specific hazardous substance. See OSHA CFR 1910, Section I, for requirements for PPE usage.

6. *What are respiratory protective devices?*

OSHA CFR 1910.134 specifies that you must use respiratory equipment when engineering controls are not feasible (for example, if you must work temporarily in a dusty attic or basement) or in an emergency. There are two types of respirators: supplied-air devices and air-purifying devices.

- Supplied-Air Respirators bring a fresh air supply from a pressurized tank or compressor. These respirators are complex and expensive. You will rarely need this kind of device in your workspace.
- Air-Purifying Respirators purify air drawn through filters or cartridges before you inhale it. This type of respirator may be made out of a variety of materials depending on the application.

Don't use air-purifying respirators as a substitute for proper ventilation.

7. *How do I select a respirator?*

Use the following criteria to select a respirator:

- OSHA requires a thorough medical exam for anyone who must wear a respirator. This physical must verify that the employee's health will not be at risk while breathing through a respirator.
- Work with your safety officer to select the proper respirator. Be sure it has been approved by the National Institute for Occupational Safety and Health (NIOSH).
- You must have a leak-tight seal between the face and respirator face piece. Facial hair that interferes with this seal is prohibited by law. You must be fit-tested and trained on the use and maintenance of your respirators. Consult with your safety officer for fit-test procedures.
- Choose the proper filtration system. Air-purifying respirators use two types of purifying material—a filter or a chemical cartridge. Filters trap dusts and mists. For chemical vapors you must use a cartridge. Choose a cartridge that is designed for the specific substance in your workspace. Consult the applicable MSDS for the specific type of respirator required (see Section C).
- Consider comfort. Respirators can become uncomfortable after a few hours. Some materials may be more irritating to a wearer than the presence of the contaminant.
- Consider cost and maintenance. Some respirators (for example, paper) are disposable. Others are not and require periodic maintenance and cartridge replacement.

Refer to Appendix H for sources of respirators. Good sources of information on respiratory protection can be found in *Conserve O Gram* 2/13, "An Introduction to Respirator Use in Collections Management," and on the OSHA Website at <<http://www.osha-slc.gov/SLTC/respiratoryprotection/index.html>>.

8. *How do I know which gloves to wear?* There are many types of gloves manufactured to protect against different types of materials. Consider the chemicals you are handling and the permeability rate. For example, gloves made from butyl give the best protection from acetone. You may use properly maintained butyl gloves for over 17 hours before replacing them. In contrast, neoprene gloves provide only 10 minutes of protection from acetone before it penetrates to your skin. Refer to the MSDS or check with manufacturers for each chemical that you are using to identify recommended types of gloves.

Refer to Appendix H for sources of gloves.

9. *What good housekeeping and personal hygiene habits do I need to develop?* Good housekeeping and personal hygiene can go far in protecting you and others from contact with hazardous substances. Follow these rules:

- Establish a routine program for cleaning floors and work surfaces.
- Change filters in ventilation systems regularly.
- Clean up any spills immediately.
- Don't allow smoking in workspaces.
- Don't allow eating or drinking in workspaces.
- After working with objects, wash your hands before eating, applying makeup, brushing your hair or leaving work.
- Take special note of personal habits and refrain from biting your nails or chewing on pencils.

10. *How do I store, handle, and label hazardous material?* Follow these rules:

- Store all chemicals in an approved dedicated space and only with compatible materials. Never store these materials in the same space with a museum collection.
- Store large quantities of flammable and combustible materials in special cabinets that meet OSHA and NFPA specifications. Refer to Appendix H for sources of these cabinets.
- Label all containers. Post appropriate warning signs in the storage area. Refer to Section C for information on labeling.
- Close all chemical containers when they are not being used.
- Wear appropriate personal protective equipment when using chemicals.

11. *How do I dispose of hazardous waste?* **Hazardous waste** is any hazardous solid, liquid, or contained gaseous material that you no longer use. You must recycle, discard, or store hazardous waste. Common materials that you use in museum tasks may become hazardous waste, such as alcohol and formaldehyde, pesticides, and other solvents.

Under the Federal Hazardous Waste Management Program, you will have to follow different rules depending on the amount of hazardous waste you generate in a given month. Work with your safety officer and the Regional Hazardous Waste Coordinator on proper disposal methods for all hazardous materials, including empty hazardous materials containers.

You must dispose of all hazardous waste in accordance with the Resource Conservation and Recovery Act (RCRA) of 1976. All cataloged museum objects that are disposed of because of hazards must first be evaluated and deaccessioned.

For a detailed explanation of the regulations, obtain a copy of the Environmental Protection Agency (EPA) publication, *Understanding the Hazardous Waste Rules: A Handbook for Small Businesses—1996 Update*. See *MH-II*, Chapter 6: Deaccessioning, Sections B.5 and H.

D. Hazardous Chemicals and Materials Used in Collections Care

Collections care requires the use of numerous hazardous chemicals. The following information gives you basic information about commonly used materials; however, you should evaluate your own workspace and identify all hazardous substances.

1. *What solvents are used regularly?*

You may find numerous hazardous substances in the curatorial workspace. These can include:

- paints
- varnishes
- waxes
- cleaning materials
- preservatives and consolidants
- adhesives

Some of the common hazardous solvents are: acetone, ethanol, kerosene, methanol, mineral spirits, toluene, turpentine, and xylene. Mineral spirits, V.M.&P® Naphtha, and Stoddard Solvent are used in cleaning wooden furniture. The clear and white lacquers recommended by the Supply and Equipment Program for numbering objects contain acetone. In natural history collections, formaldehyde, ethanol, and methanol are used to preserve wet specimens.

Rapid Guide to Hazardous Chemicals in the Workplace by Richard Lewis (2000) is an easy-to-use reference. It deals with the properties and harmful health effects of 700 common substances.

2. *What fumigants and other pesticides do museums use?*

Museums have traditionally used chemicals to control biological infestations, including fumigation and topical application of pesticides. In more recent years, Integrated Pest Management (IPM) has become the standard for protecting collections (see Chapter 5: Biological Infestations). However, many collections are still contaminated with residues from these past treatments.

Fumigation introduces a toxic gas into a fixed space that contains the objects. Fumigants that have been used on museum collections include:

- dichlorvos (DDVP, Vapona)
- ethylene oxide
- methyl bromide
- paradichlorobenzene
- naphthalene (moth balls)
- sulfuryl fluoride (Vikane®)
- thymol

Materials that have been applied through topical application include:

- arsenic
- DDT
- mercuric chloride

3. *What should I know about pesticide use?*

Pesticide residues are a serious problem in museum collections and the full extent of the problem is just becoming known. In many cases there is little documentation on past pesticide usage. Repatriated objects are of particular concern because they are returning to communities that may have little or no knowledge of the hazards of pesticide contamination.

Information in Chapter 5: Biological Infestations will help you to identify problems in your collections and show you how to limit or halt the future use of pesticides by using IPM techniques. Refer to Appendix H: Section E, for a list of fumigants that were traditionally used in museums and for health and reactivity information. The *Conserve O Gram* series has additional health and safety information about these materials. Review these publications to acquaint yourself with the dangers of pesticide use and how to manage contaminated collections.

Vikane (sulfuryl fluoride) is now the only fumigant that is legally available to use on collections. All others have been banned. It is a restricted use pesticide that requires park and regional IPM approval before application. See Chapter 5: Biological Infestations and the *Conserve O Gram* series for information on alternative non-toxic treatment strategies if you find an infestation in your collections. Work with your regional/SO curator and park IPM coordinator to develop alternative strategies to pesticide use.

