Formaldehyde (Formalin)

1. **Use of Formaldehyde (Formalin)**
    - Formaldehyde is the primary preservative/fixative used within the Anatomic Pathology Division laboratories in a 10% formalin solution. The Pathology Department uses formalin to fix grossed tissue, autopsy specimens, and Cytology cell blocks.
    - Formaldehyde is a colorless, aqueous solution that has an irritating pungent odor and is classified as an upper respiratory irritant because of its high solubility in water.

2. **Hazards Associated with Exposure to Formaldehyde (Formalin)**
    - There are several health effects, both short and long-term, that can result from exposure or over-exposure to formaldehyde. The following is a list of signs, symptoms, and actions to take in the event of sensitization to and/or acute health effects from exposure/over-exposure to formaldehyde:
        - **Skin contact**: Formaldehyde is a severe skin irritant and sensitizer. Contact with formaldehyde solutions, vapor or resins can cause eczema (dry, flaking and itching skin) and in extreme cases can lead to allergic dermatitis or hives.
        - **Clothing saturation**: The aforementioned symptoms can also be caused by contact with clothing contaminated with formaldehyde. In the event that clothing is saturated with formaldehyde, remove contaminated clothing immediately, wash the affected area with soap for at least 15 minutes, and report the incident to your supervisor and seek medical attention if necessary.
        - **Eye contact:** Exposure to formaldehyde vapor can cause reddening and a burning sensation in the eyes, accompanied by tear production. Formaldehyde solutions coming into direct contact with the eye can cause serious damage to the cornea, possibly leading to blindness. In the event formaldehyde is introduced to the eyes, wash the eyes immediately with large amounts of water and seek medical attention immediately.
        - **Ingestion:** Ingestion of small amounts of concentrated formaldehyde solution can cause severe irritation of the mouth, throat and stomach, and can lead to loss of consciousness and death. Should ingestion occur, provide a conscious victim milk, activated charcoal or water, and seek immediate medical attention.
        - **Nose, throat, and lungs**: Low ambient concentrations of formaldehyde can cause irritation of the upper respiratory tract. At higher concentrations, the effects become more severe, with levels above 10 ppm causing coughing, chest tightness and difficulty

breathing, and levels of 25 to 30 ppm causing severe respiratory tract injury. Exposure to 100 ppm is immediately dangerous to life and health leading to death from throat swelling and chemical burns to the lungs. At the first sign of any of these symptoms, seek fresh air and report the incident to your supervisor immediately.

  - **Respiratory Sensitization:** Since formaldehyde is a sensitizer, repeated exposure to formaldehyde can cause allergic asthma. Symptoms of asthma include chest tightness, shortness of breath, wheezing, and coughing.

- Chronic health effects (potential) due to long-term exposure to formaldehyde may be linked to the following:
  - **Cancer:** Although there is no conclusive evidence available to prove that formaldehyde is a human carcinogen, prolonged exposure has been associated with cancers of the lung, nasopharynx, oropharynx, and nasal passages, and it has been shown to cause cancer in animals. Formaldehyde is therefore considered to be a **probable human carcinogen**.
  - **Mutagen:** Formaldehyde is genotoxic in several in-vitro test systems, showing properties of both an initiator and a promoter.
  - **Reproductive system:** Scientists have made many attempts to study whether formaldehyde might harm pregnancy or the reproductive system. The results have been mixed and complicated. Studies clearly show that formaldehyde does not cause birth defects. There is some uncertainty whether formaldehyde might cause spontaneous abortions and sperm damage. However, it is believed that exposures in most workplaces probably do not pose any significant risk to pregnancy or the reproductive system.
- **Symptoms of Exposure:** Because formaldehyde is very water soluble it affects the mucous membranes. The effects of formaldehyde exposure can vary from person to person. Typical exposure symptoms are listed below:

Concentration in Air	Symptoms
0.1-5 ppm	Eye irritation, tears, skin irritation, respiratory tract irritation
5-20 ppm	Burning of eyes and respiratory tract, tears, difficulty in breathing/coughing
20-100 ppm	Chest tightening, pain, irregular heartbeat, severe lung irritation, pulmonary edema, death in severe cases
ppm = parts per million	

