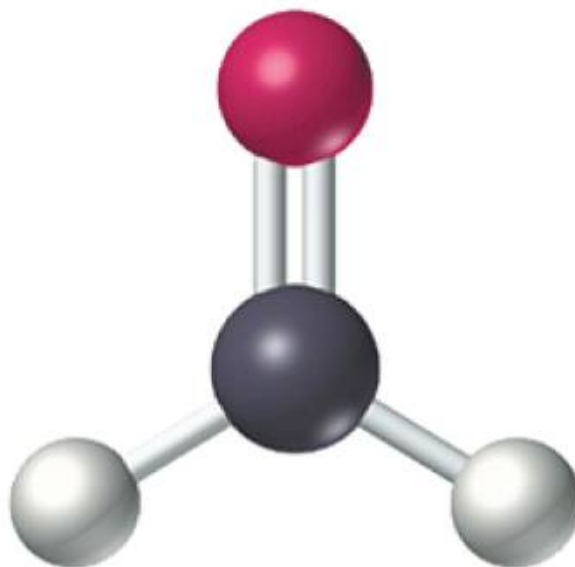
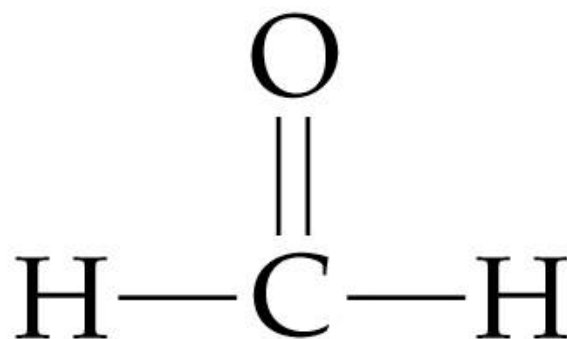


Formaldehyde Health & Safety Program



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Formaldehyde Health & Safety Program

1. Introduction

This document establishes Yale University's written compliance program for formaldehyde, as required by the Occupational Safety and Health Administration (OSHA) under Title 29 Code of Federal Regulations Part 1910.1048. This program is designed to identify work activities and personnel with potential exposure to formaldehyde ($\geq 0.1\%$) and ensure that this chemical is handled safely.

2. Responsibilities

Various departments and employees have responsibilities under this program, including:

a. Office of Environmental Health and Safety (EHS)

- Preparing, reviewing, and periodically revising this Program
- Providing supervisor and employee training and information
- Monitoring and evaluating formaldehyde exposures for University students and employees
- Evaluating engineering controls
- Evaluating personal protective equipment, providing required PPE training and fitting, as needed
- With departmental supervisors, identifying and posting regulated work areas
- Maintaining records of exposure measurements.

b. Employee Health Office

- Performing and evaluating medical surveillance as required
- Maintaining medical records.

c. Facilities

- Maintaining local exhaust ventilation systems in good working order
- Notifying EHS and laboratory departments when these systems must be temporarily shut down for maintenance or repair.

d. Supervisors

- Providing all employees with training information about formaldehyde, safe chemical handling, personal protective equipment requirements, and this Program
- Notifying EHS and Employee Health Office about workplace conditions and potentially affected employees
- Supplying required personal protective equipment to affected employees free-of-charge
- Ensuring that affected employees receive required medical evaluations.

e. Affected Employees

- Observing the procedures and requirements outlined in this Program
- Fulfilling their EHS training requirements, including Hazard Communication or Laboratory Safety, and annual Formaldehyde Safety Training
- Obtaining medical surveillance if required
- Wearing all required personal protective equipment.
- Notifying supervisor and/or EHS of any workplace changes.

3. Exposure Limits

The following table lists the various exposure limits and compliance requirements for airborne levels of formaldehyde:

Formaldehyde Level (Air)	Type of Limit	Exposure Time Duration	Compliance Requirements ¹
≥ 0.1 ppm	OSHA Exposure threshold	Any period of time	Annual formaldehyde-specific information/training
≥ 0.1 ppm	ACGIH Threshold Limit Value	8-hour time-weighted average	Non-regulatory limit, compliance requirement same as above
≥ 0.3 ppm	ACGIH ceiling limit (TLV)	Any period of time	Non-regulatory limit, compliance requirements are the same as above
≥ 0.5 ppm	OSHA Action limit (AL)	8-hour time-weighted average	Above plus: medical surveillance; periodic exposure monitoring
≥ 0.75 ppm	OSHA Permissible exposure limit (PEL)	8-hour time-weighted average	Above plus: establish and post regulated areas; respiratory protection; establish engineering and work practice controls to lower exposures below PEL, as feasible.
≥ 2 ppm	OSHA Short-term exposure limit (STEL)	15-minute time-weighted average	As above for PEL