Use of any pesticide must follow policy in NPS-77: Natural Resources Management Guideline, Integrated Pest Management (Chapter 2, p. 217-266).

You must obtain approval for using a pesticide through the Pesticide Use Proposal System (PUPS) or by telephone, as described in NPS-77. A regional/SO or WASO IPM specialist must review and approve all pesticides prior to use.

The regional/SO IPM specialist:

- consults with the regional curator to evaluate the need for pesticide use and to ensure that any approved use is an integral part of the integrated pest management process
- consults with WASO IPM specialist for concurrence if the pesticide is a restricted use product, will be used on or near an aquatic system, may affect threatened or endangered species, or is to be applied over 400 contiguous acres
- responds to park IPM coordinator within five working days with either approval or denial with suggested alternative management strategies

The park IPM coordinator:

- works with curatorial staff to ensure that pest management activities, including use of pesticides, are directed by technical experts and follow pesticide label instructions
- submits PUPS use to regional/SO IPM coordinator at end of each calendar year as directed in NPS-77

There may be times when it is appropriate to use a fumigant on museum objects. It may also be appropriate to use pest deterrent chemicals, such as crack and crevice solutions, in the museum space around collections. However, be sure you make the decision to use pesticides with the approval and advice of experienced and trained NPS staff.

4. *Are there special precautions for using silica gel in exhibition and storage cases?*

Yes. Silica gel may cause irritation to skin, eyes, and the respiratory tract. Goggles, a lab coat, vent hood (or appropriate respirator), and proper gloves should be used when working with bulk silica gel. Obtain a Material Safety Data Sheet (MSDS) from the silica gel manufacturer for further information. (Also see Sections D.5 and D.6 below.)

Cobalt impregnated silica gel should be phased out of use and replaced by Sorbead Orange, Silica Gel Yellow, or other biodegradable indicating gels. Cobalt is a skin and respiratory system sensitizer. Contact your park or regional HAZMAT coordinator to obtain information on appropriate disposal of cobalt impregnated silica gel. (See *COG 2/15*, Cobalt Indicating Silica Gel Health and Safety Update.)

5. *What is the Hazard Communication Standard?*

Your park must implement a program to communicate essential information on hazardous chemicals. This is required by OSHA's 29 CFR 1910.1200 (the Hazard Communication Standard) and NPS policy. This means you must:

- inventory all hazardous substances
- obtain and maintain a Material Safety Data Sheet (MSDS) for all hazardous chemicals
- label all hazardous substances
- receive training in the Hazard Communication Standard

6. *What is a Material Safety Data Sheet (MSDS)?*

A MSDS is a concisely written information sheet that explains the hazards of substances and how you are required to handle and use them. The OSHA standard does not require that MSDS be uniform in format; however, each sheet must contain the following information:

- product name and identification of chemicals including:
 - identification of the substance
 - manufacturer's name
 - both chemical and trade names and any synonyms
 - chemical family and chemical formula
 - name and address of the manufacturer with emergency telephone number
 - hazardous ingredients
 - percentage of each ingredient
 - recommended exposure limits for these ingredients
- physical and chemical characteristics of each hazardous chemical including:
 - physical properties (boiling point, melting point, appearance and odor threshold, solubility in water, evaporation point)
 - fire or explosion hazards (flash point, flammable limits, fire extinguishing equipment needed)
 - list of substances that cause it to burn, explode, or release toxic gases (for example, water or other chemicals)
 - list of environmental conditions that cause a dangerous reaction (for example, heat or direct sunlight)

- health hazards including:
 - known acute and chronic effects
 - exposure limits (PEL and TLV)
 - known or suspected carcinogenic effects
 - emergency and first aid procedures
 - primary route of exposure (for example, skin, nose and mouth)
- special protective information including:
 - special control measures, such as ventilation requirements
 - appropriate personal protective equipment (for example, respirators, gloves, goggles, or clothing)
- spill or leak procedures, handling and storage information:
 - special handling and storage precautions
 - procedures for cleaning up spills and leaks and disposing of resulting waste

This last information is often regulated by the U.S. Department of Transportation and by statutes and laws like the Toxic Substances Control Act and the Resource Conservation and Recovery Act. This information is especially important when you prepare your emergency operations plan (EOP).

7. *How do I get and maintain a MSDS?*

You should be able to obtain a MSDS when you purchase a hazardous chemical or a product that contains a hazardous material. If you currently have hazardous materials in your workspace and do not have a MSDS for them, you can get it by contacting the manufacturer. Always ask the manufacturer first. The manufacturer is obliged by law to provide a MSDS. There are also several institutions that maintain collections of material safety data sheets on the Web; however, they may not be the specific formulation you are using. You can search for these at <http://palimpsest.stanford.edu/bytopic/health/#msds>.

Request the MSDS whenever you make a purchase from the Government Services Administration (GSA) and other vendors. Keep the MSDS in an easily accessible file that is available to everyone in the curatorial workspace.

See Figure 11.2, Sample Material Safety Data Sheet and Figure 11.3, MSDS for Formaldehyde.

8. *How should I label hazardous substances?*

OSHA's Hazard Communication Standard requires that all chemical labels include a hazard warning. Prepare labels for chemicals you use in your daily work, such as the lacquer you use for numbering objects. Refer to Appendix H for sources of vendors who provide a variety of label materials.

Include the following information (recommended by the American National Standards Institute) on all labels:

- chemical name and any synonym
- signal word to indicate the degree of severity of a hazard (in increasing order):
 - CAUTION!
 - WARNING!
 - DANGER!
 - POISON! (used only for highly toxic chemicals)
- statement of hazard
- precautionary statement
- effects of over exposure
- first aid procedures
- chemical abstract service number

9. *What is the NFPA Hazard Symbol?*

The National Fire Protection Association (NFPA) Hazard Symbol is an effective labeling system that you should consider using. This system uses a diamond-shaped symbol to rate the health, fire, and reactivity hazard of a substance to warn personnel if there is a fire. See Figure 11.4. The hazard warning system uses a 0 to 4 rating with 0 being the least hazardous and 4 the most hazardous. You can use this label on any size container. You can also post the label on access doors to storage rooms or cabinets containing hazardous materials (for example, cellulose nitrate film). It is a warning to all employees and to firefighters. Refer to Figure 11.4 for an explanation of the NFPA warning rating system.

10. *How can I get occupational safety and health training?*

Your employer must provide you with appropriate occupational safety and health training to equip you with the knowledge and skills to safely perform your job and to respond to potential emergencies.

Contact your Regional Training Coordinator, or your Regional Safety Manager for Safety and Health for available training.

E. Hazardous Objects in Collections

1. *What type of hazardous objects are in collections?*

This section describes what to do with the most common hazards in collections including:

- pesticide residues
- hazardous geological specimens (radioactive minerals, asbestos, toxic minerals)
- cellulose nitrate and cellulose acetate film and negatives
- firearms, edged weapons, ammunition, and unexploded munitions
- medical objects and drugs/chemicals
- objects containing asbestos

You should familiarize yourself with the types of hazardous objects that are typically found in collections. Be aware of the health and safety risks. Review *Conserve O Gram* 2/10, Hazardous Materials in Your Collections, as well as references listed in Section H, to get additional information about hazardous collections and how to protect yourself.

2. *Why should I be concerned about pesticide residues in biological specimens and organic ethnographic and historic objects?*

Many historical biological specimens (birds, mammals, and plants) and ethnographic and historic organic materials were treated with pesticides. These pesticides can leave residues. See the article "Masked Hazard" listed in the references for a discussion of the problems that pesticide residues can cause.