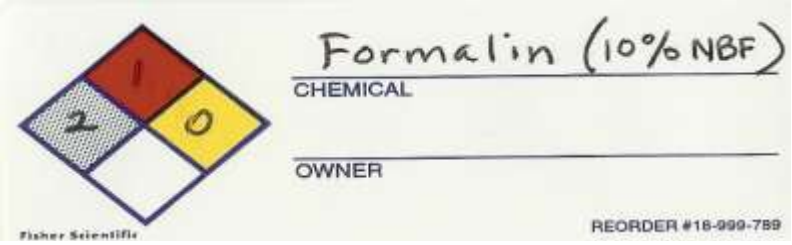
- **Medical Surveillance Program:** Employees should immediately report any adverse signs or symptoms previously presented which they suspect may be caused by exposure to formaldehyde to his or her supervisor and seek medical attention from the UMHHC's Employee Health Services office.

3. Signage

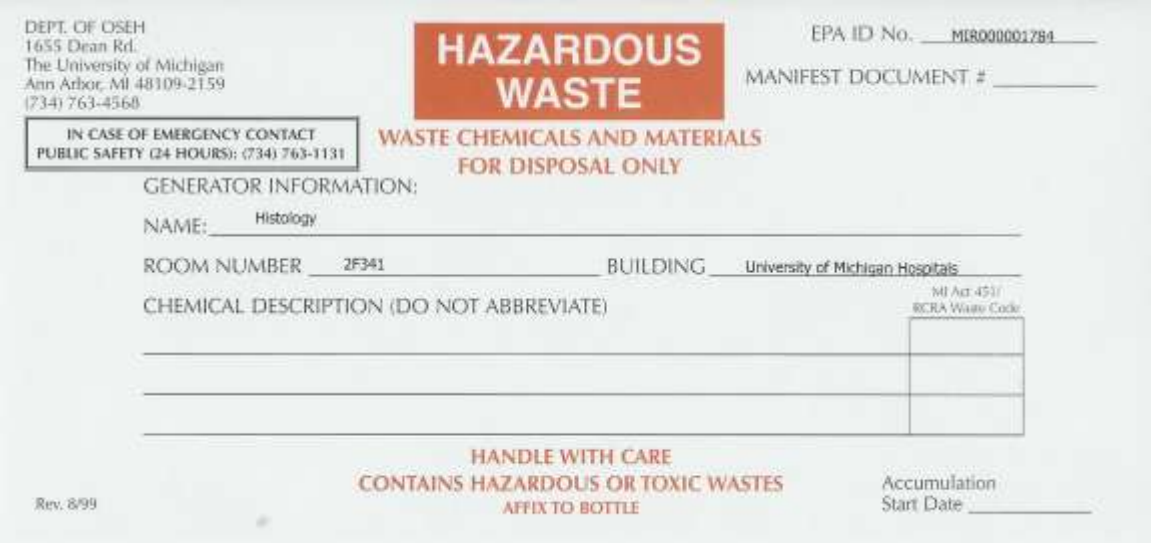
- All designated areas where formaldehyde or formalin solutions are required to be used or stored will have the following signage posted:

- Any container of formaldehyde or formalin solutions should be clearly labeled with the following:

- All secondary containers and/or working solutions/reagents of formaldehyde will have the following label:



- Waste containers of formaldehyde solutions must be immediately labeled with a UMHHC Hazardous Waste label as soon as the waste is generated.


DEPT. OF OSEH
1655 Dean Rd.
The University of Michigan
Ann Arbor, MI 48109-2159
(734) 763-4568

IN CASE OF EMERGENCY CONTACT
PUBLIC SAFETY (24 HOURS): (734) 763-1131

HAZARDOUS WASTE

WASTE CHEMICALS AND MATERIALS
FOR DISPOSAL ONLY

EPA ID No. MIR000001784

MANIFEST DOCUMENT # _____

GENERATOR INFORMATION:

NAME: Histology

ROOM NUMBER 2F341 BUILDING University of Michigan Hospitals

CHEMICAL DESCRIPTION (DO NOT ABBREVIATE)

