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GUIDELINES FOR THE SAFE USE OF FORMALDEHYDE AND PARAFORMALDEHYDE

Exposure to formaldehyde can be irritating to the eyes, nose, and upper respiratory tract. In certain individuals, repeated skin exposure to formaldehyde can cause sensitization that may result in allergic dermatitis. Formaldehyde is a known human carcinogen¹ and a suspected reproductive hazard.

The aqueous solution formalin is 37-40 percent formaldehyde in water or methanol. Paraformaldehyde is the crystallized polymer of formaldehyde (97%) that is weighed out and dissolved in solution for experimentation or for cell and tissue fixation. Typically 3-10% formalin or paraformaldehyde solutions are used to perfuse or fix tissues.

OSHA has adopted a permissible exposure limit (PEL) of 0.75 ppm (parts per million) for airborne formaldehyde averaged over an 8-hour work shift (TWA). Formaldehyde can be smelled at less than 0.5 ppm. A short-term exposure limit (STEL) of 2 ppm for 15 minutes has also been established. For an assessment of airborne formaldehyde in the work area or lab, contact EH&S at 412-624-9505 via your supervisor or PI.

1. Formaldehyde training is required for anyone exposed above 0.1 ppm for an 8-hour period.
2. All work with concentrated formalin solutions must be done in a chemical fume hood. If work tasks cannot be done in a fume hood or other engineering control, EH&S must be contacted to assure that hazardous exposures to faculty, staff and students are prevented. Recommendations for protocol modification or protective equipment will be made based on air sampling results.
3. Formaldehyde exposures can occur while dissecting or working with tissue specimens perfused with or fixed in formaldehyde. Chemical exposures can be minimized by working in a ventilated device. Eliminating puddles of formaldehyde in the specimen by rinsing or blotting the excess with paper towels can also reduce evaporation and exposure.
4. Gloves must be worn whenever tissues preserved in or fixed with formaldehyde are handled. While latex gloves provide some protection against formaldehyde, butyl or nitrile gloves are recommended and should be used when contact is anticipated.
5. Formaldehyde splashed in the eye can cause irreversible damage to the cornea. Safety glasses with side shields, face shields or splash goggles must always be worn when working with formaldehyde.
6. Labeling and Signage Requirements
 - 6.1 All forms of formaldehyde or paraformaldehyde containing 0.1 % formaldehyde or greater must be labeled in a manner to include the word "formaldehyde" and the concentration.
 - 6.2 Signs warning of flammability hazards should be posted on the doors to any area where more than 10 gallons of formaldehyde are stored.

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7. Special Safety Precautions

7.1 If formaldehyde contacts the skin, flush with water for at least 15 minutes and report to Concentra Medical Center, 120 Lytton Ave, Suite 275 or UPMC Emergency Department.

7.2 All solutions of formaldehyde and tissues preserved in formalin must be stored in tightly sealed, properly labeled, containers to prevent leakage, spills and evaporation.

7.3 Do not pour formaldehyde or formalin waste into sinks or drains. Formalin waste solutions must be placed in tightly sealed, labeled containers and segregated for disposal via the EH&S Chemical Waste Program.

7.4 All spills of formalin solutions must be cleaned up immediately.

7.4.1 Wear nitrile or butyl gloves and eye protection.

7.4.2 Cover spill with paper towel or other suitable absorbent material. Do not mop up a spill with reusable mops. If dry absorbents are used, scoop the absorbed formaldehyde solution with a dustpan into a plastic bag.

7.4.3 Double bag, seal, and label the material. Call EH&S at 624-9505 for assistance.

7.4.4 Dispose of all formalin containing material via the EH&S Chemical Waste Program.

7.5 If the spilled formaldehyde causes severe eye, nose, or throat irritation, immediately evacuate the area. Close all doors to contain vapors. Call Environmental Health and Safety at 412-624-9505.

8. Several common protocols involving formaldehyde have already been evaluated by EH&S, and based on the air monitoring results, formaldehyde exposure has been demonstrated to be sufficiently low enough to be excluded from annual training requirements. These activities include:

- a. Animal perfusion done inside a chemical fume hood
- b. Small animal perfusion involving 10cc or less formaldehyde
- c. Paraformaldehyde weighing and solution preparation done inside a certified chemical fume hood
- d. Northern blot assays done inside a certified chemical fume hood
- e. Cell fixing done inside a certified chemical fume hood or biosafety cabinet
- f. Tissue immersion into formaldehyde in screw cap vials
- g. Microscopic evaluation of fixed tissue or cells

9. Paraformaldehyde

9.1 Open containers of paraformaldehyde crystals or powder dissolved in solution give off formaldehyde vapors. Users should minimize exposures to paraformaldehyde and avoid the weighing and dissolving steps by purchasing "ready to use" buffered formalin solutions in concentrations ranging from 2 to 10 percent and using these solutions in chemical fume hoods.

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- 9.2 Paraformaldehyde is moderately toxic by skin contact. It has recently been designated as a probable human carcinogen. Skin contact with paraformaldehyde may cause itching and rash that may lead to skin allergy upon repeated exposure. It has also been reported to cause reproductive and mutagenic problems in humans exposed long term.
- 9.3 Breathing paraformaldehyde powders or vapors will irritate the nose and throat after prolonged exposure causing a cough, shortness of breath and possible lung damage including pulmonary edema. Chronic inhalation exposures may lead to an asthmatic or allergic condition with wheezing and chest tightness. Acute exposure may cause irritation to the eyes and respiratory tract.
- 9.4 All weighing and handling of paraformaldehyde should be done with adequate ventilation using chemicals fume hoods, vented balance enclosures or other local exhaust ventilation. Pre-weighed packets or purchase of prepared formalin solutions should be substituted if possible to minimize potential exposures.
10. Respiratory protection from formaldehyde vapors should not be necessary if other control measures are utilized. If ventilation measures are inadequate or not available, use of respiratory protection may be warranted. Consult EH&S. All users of respiratory protection must be enrolled in the University Respiratory Protection Program. Particulate filtering respirators (dust masks) provide no protection against formaldehyde vapors.
11. Paraformaldehyde or concentrated formalin solutions may react violently with strong oxidizing agents, ammonia, strong alkalis, isocyanates, peracids, anhydrides and inorganic acids. Contact and storage with these reactive chemicals should be avoided.
12. Paraformaldehyde and formalin solutions should be stored in a cool, well ventilated area away from heat, sunlight and moisture. Vapors emitting from paraformaldehyde and formalin solutions are flammable, and the Guidelines for the Storage and use of Flammable Liquids found in this manual apply.

¹⁻ <http://monographs.iarc.fr/ENG/Monographs/vol100F/mono100F-29.pdf>