At this time, arsenic is a residue that you can identify with a simple test. See Section E.4 below. The mercuric chloride spot tests that are currently available do not work consistently. Other pesticide residues that may be present don't have simple identification tests. A number of researchers are working in this area, and new information will be published in the *Conserve O Gram* series as it becomes available. The following *Conserve O Gram* leaflets have health and safety information on commonly used pesticides:

- 2/2, Ethylene Oxide Health and Safety Update
- 2/3, Arsenic Health and Safety Update
- 2/4, Dichlorvos (Vapona) Update
- 2/10, Hazardous Materials in Your Collection

Under no circumstances should any taxidermy mount be used for "hands-on" demonstrations for children or adults before it has been tested for the presence of arsenic.

Collect and document information on pesticide use in your collection. Talk to individuals who worked in the park in the past. Search documents such as:

- accession and catalog records
- annual reports
- maintenance records
- purchasing records
- diaries or other informal records from previous curators
- conservation records

3. *What do I do if I have specimens contaminated with arsenic?*

Arsenic can be readily absorbed through the skin, inhaled, and ingested. Arsenic can cause acute symptoms or may lead to chronic disorders. It is a known human carcinogen. In working with contaminated ethnographic and biological collections (especially bird and mammal specimens) use the following handling precautions:

- Do not touch specimens with bare skin. Wear plastic gloves and a protective smock or lab coat. Wear a dust mask rated for toxic dust. If possible, handle an object or specimen by a container or a mount.
- Always wash hands after working with specimens. Discard gloves. Keep the protective smock or lab coat clean. Do not take protective clothing home to wash—especially if you live with small children or elderly people.
- Obtain a Material Safety Data Sheet (MSDS) on arsenic and keep in the park's curatorial workspace/office. Consult the MSDS for specific information on arsenic.
- Label museum cabinets or storage spaces that house specimens contaminated with arsenic with the warning sign "ARSENIC." Also label individual specimens that have been tested. Prepare and post a written set of instructions for handling specimens contaminated with arsenic.

4. *How do I identify specimens that are contaminated with arsenic?*

You should inspect all biological collections (birds, mammals) and ethnographic objects made from organic materials (leather, basketry, textiles). These collections were typically treated with arsenic.

Test all bird and mammal specimens collected and prepared prior to the mid-1970s.

Follow these procedures to identify arsenic:

- Wear plastic gloves and a lab coat or smock while you inspect each specimen or object. Look for powdery or crystalline deposits. On bird and mammal specimens, look on the tips of feathers and hair, along

eyes, in or at the base of ears, around mouth or bill, along ventral incision, at the base of tail, and on foot pads. On ethnographic objects, look along seams, at the base and tips of feathers or hair, in areas of stitching, in folds and on the shelving beneath an object. Some application techniques, however, dispersed the arsenic as such fine powder that you may not be able to see it.

- Study each specimen and object's history. Try to determine who collected and prepared the specimen, when it was collected, and where it was collected.
- Follow the instructions for identifying arsenic residues provided in *Conserve O Gram 2/6*, Arsenic Health and Safety Update. Refer to *NPS Tools of the Trade* for sources of the EM Science arsenic test kit. Document each test with a written report and keep the reports in the museum records accession or catalog folder.
- Tag specimens and objects testing positive for arsenic with an "ARSENIC" warning sign.
- Inform the park safety office about the project and the results.
- Disclose any test results or information on suspected pesticide contamination to researchers or visitors who may touch objects and also to recipients when repatriating objects.
- Develop an emergency response plan to deal with the rescue of contaminated objects after a flood or fire. These objects are a severe health risk when wet.

5. *What hazards will I find in geological collections?*

A few types of geological specimens are hazardous. See *Conserve O Gram 11/2*, Storage Concerns for Geological Collections, for a basic discussion of health hazards. The main hazards are:

- radiation from radioactive specimens (for example, pitchblende [uraninite] is strongly radioactive)
- radon from fossils
- toxic minerals (for example, antimony, arsenic, barium, boron, copper, fluorine, lead, uranium, zinc)
- asbestos (a carcinogen)
- clay and quartz dust
- off-gassing from mercury compounds

Certain individuals may also have allergic responses, such as dermatitis, from particular minerals.

Label all known hazardous materials.

6. *Why are cellulose nitrate and diacetate negatives hazardous?*

Both aging cellulose nitrate and acetate film off-gas chemicals that can be irritants and toxic hazards. Cellulose nitrate emits nitrogen oxide gas, which has a sweet odor; cellulose acetate emits acetic acid, which has a sharp vinegar odor.

Cellulose nitrate is also volatile and flammable. Motion picture film is especially dangerous and in extreme cases has been known to self-ignite when stored improperly. The by-products can also cause deterioration of other materials stored in the same space.

Acute symptoms include:

- eye irritation
- rashes and sores on the face and skin
- vertigo
- nausea
- headaches
- swollen glands
- respiratory irritation and difficulty breathing

Repeated exposure by inhalation to the emissions of these deteriorating films may result in chronic symptoms, such as bronchia irritation or development of an emphysema-like condition. See Appendix M: Management of Cellulose Nitrate and Ester Film, for more information on the hazards of cellulose nitrate and acetate film.

In addition, the silver salts present in negative emulsions may irritate the skin.

7. *How can I protect myself when working with cellulose nitrate and acetate film?*

To protect yourself when working with nitrate and acetate film follow these steps:

- Plan for your project. Make sure you have the required work-space, equipment, and time. Identify any special protective equipment you will need.
- Ensure that the workspace has proper ventilation to remove emitted gases from your breathing zone. See Section C for a discussion of ventilation and respirators.
- Wear goggles unless proper ventilation is established. Do not wear contact lenses. Gases can concentrate under contact lenses causing eye injury and damage to the contact lens.
- Wear plastic gloves (vinyl, latex, nitrile) to minimize the risk of skin irritation. You can wear cotton gloves over the plastic gloves.
- Don't work with nitrate and acetate negatives more than two or three hours a day.

- After each work session, clean the work surface with a solution of baking soda and water. Mix one teaspoon baking soda with one pint of water. This solution neutralizes any acid that the negatives deposit.
- Keep a log in the work area. Note any odors you detect, the time spent each day on the project, and physical discomfort you have during or after work. If you experience any ill effects, notify your supervisor and the park safety officer.

8. *What particular concerns should I have with archival records?*

Other major archival health and safety issues are:

- asbestos that has contaminated records (See *Conserve O Gram* 2/11, Health and Safety Risks of Asbestos.)
- broken glass plate negatives and transparencies, which can be difficult to handle without cutting yourself
- bird, bat, insect, and rodent contaminated materials or flooded materials that may have viral or bacterial contamination, including hantavirus (See *Conserve O Gram* 2/8, Hantavirus Disease Health and Safety Update.)
- chemically or radiologically contaminated records
- mold, fungi, and yeasts, which can cause allergies, asthma, histoplasmosis, and ringworm (See *Conserve O Gram* 3/4, Mold and Mildew: Prevention of Microorganism Growth on Museum Collections.)

9. *What do I need to know about firearms and live ammunition?*

You must inspect all firearms when you acquire them to make sure they are not loaded. Until a historic firearm is examined, treat it as if it were loaded. Inspect all breach loading firearms and pistols for cartridges. Remove any cartridges that you find.

Follow these steps to check a muzzleloader for live ammunition. You will need a wooden dowel smaller in diameter than the firearm's caliber and longer than its barrel.