MI Act 451/ RCRA Waste Code

HANDLE WITH CARE
CONTAINS HAZARDOUS OR TOXIC WASTES
AFFIX TO BOTTLE

Rev. 8/99

Accumulation Start Date _____

- The following signage will be posted when chemicals are being changed on the processors in the Histology laboratory:

4. Air monitoring, Results, and Documentation

- In the event of odor complaints, overexposure signs and symptoms, change in personnel, procedure/process, or new equipment, formaldehyde exposure monitoring may be required to ensure that employees are not over-exposed to formaldehyde vapors. Monitoring will be conducted by Safety Management Services (764-4427).
- **Frequency of monitoring:** Exposure monitoring should be conducted for each job classification and for each work shift. It is critical to repeat the monitoring process each time there is a change in production,

equipment, process, personnel, or control measures that result in new or additional exposure to formaldehyde.

The laboratory may discontinue periodic formaldehyde monitoring if results from 2 consecutive sampling periods taken at least 7 days apart show that employee exposure is below the action level and the short-term exposure limit, and 1) no change has occurred in production, equipment, process, or personnel or control measures that may result in new or additional exposure to formaldehyde, and 2) there have been no reports of conditions that may be associated with formaldehyde exposure.

If any personnel report signs or symptoms of respiratory or dermal conditions associated with formaldehyde exposure, the laboratory must promptly monitor the affected person's exposure.

- **Regulatory Exposure Limits:** The following standards are applicable to occupational exposure to Formaldehyde:
  - Michigan Department of Consumer and Industry Services (MIOSHA) Part 306. Formaldehyde
  - MIOSHA Permissible Exposure Limits (PEL):
    - 0.75 ppm as an 8 hour Time-Weighted Average (TWA)
    - 2.0 ppm as a 15 minute Short Term Exposure Limit (STEL)
    - MIOSHA has also established an Action Level of 0.5 ppm, averaged as an 8 hour TWA.
  - The American Council for Governmental Industrial Hygienists (ACGIH) recommends:
    - 0.3 ppm as a ceiling limit that should not be exceeded at any time (usually a 15 minute sample if instantaneous measurements are not feasible).

PELs are the maximum amounts or concentrations of a chemical that a worker may be exposed to under OSHA regulations. PEL's can be defined in two different ways:

1. Ceiling values - at no time should this exposure limit be exceeded.
2. 8-hour Time Weighted Averages (TWA) - are an average value of exposure over the course of an 8 hour work shift.

Time Weighted Average (TWA) is the permitted exposure limit of airborne concentrations of substances that a worker may be exposed to over an eight hour working day for a five day working week. Higher levels of exposure are permitted provided they are compensated for by equivalent exposures below the standard during the working day (see STEL).

TWA levels are usually lower than ceiling values. Thus, a worker may be exposed to a level higher than the TWA for part of the day (but still lower than the ceiling value) as long as he/she is exposed to levels below the TWA for the rest of the day.

STELs are expressed as airborne concentrations of substances averaged over a period of fifteen minutes. Workers should not be exposed at the STEL concentration continuously for longer than fifteen minutes, or for more than four such periods per working day. A minimum of sixty minutes should be allowed between successive exposures at the STEL concentration.

- The area supervisor shall report the results of all formaldehyde monitoring to the person(s) monitored within 15 calendar days of the date on which the area supervisor receives the results. Notification must either be in writing, either by distributing copies of the results of the exposure monitoring to the affected (those conducting the same job tasks) employees or by posting the results (results should be posted for a minimum of three days). Once the results have been reviewed by all affected employees, a copy should be filed in the Department's Formaldehyde Program and Training Manual. If the PEL has been exceeded, effected employees must be notified, in writing, of the corrective action being taken.
- TWA measurements may be taken at any time, at the discretion of the area supervisor. If monitoring results indicate that either the PEL or the STEL has been exceeded, the use of respirators and/or other protective equipment is required by all personnel in the area, as soon as the report is received (NOTE: Gloves, goggles, face shields, and other protective clothing may be necessary at much lower exposure levels). OSHA specifies full-facepiece respirators with cartridges specifically approved for formaldehyde exposure. The employer shall select protective clothing and equipment based upon the form of formaldehyde to be encountered, the condition of use, and the hazard to be prevented. The employer shall provide these protective devices to the employee at no cost and assure that the employee wears them.
- The university/hospital shall establish regulated areas where the concentration of airborne formaldehyde exceeds either the TWA or the STEL and post the following signage at all entrance/access ways:

5. Engineering and Safe Work Practices/Administrative Controls

- **Safe Work Practices/Administrative Controls.** Safe work practices and administrative controls are an important part of a safe working environment. If an employee is asked to perform a task in a certain manner to limit the exposure to formaldehyde, then the recommended procedures should be followed exactly as outlined. In context with minimizing formaldehyde exposure, the following work practices should be applied:
  - As with any laboratory chemical, do not mouth pipette formaldehyde solutions.
  - Do not eat or drink where formaldehyde is handled, processed, or stored, since the chemical can be ingested**.**
  - Always wash hands thoroughly after using formaldehyde, even if gloves are worn.
  - Minimize the amount of formaldehyde used by using only the amount required to perform the required procedure.
  - Ensure that formaldehyde containers are appropriately labeled with proper health hazards.
  - A tray should be used for any work with formaldehyde, in order to contain potential spills
  - Keep formaldehyde stored in closed containers in well ventilated areas.
  - When possible, ensure that formaldehyde solutions are handled within a properly functioning chemical fume hood.
  - Spill cleanup material should be available in any area where formaldehyde is used or stored. Products such as formaldehyde neutralizing powders, or formaldehyde neutralizing pads can be placed where leaks or drips might occur.
  - Provide continuing training and education to personnel.
- **Engineering Controls**
  - Ventilation is the most widely applied engineering control method for reducing the concentration of airborne substances in the breathing zones of workers. Either local exhaust ventilation or general dilution ventilation should be used for this purpose whenever possible.
  - The processor and waste room shall be appropriately labeled regarding the potential danger that exists within the room. Only persons trained in recognizing the hazards of formaldehyde to are permitted access to this room.

6. Formaldehyde (Formalin) Personal Protective Equipment (PPE)

- Certain types of PPE are effective in controlling formaldehyde exposure. In normal work situations, PPE should be used only as a supplement to engineering controls. Employees must not take formaldehyde-contaminated materials, clothing, or equipment home. At a *minimum*, PPE that should be utilized when working with formaldehyde are:
    - **Impermeable Gloves:** Gloves made of natural or butyl rubber, Nitrile, or Neoprene are recommended to protect skin from contact with formaldehyde. Latex gloves should only be used when short-term, incidental contact is expected. Gloves that have not been contaminated with formaldehyde may be discarded in the regular trash. Disposable gloves contaminated with formaldehyde must be thoroughly rinsed before being discarded in the regular trash. Heavily contaminated gloves must be disposed of as chemical waste.
    - **Eye and Face Protection:** Always use chemical goggles or a face shield when handling formaldehyde solutions to minimize the risk of even a small splash or vapor exposure to the corneas. If a face shield is worn, chemical goggles are also required if there is a possibility of a splash to the eyes.
    - **Lab coats/aprons:** An impervious lab coat must be worn, completely snapped or buttoned, when working with formaldehyde. In the event that there may be an exposure to a large amount of formaldehyde, a disposable apron may be utilized in conjunction with a lab coat and **never** as the sole clothing barrier to exposure.
    - **Respiratory Protection:** If an employee may be exposed to formaldehyde vapor concentrations where respiratory protection is warranted, please contact Safety Management Services for guidance on appropriate respirators for formaldehyde vapor protection. When employees are required to wear respirators to reduce exposure, they must be enrolled in UMHHCs Respiratory Protection Program as required by OSHA. Work operations which may warrant respiratory protection include the following:
        1. During the installation of engineering controls.
        2. Work operations for which engineering controls and work practices are not feasible.
        3. Work operations for which engineering controls and work practice controls do not reduce employee exposure below the PEL.
        4. Emergencies.

7. Formaldehyde (Formalin) Storage

- Formaldehyde and its solutions should not be stored near strong oxidizers (e.g., permanganates, nitrates, peroxides, and chlorates), amines, acids, or alkaline materials. Formaldehyde reacts with HCL (bleach) to form a potent carcinogen, bis-chloromethyl ether.