¹In addition to Hazard Communication or Laboratory Safety training

4. Exposure Monitoring

It is the responsibility of the University to monitor employees for formaldehyde exposure. Initial monitoring must be initiated when any of these conditions are met:

- the formaldehyde in use is a gas,
- mixtures or solutions are composed of greater than 0.1 percent formaldehyde, and/or
- materials being used are capable of releasing formaldehyde into the air, under reasonably foreseeable conditions of use, at concentrations reaching or exceeding 0.1 ppm.

Monitoring will also be performed if an employee reports any signs or symptoms of respiratory or dermal conditions associated with formaldehyde exposure. If there is a concern regarding exposure to formaldehyde or formaldehyde solutions, please contact Yale EHS so that a risk assessment can be conducted to determine if exposure monitoring is necessary. Additionally, if there is a change in the process, equipment, personnel, or control measures that may result in new or additional exposure to formaldehyde, exposure monitoring will be conducted.

EHS will measure exposure levels every 6 months for anyone shown to be at or above the Action Level (AL) or above the Short-Term Exposure Limit (STEL). Notification of monitoring results will be given within 15 days of receipt of results, and if necessary, corrective action taken to decrease exposure. Additional monitoring may be required if an employee experiences symptoms associated with formaldehyde exposure.

If EHS can document that the presence of formaldehyde or formaldehyde-releasing products in the workplace does not result in airborne concentrations of formaldehyde that would cause an employee to

be exposed at or above the AL or STEL under foreseeable conditions of use, then monitoring may not be required.

All exposure sampling strategies are selected to identify areas and employees likely to be exposed to formaldehyde at or above the action level or recommended TLV. Depending upon the work location and frequency of operations, exposure monitoring will be conducted with area measurements, personal dosimetry, or a combination of techniques.

5. Employees and Activities Covered by Program

Formaldehyde is widely used in research and clinical support laboratories at Yale University. However, since it is primarily used in very small quantities and generally handled under local exhaust ventilation in most laboratories (i.e., fume hoods), the potential for employee exposures above the 0.1 ppm threshold is very low in the majority of cases. Based on this information, laboratory researchers handling formaldehyde exclusively in small, laboratory-scale quantities and operations, within a fume hood, are conditionally exempt from this program provided that they have completed the University's Laboratory Safety training.

Some work activities and employee classifications carry the potential to exceed the 0.1 ppm threshold limit, and are therefore included in this program. Unlike most research activities involving formaldehyde, these operations typically involve routine work with larger volumes of formaldehyde in service/support functions such as clinical-related autopsy services, surgical specimen preservation, cadaver embalming for anatomical dissection laboratories, and museum specimen preservation. These kinds of operations have been identified through historical surveys, workplace hazard assessments, and exposure monitoring. A summary of existing monitoring data is available in EHS (Reference 1). Reference 2 provides a listing of Departments and job activities that are currently covered by this program.

6. Labels and Safety Data Sheets

All containers containing formaldehyde and formaldehyde solutions outside of research laboratories need to be labeled with the identity of the contents and physical and health hazard warnings as required by the OSHA hazard communication standard.

Safety Data Sheets (SDSs) are available on the EHS website at www.ehs.yale.edu. Appendix D also provides safety information on formaldehyde.

7. Regulated Areas

Work areas where formaldehyde is anticipated to exceed the STEL or 8-hour TWA PEL must be identified as regulated areas and entry restricted to trained employees. Regulated areas are posted with signs or labels as shown in Appendix C.

8. Medical Surveillance

Medical evaluation and surveillance as described in 29 CFR Part 1910.1048(l) is available through the Employee Health Office to all employees exposed to formaldehyde at or above the STEL or AL. Medical services are also available to employees involved in a spill, splash, or other emergency condition that causes a potential over-exposure. Routine and emergency examinations from the Employee Health Office are available free-of-charge to all affected employees.

9. Work Practices

As outlined in both the University's Hazard Communication and Chemical Hygiene Programs, work practices and administrative procedures are important for ensuring the safe handling of toxic chemicals

such as formaldehyde.