- Select a safe, dedicated work area. Place the firearm on a padded table. Point the muzzle so nothing will be harmed if it accidentally fires. ***Never stand in front of a firearm's muzzle.***
- Wear leather gloves and safety goggles.
- Be sure the firearm is not cocked.
- Standing to the side of the firearm, gently push the dowel into the muzzle until it stops. Hold the dowel between the thumb and forefinger so that the dowel will be propelled ***between*** the fingers should the firearm discharge. ***Do not hold the dowel in such a way that it can be propelled into your hand.***
- Place a pencil mark on the dowel where it just clears the muzzle of the barrel.

- Gently withdraw the dowel from the barrel.
- Place the dowel on top of the barrel with the pencil mark aligned with the muzzle. If the other end of the dowel extends the full length of the barrel, the weapon is not loaded. However, if the measurement indicates that the dowel stopped forward of the touch-hole, consider the firearm to be loaded with a live round.
- Inform the Park Safety Officer of the potential problem. Label the firearm as unsafe and arrange to store it in a secure space.
- Contact the regional/SO curator for instructions on disarming the weapon.

See *Conserve O Gram* 10/1, Caring for Historic Longarms: Storage and Handling Requirements, for more information on safely disarming weapons.

10. *What do I need to know about small arms ammunition?*

Small arms ammunition includes Revolutionary and Civil War paper musket cartridges; metallic cartridges used in the American West; and contemporary pistol, rifle, and machine gun ammunition from World Wars I and II. These small arms cartridges do not pose a serious risk unless they are damaged. Tests conducted by the U.S. Army, the National Rifle Association, the arms industry, and several fire and insurance companies have repeatedly demonstrated that such ammunition will not detonate by itself. This kind of ammunition requires a direct blow to its primer or a direct spark or flame to detonate the powder. If this ammunition is accidentally detonated when it's not confined within the barrel of a firearm, the pressure drops rapidly. The bullet will fly out of the cartridge with about the same velocity as a cork from a champagne bottle.

Follow these general rules for safely handling small arms ammunition:

- Never attempt to deactivate small arms ammunition. Procedures such as drilling holes in a cartridge case or pulling a bullet to remove the powder and charge can be extremely dangerous. If you must deactivate the ammunition, contact a specialist.
- As with all museum collections, prohibit smoking.
- In parks with large collections, store live cartridges in a separate museum specimen cabinet. Clearly label the cabinet with a warning sign to notify fire-fighting personnel.
- If you want to put fixed ammunition on exhibit, it must be rendered inert. Contact the regional/SO curator for guidance in rendering ammunition inert.

11. *What do I need to know about unexploded munitions?*

Unexploded munitions (e.g., cannon balls, Borman fuses, grenades, artillery projectiles) constitute a major health and safety risk.

Treat any unexploded ordnance discovered in a collection with extreme caution. Considerations for the safety of staff, visitors, and resources take precedence over the preservation of even rare ordnance.

Don't handle this material unless you have received specific training and authorization in writing by the superintendent. If you discover ordnance that you suspect is unexploded, immediately take the following steps:

- Do not move or disturb the object.
- Keep all other persons away from the object. Secure the storage space.
- Notify the Chief Park Ranger or other designated protection officer and the Park Safety Officer. Contact the regional/SO curator.
- Work with the Chief Park Ranger and the regional/SO curator to have the object(s) examined and evaluated by an appropriate authority to identify the type of ordnance, manufacturer, historic period, and significance.

If the object is rare, novel, or limited in production (for example, Whitworth projectile, Armstrong projectile, Confederate Mullane projectile) or is identified in the park's approved Scope of Collection Statement, make every attempt to defuse it and preserve the inert object in the collection.

12. *What types of hazardous medical objects and drugs/chemicals are in collections?*

Museum collections can contain a variety of hazardous medical objects and drugs/chemicals.

Handle old medical equipment and medicine or chemical bottles with extreme caution.

Knives, saws, scissors, and other objects from military and civilian medical kits may still carry viable germs and may contain active toxic substances (for example, strychnine, opium, and morphine). The active ingredients of drugs or chemicals, originally very potent, may have become even more potent over time. Drugs, medicinals, and other preparations in pharmaceutical collections may contain toxic materials and/or controlled substances (for example, narcotics). The Controlled Substances Act of 1970 regulates these types of substances. Watch for bottles containing:

- acids and other corrosive liquids (for example, nitric acid)
- fuels (for example, kerosene, naptha®)
- solvents (for example, paint thinners, turpentine)

These chemicals are hazardous and pose the threat of fire. Very often old chemicals contain such labels as "Oil of Vitriol" (sulfuric acid) and "Aqua Fortis" (nitric acid).

13. *What should I do with medical objects and drugs/chemicals?*

Survey the park's collections to determine if they contain any drugs, medicinals, or other preparations that pose potential health or safety hazards. Report findings to the park Safety Officer. If the survey identifies that such materials are in the collection, notify the regional/SO curator and regional Risk Manager and proceed with the following steps:

- Prepare an inventory of the drugs and medicinal chemicals. Start with the containers that have labels. Include the following information in the inventory:
 - name of the substance
 - all information on the label
 - type of container (for example, glass bottle, metal canister, cardboard box) and its lid or stopper
 - condition of container (for example, condition of seal; cracked, chipped bottle; rusty metal; punctured box)
 - other (for example, strong odor being emitted from container)
- List material that cannot be identified and isolate it on a separate shelf for a more detailed examination. Agents of the U.S. Department of Justice, state agencies (such as state crime labs), local pharmacists, and local pharmaceutical manufacturers can provide assistance with identifying this material.
- Conduct a detailed examination. Based on the inventory list or an examination by appropriate specialists, divide the substances into the following groups:
 - "over-the-counter" preparations that are considered non-toxic if precautions are followed and that are not controlled substances
 - non-controlled drugs or preparations that may be toxic or potentially hazardous in some applications or that would require a physician's prescription to get today
 - controlled substances (such as narcotics and dangerous drugs) as defined by the Controlled Substances Act of 1970
 - drugs that may pose a health/safety hazard because of their age or level of deterioration
- Implement an action plan. Based on your inventory and on the detailed examination, pursue the following actions:

<i>If drugs, medicinals, and preparations...</i>	<i>Then you should...</i>
are not controlled, are non-toxic (with usual precautions), and pose no other hazards to the rest of the collection or to the staff,	retain them.
are not controlled but may be toxic or require a prescription to obtain,	retain them only if they are stable and pose no health- hazards to the staff or risk to the rest of the collection. House this material in a locked utility cabinet.

If these materials will become a hazard in the future, consider depositing a sample with the Division of Medical Sciences at the Smithsonian Institution, National Museum of American History (NMAH) and destroying the remainder. This ensures that future staff will not be exposed to hazards from these substances. Check with the division in advance to determine what size sample to save.

- Destroy drugs and medical chemicals that are:
 - controlled substances as defined by the Controlled Substances Act of 1970
 - so toxic that their continued presence in the collection poses an unacceptable risk
 - an immediate hazard to the rest of the collection or the staff because they are dangerously unstable, corrosive, or explosive

If you must destroy material, for whatever reason, retain a small sample for research and reference purposes, and deposit it with the Division of Medical Sciences at the NMAH. Take, account for, and transmit samples of controlled substances in accordance with Drug Enforcement Administration (DEA) procedures. Contact the DEA for assistance. If the specimen to be destroyed is not a controlled substance, contact the Regional Hazardous Waste Coordinator for instruction on proper disposal of the material.

14. *What should I do with original containers?*

Take into account preservation of the original containers when saving or destroying drugs and medical chemicals in the collection. You can open an original, unopened container for the purpose of removing its contents only when:

- the act of opening will not permanently damage the container or diminish its value
- there are urgent and compelling health and safety reasons for opening the container
- the contents are endangering the container (for example, by corrosion) and removal of the contents is the only way to stop the problem

- the act of opening the container poses no safety problem (for example, container exploding or releasing toxic material)

If you are keeping substances in the collection, you may want to transfer them to modern containers. Do this if the original containers can no longer hold them safely. Preserving the original containers is a high priority.