- Store formaldehyde in labeled, chemically compatible containers, away from heat and flame. Large volume containers, such as 4-liter bottles, should be stored under the ducted laboratory hood, or on a low, protected shelf or in another location where they will not be accidentally spilled or knocked over. Containers larger than 4-liters should be stored inside a deep pan or other secondary containment. Do not store formaldehyde bottles in any area where a leak would flow to a drain.

- Specimen containers should be stored in a tray or a secondary container such as a heavy duty plastic storage container, so that any spills would be contained. Formaldehyde storage areas should be checked weekly for any signs of leakage.

8. Formaldehyde Spills

- For small spills of formaldehyde solutions (i.e., less than 50 cc or ml), apply a formaldehyde absorbent powder such as Spill-X-FP Formaldehyde Polymerizer. Place all spill clean-up materials in a labeled, plastic air tight bag and store in a well ventilated area. Do not use red bags for disposal of formaldehyde spills.
- For larger spills (i.e., greater than 50 cc/ml), contain the spill if possible to do so without exposure to the chemical; otherwise, immediately leave the area and contact Safety Management Services (764-4427) Monday thru Friday during regular business hours (8:00 am – 4:30 pm) or Security (936-7890) after normal business hours (4:30 pm – 8:00 am) and on weekends. If you are splashed with formaldehyde, use the emergency shower and eyewash immediately, to prevent serious injury.
- Managers of laboratories where formaldehyde is utilized shall create and maintain a program to detect leaks and spills. The leak and spill detection program should include:
    1. Regular visual inspections for leaks and spills.
    2. Preventive maintenance of equipment, including surveys for leaks, at regular intervals.
    3. Regular testing of monitoring equipment to assure proper function.

4. Provisions for formaldehyde spill containment, surface decontamination, and waste disposal in work areas where spillage may occur.
5. Prompt cleanup of spills and repair of leaks using persons who wear appropriate protective clothing and equipment and are trained in the proper methods for formaldehyde cleanup and decontamination.

- For areas where large amounts of formaldehyde could be released from an accident or from equipment failure, the area supervisor should develop and maintain procedures to be followed in the event of an emergency spill/leak. Any excessive formaldehyde exposure may be detected by eye or skin irritation, or respiratory distress. Should it be determined that a leak has occurred it is important to evacuate the area immediately, contain and clean up the spill (only if properly trained and personally protected to do so) and to try and keep the vapors from spreading using any ventilation or protective measures available. Emergency spill procedures should include/address the following:
  - Spilled material should not be touched by those not properly trained and lacking proper PPE.
  - All ignition sources should be shut off.
  - Isolate the hazard area and deny entry to unnecessary persons.
  - All persons in severe respiratory distress or suffering from dizziness or serious skin disorders or other significant medical problems should be taken to the Emergency Department immediately for evaluation.
  - Contact Safety Management Services (764-4427) Monday thru Friday during regular business hours (8:00 am – 4:30 pm) or Security (936-7890) after normal business hours (4:30 pm – 8:00 am) and on weekends and notify staff of the hazardous chemical leak or spill.

9. Formaldehyde (Formalin) Disposal

- Formaldehyde, as for all hazardous chemical waste, must be collected following the requirements of the UMHHC Hazardous Waste Management Plan, which can be found at: http://www.med.umich.edu/i/policies/umh/05-03-026.html. All containers must have appropriate lids and be clearly labeled using UMHHC Hazardous Waste labels.
- Biological materials (i.e., human and non-human tissues) preserved in formaldehyde must be disposed of as medical waste with any remaining formaldehyde solutions collected and disposed of as

chemical waste. If necessary, the formaldehyde solutions should be filtered prior to disposal to remove any remaining bits of tissue.

References

Formaldehyde Policy, Virginia Commonwealth University Office of Health & Safety Chemical/Biological Safety Section, http://www.vcu.edu/oehs/chemical/formaldehyde.pdf

University of Medicine and Dentistry of New Jersey EOHSS Guidelines: Formaldehyde October 2004. http://www2.umdnj.edu/eohssweb/publications/formaldehyde.pdf

Gile, T. J. (2007, April). *Complete Guide to Laboratory Safety* (2nd ed.). Marblehead, MA: HCPro, Inc.

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