- Know the location of the nearest eyewash and safety shower, and the locations of spill supplies, personal protective equipment, and other safety equipment.
- Never eat, drink, smoke, or apply cosmetics in a laboratory or near chemicals.
- Upon arrival, check shipments of formaldehyde for leakage before accepting the package and report any damages to the supervisor and receiving department.
- Never deface the labels on chemical containers and replace them if worn or illegible.
- Handle formaldehyde in a manner that minimizes the potential for skin exposure and releases into the air.
- Manipulate and transfer only the smallest volume of formaldehyde needed for your work and use standard equipment to ensure safe transfer and always handle under local exhaust ventilation.
- Keep spill absorbents available and situate the receiving container on a spill pad or other absorbent material.
- Keep containers closed except when actually transferring or using them.
- Store formaldehyde containers in a secure location as close to ground level as possible.
- Perform transfers and mixing in a laboratory hood or at another source of local exhaust, such as an elephant trunk. Never handle formaldehyde solutions at the open bench.

10. Engineering Controls

Local ventilation is the most efficient applied engineering control for limiting employee exposures to formaldehyde. Laboratory fume hoods are very efficient at control exposures, and should be used whenever handling volatile or toxic chemicals, including formaldehyde, in the laboratory. Other local devices, such as elephant trunks, downdraft tables, and back slot ventilation should be used when fume hoods are not feasible. Fume hoods are evaluated and their flow rates measured by Yale Environmental Health and Safety on at least an annual basis.

Laboratories and other work areas where formaldehyde is handled must be equipped with an eyewash station and deluge shower in the immediate area capable of providing emergency rinsing and flushing for 15 minutes with fresh water.

11. Personal Protective Equipment

Personal protective equipment (PPE) is required whenever handling formaldehyde. For most operations, basic PPE consists of a laboratory coat, apron or gown, safety glasses or goggles and/or face shield, and gloves. In the unlikely event that exposures are anticipated to exceed the STEL or PEL, respiratory protection is also required. Respirators will be selected and used according to criteria from Table 1, 29CFR Part 1910.1048 and the University's Respiratory Protection Program.

The style and grade of gloves should be selected according to the concentration and quantity of formaldehyde used, and the potential for hand contact. For small quantity procedures with mechanical transfer devices, disposable nitrile gloves should be sufficient, provided that gloves are removed and replaced if splashed. For larger volume operations or those where contact with liquid formaldehyde is more likely, heavier utility-grade nitrile, or butyl rubber gloves must be worn over the exam-style nitrile gloves.

12. Emergency Procedures

Spill absorbing supplies must be kept on-hand and available for emergency use in areas where large volumes of formaldehyde could be released in an accident or from equipment failure. Yale Environmental Health & Safety can provide assistance in selecting appropriate supplies.

Very small incidental spills that occur during the course of ordinary work can be cleaned up by

area staff. Work from the perimeter inwards, and absorb spilled liquid with paper towels or absorbent. Routine workplace personal protective equipment is generally sufficient for these kinds of spills. Collect absorbed material into heavy plastic bags, and seal and label them for collection as hazardous chemical waste. **It is not considered to be a small spill if respiratory protection is necessary to clean it up.**

Large spills and any incident that may cause a potential over-exposure should immediately be communicated to emergency responders. Safely leave the area and summon emergency assistance by dialing 911 from any Yale telephone. Give the dispatcher as much information about the nature and location of the spill, and whether or not any one has been contaminated or injured.

More detailed emergency procedures are described in the Substance Safety Guidelines (Appendix D), provided to all departments covered by this Program.

13. Training and Information

All employees working with chemicals must receive training appropriate to their workplace, i.e., either Hazard Communication or Laboratory Safety training. Employees working with formaldehyde where exposures could exceed 0.1 ppm also receive additional formaldehyde-specific training information on an annual basis. This information is provided by supervisors and by Yale Environmental Health & Safety (Appendix D); students and staff involved in anatomical dissection are also provided with copies of Appendix F. Annual training is provided by either direct training sessions, web-based training, or through training and informational fact sheets that are distributed to all affected workers (Appendix E). Additional copies of this program, OSHA's Formaldehyde Standard, and other related materials are available from the Yale Environmental Health and Safety.

14. Record Keeping

Exposure measurements and training records will be maintained for at least thirty (30) years by Yale Environmental Health and Safety. Records of medical examinations will be kept by the Employee Health Office for the duration of the affected employee's employment plus thirty (30) years.