If your collections include original, unopened containers of substances that must be destroyed to comply with the law, the containers are in good condition and thus would not have to be opened otherwise, but can't be opened without causing unacceptable permanent damage, then the containers and their contents shall be deaccessioned (out of scope) and transferred to the Division of Medical Sciences at the Smithsonian Institution.

Keep full descriptive information about the transferred objects, including one or more photographs, with the park's catalog records. Refer to *MH-II*, Chapter 6: Deaccessioning, for information on deaccessioning hazardous material.

When substances in the collection are to be destroyed, save the original containers. Previously opened containers may be emptied as necessary with routine precautions taken for their preservation. Clean emptied containers thoroughly before returning them to storage or exhibit.

If the container held a controlled substance, NO residue may remain in the container according to DEA regulations.

F. Safety Rules for Lifting and Carrying

Chapter 6 in this handbook discusses the importance of using proper techniques when lifting and carrying museum objects. Improper handling techniques may lead to accidental damage to the object. You may injure yourself by improperly lifting and carrying boxes of objects, furniture, and other large and heavy objects. Safely lifting and carrying museum objects requires planning.

1. *How should I plan for lifting and moving objects?*

Careful planning before lifting and moving objects can minimize the chance of injury. Follow these guidelines:

- Consider the size and weight of the load and ask for help if the object is too heavy or bulky to lift and carry safely by yourself.
- Examine the objects for hazards: sharp or broken edges, or contamination, such as mold, or asbestos.
- Have mechanical help at hand. Use a push cart or handtruck to move heavy or bulky objects.

2. *How do I lift and carry an object safely?*

Follow these rules:

- Get close to the object.
- Keep your back *straight* (not arched) when lifting.
- Keep head high and chin tucked.
- Keep feet apart, one foot ahead and one foot behind, to maintain a wide base of support.
- Use legs to help with the lift.
- Push or pull large, heavy objects on a cart, when possible, rather than carry them.
- Use teamwork and good communication when two or more are helping with a load.
- Pivot your feet rather than twisting them when turning with a load.

3. *How do I reach for an object safely?*

Follow these rules to avoid injury when reaching for museum objects.

- Use a step stool for objects slightly out of reach.
- Use an appropriate and sturdy ladder to reach objects on high shelves.
- Maintain proper posture when reaching overhead.
- Store heaviest objects between knee and chest height.

G. Workspace Conditions

1. *What makes a safe and healthy curatorial workspace?*

A safe and healthy curatorial work environment includes good lighting, ventilation, good housekeeping, appropriate type and number of fire extinguishers, and a comfortable chair. Consult with your safety officer on steps that you can take to improve your workspace. You can find information about creating or improving your workspace by referring to sources in Section I, Web Resources, and Section J, References.

2. *When should I worry about radon?*

Radon may be a concern in some curatorial workspaces, especially in basements or certain well-sealed spaces. The natural disintegration of uranium generates radon gas. Radon is prevalent in areas where soils and rocks naturally contain uranium, phosphates, and pitchblende. It may also be a problem where the soil is contaminated with the by-products from uranium or phosphate mining. This colorless, odorless gas seeps into structures through dirt floors, cracks in concrete floors and walls, floor drains, sumps, slab joints, and cracks and pores in concrete block walls. Radon tends to accumulate in enclosed spaces. Levels of radon depend on the structure's construction and on the concentration of radon in the soil.

Radon in the short-lived gaseous state is not harmful. However, the gas breaks down into radioactive particulates (for example, heavy metals) called "radon daughters." These radioactive decay products attach themselves to dust or exist as free ions. If you inhale these particles, they can become trapped in the lung tissues and eventually cause lung cancer. Curatorial staff should determine if there is a potential radon problem in museum collection spaces, especially in work and storage areas (for example, basements or well-sealed spaces).

3. *How do I know if there is radon in my workspace?*

Discuss a radon monitoring program with the park Safety Officer or the Regional Risk Manager. Radon may already have been identified in park structures.

If radon levels have not been determined, request a short-term screening measurement. There are numerous types of monitoring equipment. Work with an individual who has experience and training in monitoring. For assistance in finding individuals experienced in testing for radon you can contact your state radon office. Contacts are listed on the EPA website at <<http://www.epa.gov/iaq/contacts.html>>. You can also contact the EPA at: U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Indoor Environments Division (6609J), 401 M Street SW, Washington, DC 20460; (202) 564-9370; fax: (202) 565-2038.

The amount of radon in the air is measured in "picocuries of radon per liter of air," or "pCi/L." Sometimes test results are expressed in Working Levels (WL). A level of 0.02 WL is equal to about 4 pCi/L.

Practical remediation methods typically can reduce the indoor radon concentrations to well below 4 pCi/L, the current EPA action level for all occupied buildings. EPA indicates that most structures can be reduced readily to below 2 pCi/L.

4. *What do I do if there is a radon problem in the workspace?*

Work with other park staff to reduce the flow of radon into the space. The methods for reducing radon flow include covering exposed earth and sealing cracks and openings (for example, pores in concrete blocks, openings around utility pipes, joints between basement floors and walls, floor drains). This method can achieve the desired reduction in radon levels at small cost. You must implement this method before using other methods. If the radon remains at an unacceptable level, try one or both of the following methods:

- Ventilate the space with natural, forced, or heat recovery systems. Ventilation reduces radon levels by replacing radon-laden indoor air with outdoor air. Change in ventilation, however, may cause problems maintaining the appropriate environment for museum objects.
- Install a system to keep radon from entering space. These more expensive methods include drain-tile suction, sub-slab suction, and block-wall ventilation prevention of space depressurization, and space pressurization.

For a detailed discussion on radon reduction methods, get a copy of the EPA publication *Consumer's Guide to Radon Reduction: How to Reduce Radon Levels in Your Home* (1992) from the nearest EPA Regional Office, or download it from the EPA Website at <<http://www.epa.gov/iedweb00/radon/pubs/consguid.html>>.

H. Glossary*

Acute conditions: severe, often dangerous conditions in which relatively rapid changes occur

Acute exposure: intense exposure to a hazardous substance over a relatively short period of time

Boiling point: temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which the liquid changes to a vapor. The boiling point is usually expressed in degrees Fahrenheit. *If a flammable material has a low boiling point, it indicates a special fire hazard.*

Breathing Zone: ambient environment in which a person performs normal respiration (around nose and mouth)

Ceiling ("C"): concentration of a substance that should not be exceeded, even for an instant. It may be written as Threshold Limit Value-Ceiling or TLV-C.

Carcinogen: substance or physical agent that may cause cancer in animals or humans

Chronic conditions: persistent, prolonged, or repeated conditions

Chronic exposure: exposure occurring over a period of days, weeks, or years

Combustible liquids: liquids with flash points at or above 100°F (37.8°C) or those that will burn. They do not ignite as easily as flammable liquids. However, combustible liquids can be ignited under certain circumstances, and must be handled with caution. (Substances, such as wood and paper are termed "ordinary combustibles.")

Flammable liquids: liquids with flash points below 100°F

Flash Point: lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture and burn when a source of ignition (e.g., sparks, open flames, cigarettes) is present. Two tests are used to determine the flash point: open cup and closed cup. The test method is indicated on the MSDS after the flash point.

Hazardous material: chemical or mixture of chemicals that is toxic, highly toxic, an irritant, a corrosive, a strong oxidizer, a strong sensitizer, combustible, flammable, extremely flammable, dangerously reactive, pressure-generating, or otherwise may cause substantial personal injury or substantial illness during or as a direct result of any customary or reasonable foreseeable handling or use

Lower Explosive Limit (LEL): lowest concentration of a substance that will produce a fire or flash when an ignition source (for example, flame, spark) is present. It is expressed in percent of vapor or gas in the air by volume. Below the LEL the air/contaminant mixture is theoretically too "lean" to burn.

Mutagen: anything that can cause a change (or mutation) in the genetic material of a living cell

Narcosis: stupor or unconsciousness caused by exposure to a chemical substance

Odor threshold: minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor

Permissible Exposure Limit (PEL): exposure limit that is published and enforced by OSHA as a legal standard. PEL may be a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short-term exposure limit (STEL), or a ceiling (C). The PELs are found in Tables Z-1, Z-2, or Z-3 of OSHA regulations 1910.1000.

Reactivity: substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosion, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, or mixing with water and dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on a MSDS.

Short Term Exposure Limit (STEL): maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures

Threshold Limit Value (TLV): airborne concentrations of substances established by the ACGIH that represent conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLVs: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C).

Time Weighted Average (TLV-TWA): average time, over a given work period (for example, 8-hour workday), of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period.

Toxicity: potential of a substance to exert a harmful effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place

Trade name: commercial name or trademark by which a chemical is known. One chemical may have a variety of trade names depending on the manufacturers or distributors involved

Upper Explosive Limit (UEL): highest concentration (expressed in percent of vapor or gas in the air by volume) of a substance that will burn or explode when an ignition source is present. Theoretically, above this limit, the mixture is said to be too "rich" to support combustion. The difference between the LEL and the UEL constitutes the flammable range or explosive range of a substance. That is, if the LEL is 1 ppm and the UEL is 5 ppm, then the explosive range of the chemical is 1ppm to 5 ppm.

Vapor: gaseous form of substances that are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids, such as solvents. Solvents with low boiling points will evaporate readily.

* This glossary was prepared by excerpting selected terms and definitions from the Glossary (Appendix D), 1161-1234, in *Fundamentals of Industrial Hygiene* (Second Edition), edited by Julian B. Olishifski.

I. Web Resources

NPS Occupational Safety and Health Program: <<http://www.nps.gov/riskmgmt>>. (Director's Order #50B and Reference Manual 50B are also available through a link on this page.)

Department of Interior Manual, Part 485 Safety and Occupational Health Program: <http://www.nps.gov/riskmgmt/act_man.htm>.

AIC Health and Safety Guides: <<http://palimpsest.stanford.edu/aic/health/>>.

Conservation OnLine, Health and Safety Links: <<http://palimpsest.stanford.edu/bytopic/health/>>.

Environmental Protection Agency: <<http://www.epa.gov/>>.

ErgoWeb: <<http://ergoweb.com/Pub/ewhome.html>>.

National Institute for Occupational Safety and Health: <<http://www.cdc.gov/niosh/homepage.html>>.

Occupational Safety and Health Organization (OSHA), Department of Labor: <<http://www.osha.gov/>>.

OSHA information on respiratory protection: <<http://www.osha-slc.gov/SLTC/respiratoryprotection/index.html>>.

The Physical and Theoretical Chemistry Laboratory, Oxford University, Guide to Gloves:
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J. Selected Bibliography

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K. List of Figures

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Dilution Ventilation	
<i>Advantages</i>	<i>Disadvantages</i>
<ul style="list-style-type: none"> • low equipment and installation costs 	<ul style="list-style-type: none"> • does not eliminate exposure to contaminated area
<ul style="list-style-type: none"> • effective control for small amounts of low and medium toxicity solvents 	<ul style="list-style-type: none"> • should not be used for high toxicity vapors and gases
<ul style="list-style-type: none"> • effective control for flammable and combustible gases and vapors 	<ul style="list-style-type: none"> • should not be used for large amounts of gases and vapors
<ul style="list-style-type: none"> • requires little maintenance 	<ul style="list-style-type: none"> • ineffective for particulates (dust, metal particles, metal fumes)
	<ul style="list-style-type: none"> • requires large volumes of heated or cooled make-up air
	<ul style="list-style-type: none"> • not effective for handling surges of gases or irregular emissions
	<ul style="list-style-type: none"> • people working close to contaminant source can still have large exposures
Local Exhaust Ventilation	
<i>Advantages</i>	<i>Disadvantages</i>
<ul style="list-style-type: none"> • captures contaminants at source and removes them from workplace 	<ul style="list-style-type: none"> • system design and installation can be expensive
<ul style="list-style-type: none"> • can handle all types of contaminants, including dusts, metal fumes, etc. 	<ul style="list-style-type: none"> • requires regular cleaning, inspection and maintenance
<ul style="list-style-type: none"> • requires small amounts of make-up air since uses low exhaust volumes 	
<ul style="list-style-type: none"> • low on-going energy costs because of low amounts of make-up air 	
<ul style="list-style-type: none"> • only alternative for high toxicity airborne materials 	

Figure 11.1. Comparison of Dilution and Local Exhaust Ventilation (after Clark, et. al., 1984).

Material Safety Data Sheet

May be used to comply with
 OSHA's Hazard Communication Standard,
 29 CFR 1910.1200. Standard must be Form Approved
 consulted for specific requirements. OMB No. 1218-0072

U.S. Department of Labor

Occupational Safety and Health Administration
 (Non-Mandatory Form)



IDENTITY (As Used on Label and List)	Emergency Telephone Number
--------------------------------------	----------------------------

Section I

Manufacturer's Name	Emergency Telephone Number
Address (Number, Street, City, State, and ZIP Code)	Telephone Number for Information
	Date Prepared
	Signature of Preparer (optional)

Section II - Hazard Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Names(s))	OSHA PEL	ACGIH TLV	Other limits Recommended	% (optional)

Section III - Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H ₂ O = 1)	
Vapor Pressure (mm Hg.)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	
Solubility in Water			
Appearance and Odor			

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
Extinguishing Media			
Special Fire Fighting Procedures			
Unusual Fire and Explosion Hazards			

(Reproduce locally)

OSHA 174, Sept. 1985

Figure 11.2. Sample Material Safety Data Sheet

Section V - Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable		
Incompatibility (<i>Materials to Avoid</i>)			
Hazardous Decomposition or Byproducts			
Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur		

Section VI – Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?
Health Hazards (<i>Acute and Chronic</i>)			
Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?
Signs and Symptoms of Exposure			
Medical Conditions Generally Aggravated by Exposure			
Emergency and First Aid Procedures			

Section VII - Precautions for Safe Handling and Use

Respiratory Protection (<i>Specify Type</i>)			
Ventilation	Local Exhaust	Special	
	Mechanical (<i>General</i>)	Other	
Protective Gloves		Eye Protection	
Other Protective Clothing or Equipment			
Work/Hygienic Practices			

Figure 11.2. Sample Material Safety Data Sheet (cont.)



Material Safety Data Sheet

Formaldehyde Solution 37%

ACC# 50002

Section 1 - Chemical Product and Company Identification

MSDS Name: Formaldehyde Solution 37%

Catalog Numbers: S74337, S74338, S80018-2, BP530-25, BP530-500, BP53025, BP531-25, BP531-500, F75P20, F75P4, F77 20, F77 200, F7720, F77200, F77200LC, F7720LC, F77P 20, F77P 4, F77P20, F77P4, F79 1, F79 20, F79 200, F79 4, F79 500, F791, F7920, F79200, F794, F79500, F79J4, F79P 20, F79P 4, F79P20, F79P4, NC9475399, S74337MF, S74338MF

Synonyms: None.