15. Waste Disposal

Formaldehyde-containing materials must be disposed as hazardous chemical waste. Once waste is generated and prepared for pick-up, notify Yale Environmental Health and Safety to arrange for pick-up.

Liquid wastes must be collected in impervious, closable containers and identified as hazardous waste with tags and labels available from Yale Environmental Health and Safety.

Biological specimens preserved in formaldehyde may be disposed in several ways. Where specimens constitute a very small fraction (i.e., < 5-10%) of the overall volume, collect as liquid waste, above. Where the tissue or specimens constitute a larger, bulkier fraction of the overall waste volume, the liquid fraction should be decanted and the wastes separated into solid and liquid streams. Use caution whenever decanting or straining formaldehyde to avoid free liquids remaining with the solids, and work only in a fume hood or other local exhaust extractor to prevent over-exposure to formaldehyde vapors. If the specimens were derived from humans, primates, or other mammals, the solid samples must be disposed of as potentially infectious biomedical waste using red biomedical waste disposal bags.

Appendices:

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Appendix A:

OSHA's Formaldehyde Standard (29 CFR Part 1910.1048)

www.osha.gov

Appendix B:

Exposure Monitoring and Survey Data Collection Forms

YALE UNIVERSITY Office of Environmental Health & Safety	AIR SAMPLING SURVEY FORM
DATE:	SURVEYOR(S):

I. AREA INFORMATION		
DEPT:	BLDG:	ROOM:
SOURCE:		
ENGINEERING CONTROLS:		

II. EMPLOYEE INFORMATION		
LAST NAME:	FIRST NAME:	Net ID:
DEPT:	JOB TITLE:	
EXPOSURE DURATION (HRS):	EXPOSURE (TIMES PER DAY):	EXPOSURE (DAYS PER YEAR):
JOB PERFORMED:		
PPE USED:		

III. SURVEY INSTRUMENT INFORMATION			
INSTRUMENT:	MODEL:	SERIAL NO:	
CALIBRATION METHOD: <input type="checkbox"/> BIOS DC-2 <input type="checkbox"/> Gilibrator <input type="checkbox"/> OTHER	PRE-CAL: (liters/min) _____ _____ AVERAGE _____ = _____	POST-CAL: (liters/min) _____ _____ AVERAGE _____ = _____	OVERALL AVERAGE (l/min) = _____
MEDIA:	MFGR/PART NO:	LOT/BATCH:	

IV. SAMPLING INFORMATION & RESULTS						
METHOD:						
SAMPLE NO.	“ON”	“OFF”	TIME (min)	FLOW (l/min)	VOLUME (liters)	LOCATION/ACTIVITY/COMMENTS

V. ADDITIONAL COMMENTS

VI. COPIES TO: <input type="checkbox"/> EMPLOYEE <input type="checkbox"/> SUPERVISOR _____ <input type="checkbox"/> EMPLOYEE HEALTH
--

Attach completed sheet to laboratory analysis report and Yale EHS report of results to affected department/personnel

Appendix C:
Regulated Area Postings

DANGER

FORMALDEHYDE

**Irritant and Potential
Cancer Hazard:
Authorized Personnel Only**

Appendix D:
Formaldehyde Information

SUBSTANCE SAFETY GUIDELINES FOR FORMALDEHYDE

This Guideline provides information about formaldehyde and is designed to inform laboratory employees working with this chemical of their rights and duties under Yale University's formaldehyde safety program, as required by OSHA (20 CFR Part 1910.1048). Although the precise hazards associated with exposure to formaldehyde depend upon both its form (solid, liquid, or gas) and concentration, this document will discuss concentrated formaldehyde (37% in water, no stabilizers or inhibitors). Since most laboratories routinely work with more dilute solutions of formaldehyde, the information contained herein should be considered "worst-case" for the majority of formaldehyde users.