Company Identification:

Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410

For information, call: 201-796-7100

Emergency Number: 201-796-7100

For CHEMTREC assistance, call: 800-424-9300

For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
50-00-0	Formaldehyde	37	200-001-8
67-56-1	Methyl alcohol	15	200-659-6
7732-18-5	Water	48	231-791-2
Not avail.	Odor mask	0.0-1.1	unlisted

Hazard Symbols: T

Risk Phrases: 10 23/24/25 34 40 43

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: not available. Flash Point: 50 deg C. **Danger! Flammable liquid.** May cause allergic skin reaction. This substance has caused adverse reproductive and fetal effects in animals. May cause central nervous system depression. Cannot be made non-poisonous. May cause liver and kidney damage. Causes eye and skin irritation. Causes digestive and respiratory tract irritation. May be fatal or cause blindness if swallowed. Contains formaldehyde. Respiratory sensitizer. Potential cancer hazard. Vapor harmful.

Target Organs: Kidneys, central nervous system, liver.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (Reproduced by permission of Fisher Scientific.)

Potential Health Effects

Eye: Causes eye irritation. May cause chemical conjunctivitis and corneal damage.

Skin: Causes skin irritation. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material. May cause cyanosis of the extremities.

Ingestion: May be fatal or cause blindness if swallowed. Causes gastrointestinal irritation with nausea, vomiting and diarrhea. May cause liver and kidney damage. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. May cause central nervous system depression.

Inhalation: Inhalation of high concentrations may cause central nervous system effects characterized by headache, dizziness, unconsciousness and coma. Causes respiratory tract irritation. May cause asthmatic attacks due to allergic sensitization of the respiratory tract. Aspiration may lead to pulmonary edema. Vapors may cause dizziness or suffocation. May cause burning sensation in the chest.

Chronic: Repeated exposure may cause skin discoloration and thickening and nail decay. Repeated inhalation is associated with nasal and nasopharyngeal cancer.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed.

Skin: Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse. Destroy contaminated shoes.

Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation: Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Notes to Physician: Treat symptomatically and supportively.

Section 5 - Firefighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. Vapors may form an explosive mixture with air. Vapors can travel to a source of ignition and flash back. Will burn if involved in a fire. Use water spray to keep fire-exposed containers cool. Containers may explode in the heat of a fire. Flammable Liquid.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. Use water spray to cool fire-exposed containers. Water may be ineffective. Do NOT use straight streams of water.

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Avoid runoff into storm sewers and ditches, which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Remove all sources of ignition. Use a spark-proof tool. Provide ventilation. A vapor suppressing foam may be used to reduce vapors.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Avoid contact with heat, sparks and flame. Avoid ingestion and inhalation. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.

Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area. Keep containers tightly closed.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Formaldehyde	C 0.3 ppm	0.016 ppm TWA; NIOSH Potential Occupational Carcinogen - see Appendix A Potential NIOSH carcinogen.	0.75 ppm TWA PEL; 2 ppm STEL; 0.5 ppm TWA action leve
Methyl alcohol	200 ppm; 250 ppm STEL; skin - potential for cutaneous absorption	200 ppm TWA; 260 mg/m ³ TWA 6000 ppm IDLH	200 ppm TWA; 260 mg/m ³ TWA
Water	none listed	none listed	none listed

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

OSHA Vacated PELs: Formaldehyde: 3 ppm TWA (unless specified in 1910.1048) Methyl alcohol: 200 ppm TWA; 260 mg/m³ TWA Water: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Liquid

Appearance: not available

Odor: None reported

pH: Not available.

Vapor Pressure: Not available.

Vapor Density: >1.0

Evaporation Rate:Not available.

Viscosity: Not available.

Boiling Point: 212 deg F

Freezing/Melting Point:32 deg F

Decomposition Temperature:Not available.

Autoignition Temperature: Not applicable.

Flash Point: 50 deg C (122.00 deg F)

NFPA Rating: Not published.

Explosion Limits, Lower:Not available.

Upper: Not available.

Solubility: soluble in water

Specific Gravity/Density:Not available.

Molecular Formula:Mixture

Molecular Weight:Not available

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.

Conditions to Avoid: Incompatible materials, ignition sources, excess heat, oxidizers.

Incompatibilities with Other Materials: Strong oxidizing agents.

Hazardous Decomposition Products: Carbon monoxide, oxides of phosphorus, irritating and toxic fumes and gases, carbon dioxide, toxic fumes of sodium oxide.

Hazardous Polymerization: Has not been reported.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

Section 11 - Toxicological Information

RTECS#:

CAS# 50-00-0: LP8925000

CAS# 67-56-1: PC1400000

CAS# 7732-18-5: ZC0110000

LD50/LC50:

CAS# 50-00-0:

Inhalation, mouse: LC50 = 400 mg/m³/2H;

Inhalation, rat: LC50 = 203 mg/m³;

Oral, mouse: LD50 = 42 mg/kg;

Oral, rat: LD50 = 100 mg/kg;

Skin, rabbit: LD50 = 270 mg/kg; <BR.

CAS# 67-56-1:

Inhalation, rat: LC50 = 64000 ppm/4H;

Oral, mouse: LD50 = 7300 mg/kg;

Oral, rabbit: LD50 = 14200 mg/kg;

Oral, rat: LD50 = 5628 mg/kg;

Skin, rabbit: LD50 = 15800 mg/kg; <BR.

CAS# 7732-18-5:

Oral, rat: LD50 = >90 mL/kg; <BR.

Carcinogenicity:

CAS# 50-00-0:

ACGIH: A2 - suspected human carcinogen

California: carcinogen; initial date 1/1/88

NIOSH: occupational carcinogen

NTP: Suspect carcinogen

OSHA: Possible Select carcinogen

IARC: Group 2A carcinogen **CAS# 67-56-1:** Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. **CAS# 7732-18-5:** Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

Epidemiology: No data available.

Teratogenicity: No data available.

Reproductive Effects: No data available.

Neurotoxicity: No data available.

Mutagenicity: No data available.

Other Studies: No data available.

Section 12 - Ecological Information

Ecotoxicity: Not available.

Environmental Fate: Not available.

Physical/Chemical: Not available.

Other: Not available.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series: CAS# 50-00-0: waste number U122. CAS# 67-56-1: waste number U154; (Ignitable waste).

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	FORMALDEHYDE, SOLUTIONS, FLAMMABLE				No information available.
Hazard Class:	3				
UN Number:	UN1198				
Packing Group:	III				

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 50-00-0 is listed on the TSCA inventory.

CAS# 67-56-1 is listed on the TSCA inventory.

CAS# 7732-18-5 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

CAS# 50-00-0: final RQ = 100 pounds (45.4 kg) CAS# 67-56-1: final RQ = 5000 pounds (2270 kg)

Section 302 (TPQ)

CAS# 50-00-0: TPQ = 500 pounds; RQ = 100 pounds (does not meet toxicity criteria but because of high production volume and recognized toxicity is considered a chemical of concern)

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

SARA Codes

CAS # 50-00-0: acute, chronic. CAS # 67-56-1: acute, flammable.

Section 313

This material contains Formaldehyde (CAS# 50-00-0, 37%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373. This material contains Methyl alcohol (CAS# 67-56-1, 15%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

CAS# 50-00-0 is listed as a hazardous air pollutant (HAP). CAS# 67-56-1 is listed as a hazardous air pollutant (HAP). This material does not contain any Class 1 Ozone depleters. This material does not contain any Class 2 Ozone depleters.