SUBSTANCE IDENTIFICATION

Chemical Name: Formaldehyde Solution
Chemical Family: Aldehyde
Chemical Formula: HCHO
Molecular Weight: 30.03
CAS Number: 50-00-0

Synonyms: Formalin; Formic Aldehyde; Paraform; Formol; Formalin (Methanol-free); Formalith; Methanal; Methyl Aldehyde; Methylene Glycol; Methylene Oxide; Tetraoxymethalene; Oxomethane; Oxymethylene

Components & Contaminants: 37% Formaldehyde, 63% Water
(Inhibited solutions may contain up to 10% methanol by volume).
Other Contaminants: Formic acid (alcohol free)

EXPOSURE LIMITS

OSHA: 0.75 ppm (eight hour time weighted average)
2 ppm (fifteen minute time weighted average)

PHYSICAL DATA

Description: Colorless liquid, pungent odor	Boiling point: 214 deg. F (101 deg. C)
Specific Gravity: 1.08 (H ₂ O=1 @20 deg. C)	pH: 2.8-4.0
Solubility in Water: Miscible	Solvent Solubility: Soluble in alcohol, acetone
Vapor Density: 1.04 (Air= 1 @ 20 deg. C)	Odor Threshold: 0.8-1 ppm

FIRE AND EXPLOSION HAZARD

Moderate fire and explosion hazard when exposed to heat or flame, depending on formulation of the solution and whether it contains methanol. The flash point of 37% formaldehyde solutions is above normal room temperature, but the explosion range is very wide, from 7 to 73% by volume in air. Reaction of formaldehyde with nitrogen dioxide, nitromethane, perchloric acid and aniline, or peroxyformic acid yields explosive compounds.

Flash Point: 185 deg. F (85 deg. C) closed cup
Lower Explosion Limit: 7%
Upper Explosion Limit: 73%
Autoignition Temperature: 806 deg. F (430 deg. C)
Flammability Class (OSHA): III A

Extinguishing Media: Use dry chemical, “alcohol foam”, carbon dioxide, or water in flooding amounts as fog. Solid streams may not be effective. Cool fire-exposed containers with water from side until well after fire is out. Use of water spray to flush spills can also dilute the spill to produce nonflammable mixtures. Water runoff, however, should be contained for treatment.

NATIONAL FIRE PROTECTION ASSOCIATION DESIGNATION

Health: 2-Materials hazardous to health, but areas may be entered with full-faced mask self-contained breathing apparatus which provides eye protection.

Flammability: 2-Materials which must be moderately heated before ignition will occur. Water spray may be used to extinguish the fire because the material can be cooled below its flash point.

Reactivity: D-Materials which (in themselves) are normally stable even under fire exposure conditions and which are not reactive with water. Normal fire fighting procedures may be used.

REACTIVITY

Stability: Formaldehyde solutions may self-polymerize to form paraformaldehyde which precipitates.

Incompatibilities (i.e., materials to avoid): Strong oxidizing agents, caustics, strong alkalis, isocyanates, anhydrides, oxides, and inorganic acids. Formaldehyde reacts with hydrochloric acid to form the potent carcinogen, bis-chloromethyl ether. Formaldehyde reacts with nitrogen dioxide, nitromethane, perchloric acid and aniline, or peroxyformic acid to yield explosive compounds. A violent reaction occurs when formaldehyde is mixed with strong oxidizers.

Hazardous Combustion or Decomposition Products: Oxygen from the air can oxidize formaldehyde to formic acid, especially when heated. Formic acid is corrosive.

HEALTH HAZARD DATA

ACUTE EFFECTS OF EXPOSURE

Ingestion (Swallowing): Liquids containing 10-40% formaldehyde cause severe irritation and inflammation of the mouth, throat, and stomach. Severe stomach pains will follow ingestion with possible loss of consciousness and death. Ingestion of dilute formaldehyde solutions (0.03-0.04%) may cause discomfort in the stomach and pharynx.

Inhalation (Breathing): Formaldehyde is highly irritating to the upper respiratory tract and eyes. Concentrations of 0.5 to 2.0 ppm may irritate the eyes, nose, and throat of some individuals. Concentrations of 3 to 5 ppm may also cause tearing of the eyes and are intolerable to some persons. Concentrations of 10 to 20 ppm cause difficulty in breathing, burning of the nose and throat, cough, and heavy tearing of the eyes, and 25 to 30 ppm causes severe respiratory tract injury leading to pulmonary edema and pneumonitis. A concentration of 100 ppm is immediately dangerous to life and health. Deaths from accidental exposure to high concentrations of formaldehyde have been reported.

Skin (Dermal): Formalin is a severe skin irritant and a sensitizer. Contact with formalin causes white discoloration, smarting, drying, cracking, and scaling. Prolonged and repeated contact can cause numbness and a hardening or tanning of the skin. Previously exposed persons may react to future exposure with an allergic eczematous dermatitis or hives.