Clean Water Act:

CAS# 50-00-0 is listed as a Hazardous Substance under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

CAS# 50-00-0 is considered highly hazardous by OSHA.

STATE

CAS# 50-00-0 can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

CAS# 67-56-1 can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act: WARNING: This product contains Formaldehyde, a chemical known to the state of California to cause cancer. California No Significant Risk Level: CAS# 50-00-0: no significant risk level = 40 ug/day

European/International Regulations**European Labeling in Accordance with EC Directives****Hazard Symbols:**

T

Risk Phrases:

R 10 Flammable. R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed. R 34 Causes burns. R 40 Possible risks of irreversible effects. R 43 May cause sensitization by skin contact.

Safety Phrases:

S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S 36/37 Wear suitable protective clothing and gloves. S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S 51 Use only in well-ventilated areas.

WGK (Water Danger/Protection)

CAS# 50-00-0: 2

CAS# 67-56-1: 1

CAS# 7732-18-5: No information available.

Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)

Canada

CAS# 50-00-0 is listed on Canada's DSL/NDSL List.

CAS# 67-56-1 is listed on Canada's DSL/NDSL List.

CAS# 7732-18-5 is listed on Canada's DSL/NDSL List.

This product has a WHMIS classification of B2, D1A, D2B.

CAS# 50-00-0 is not listed on Canada's Ingredient Disclosure List.

CAS# 67-56-1 is not listed on Canada's Ingredient Disclosure List.

CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

Exposure Limits

CAS# 50-00-0: OEL-ARAB Republic of Egypt: TWA 2 ppm (3 mg/m³) OEL-AUSTRALIA: TWA 1 ppm (1.5 mg/m³); STEL 2 ppm (3 mg/m³); CAR OEL-BELGIUM: TWA 1 ppm (1.2 mg/m³); STEL 2 ppm (2.5 mg/m³); CAR OEL-CZECHOSLOVAKIA: TWA 0.5 mg/m³; STEL 1 mg/m³ OEL-DENMARK: STEL 0.3 ppm (0.4 mg/m³); Carcinogen OEL-FINLAND: STEL 1 ppm (1.3 mg/m³); Skin OEL-FRANCE: STEL 2 ppm (3 mg/m³) OEL-GERMANY: TWA 0.5 ppm (0.6 mg/m³); Carcinogen OEL-HUNGARY: STEL 0.6 mg/m³; Carcinogen OEL-JAPAN: TWA 0.5 ppm (0.61 mg/m³); Carcinogen OEL-THE NETHERLANDS: TWA 1 ppm (1.5 mg/m³); STEL 2 ppm (3 mg/m³) OEL-THE PHILIPPINES: TWA 5 ppm (6 mg/m³) OEL-POLAND: TWA 2 mg/m³ OEL-RUSSIA: TWA 0.5 ppm; STEL 0.5 mg/m³; Skin OEL-SWEDEN: TWA 0.5 ppm (0.6 mg/m³); STEL 1 ppm (1. mg/m³) OEL-SWITZERLAND: TWA 0.5 ppm (0.6 mg/m³); STEL 1 pp (1.2 mg/m³) OEL-THAILAND: TWA 3 ppm; STEL 5 ppm OEL-TURKEY: TWA 5 ppm (6 mg/m³) OEL-UNITED KINGDOM: TWA 2 ppm (2.5 mg/m³); STEL 2 ppm (2.5 mg/m³) OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

CAS# 67-56-1: OEL-ARAB Republic of Egypt: TWA 200 ppm (260 mg/m³); Skin OEL-AUSTRALIA: TWA 200 ppm (260 mg/m³); STEL 250 ppm; Skin OEL-BELGIUM: TWA 200 ppm (262 mg/m³); STEL 250 ppm; Skin OEL-CZECHOSLOVAKIA: TWA 100 mg/m³; STEL 500 mg/m³ OEL-DENMARK: TWA 200 ppm (260 mg/m³); Skin OEL-FINLAND: TWA 200 ppm (260 mg/m³); STEL 250 ppm; Skin OEL-FRANCE: TWA 200 ppm (260 mg/m³); STEL 1000 ppm (1300 mg/m³) OEL-GERMANY: TWA 200 ppm (260 mg/m³); Skin OEL-HUNGARY: TWA 50 mg/m³; STEL 100 mg/m³; Skin JAN9 OEL-JAPAN: TWA 200 ppm (260 mg/m³); Skin OEL-THE NETHERLANDS: TWA 200 ppm (260 mg/m³); Skin OEL-THE PHILIPPINES: TWA 200 ppm (260 mg/m³) OEL-POLAND: TWA 100 mg/m³ OEL-RUSSIA: TWA 200 ppm; STEL 5 mg/m³; Skin OEL-SWEDEN: TWA 200 ppm (250 mg/m³); STEL 250 ppm (350 mg/m³); Skin OEL-SWITZERLAND: TWA 200 ppm (260 mg/m³); STEL 400 ppm; Skin OEL-THAILAND: TWA 200 ppm (260 mg/m³) OEL-TURKEY: TWA 200 ppm (260 mg/m³) OEL-UNITED KINGDOM: TWA 200 ppm (260 mg/m³); STEL 250 ppm; Skin OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

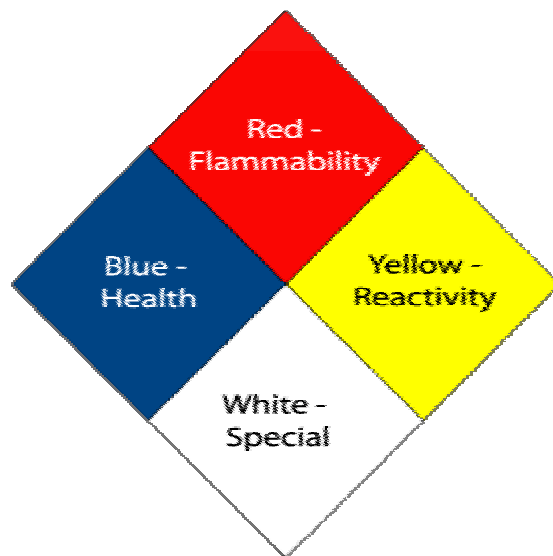
Section 16 - Additional Information

MSDS Creation Date: 7/12/1999

Revision #6 Date: 8/02/2000

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Figure 11.3. Material Safety Data Sheet for Formaldehyde Solution (cont.) (Reproduced by permission of Fisher Scientific.)



General Rating Summary

Health (Blue)

- 4 **Danger** May be fatal on short exposure. Specialized protective equipment required.
- 3 **Warning** Corrosive or toxic. Avoid skin contact or inhalation.
- 2 **Warning** May be harmful if inhaled or absorbed.
- 1 **Caution** May be irritating.
- 0 No unusual hazard.

Flammability (Red)

- 4 **Danger** Flammable gas or extremely flammable liquid.
- 3 **Warning** Flammable liquid flash point below 100° F.
- 2 **Caution** Combustible liquid flash point of 100° to 200° F.
- 1 Combustible if heated.
- 0 Not combustible.

Reactivity (Yellow)

- 4 **Danger** Explosive material at room temperature.
- 3 **Danger** May be explosive if shocked, heated under confinement, or mixed with water.
- 2 **Warning** Unstable or may react violently if mixed with water.
- 1 **Caution** May react if heated or mixed with water but not violently.
- 0 **Stable** Not reactive when mixed with water.

Special Notice Key (White)

- W Water Reactive
- OX Oxidizing Agent

Figure 11.4. The NFPA Hazard Symbol and Key to Color Code and Numbering System