Eye Contact: Formaldehyde solutions splashed in the eye can cause injuries ranging from

transient discomfort to severe, permanent corneal clouding and loss of vision. The severity of the effect depends on the concentration of formaldehyde in the solution and whether or not the eyes are flushed with water immediately after the accident.

Acute Animal Toxicity:

Oral, rats: LD50=800 mg/kg

Oral, mouse: LD50=42 mg/kg

Inhalation, rats: LCLo=250 mg/kg

Inhalation, mouse: LCLo=900 mg/kg

Inhalation, rats: LC50=590 mg/kg

Note - The perception of formaldehyde by odor and eye irritation becomes less sensitive with time as one adapts to formaldehyde. This can lead to overexposure if a worker is relying on formaldehyde's warning properties to alert the potential for exposure.

CHRONIC EFFECTS OF EXPOSURE

Carcinogenicity: Formaldehyde has the potential to cause cancer in humans. Repeated and prolonged exposure increases the risk. Various animal experiments have conclusively shown formaldehyde to be a carcinogen in rats. In humans, formaldehyde exposure has been associated with cancers of the lung, nasopharynx and oropharynx, and nasal passages.

Mutagenicity: Formaldehyde is genotoxic in several *in vitro* test systems showing properties of both an initiator and a promoter.

Toxicity: Prolonged or repeated exposure to formaldehyde may result in respiratory impairment. Rats exposed to formaldehyde at 2 ppm developed benign nasal tumors and changes of the cell structure in the nose as well as inflamed mucous membranes of the nose. Structural changes in the epithelial cells in the human nose have also been observed. Some persons have developed asthma or bronchitis following exposure to formaldehyde, most often as the result of an accidental spill involving a single exposure to a high concentration of formaldehyde.

EMERGENCY AND FIRST AID PROCEDURES

Ingestion (Swallowing): If the victim is conscious, dilute, inactivate, or absorb the ingested formaldehyde by giving milk, activated charcoal, or water. Any organic material will inactivate formaldehyde. Keep affected person warm and at rest. Get medical attention immediately. If vomiting occurs, keep head lower than hips.

Inhalation (Breathing): Remove the victim from the exposure area to fresh air immediately. Where the formaldehyde concentration may be very high, each rescuer must put on a self-contained breathing apparatus before attempting to remove the victim, and medical personnel should be informed of the formaldehyde exposure immediately. If breathing has stopped, give artificial respiration. Keep the affected person warm and at rest. Qualified first-aid or medical personnel should administer oxygen, if available, and maintain the patient's airways and blood pressure until the victim can be transported to a medical facility. If exposure results in a highly irritated upper respiratory tract and coughing continues for more than 10 minutes, the worker should be hospitalized for observation and treatment.

Skin Contact: Remove contaminated clothing (including shoes) immediately. Wash the affected area of your body with soap or mild detergent and large amounts of water until no evidence of the chemical remains (at least 15 to 20 minutes). If there are chemical burns, get first aid to cover the area with sterile, dry dressing, and bandages. Get medical attention if you experience appreciable eye or respiratory irritation.

Eye Contact: Wash the eyes immediately with large amounts of water occasionally lifting lower and upper lids, until no evidence of chemical remains (at least 15 to 20 minutes). In case of burns, apply sterile bandages loosely without medication. Get medical attention immediately. If you have experienced appreciable eye irritation from a splash or excessive exposure, you should be referred promptly to an ophthalmologist for evaluation.

EMERGENCY PROCEDURES

General Information - Emergencies: If you work in an area where a large amount of formaldehyde could be released in an accident or from equipment failure, make sure that spill absorbing supplies are on-hand and available for use in a spill. The Office of Environmental Health & Safety can assist you in selecting appropriate supplies. In the event of a large spill or release, leave the area immediately and summon emergency assistance by dialing 111 from any Yale telephone. You can also call the Yale Police Department directly at 432-4400 or the Office of Environmental Health & Safety (785-3555). Give the dispatcher as much information about the nature and location of the spill, and whether or not any one has been contaminated or injured.

Personal Contamination: If you are splashed with formaldehyde, immediately flush the affected area with water from the deluge emergency showers or eyewash fountains in your laboratory or in the hallway to prevent serious injury. Flush with water for at least 10 minutes and notify others to summon medical assistance (x111 from any Yale telephone).

Spills and Leaks: Place leaking container into a secondary container (such as a tray) and move to a well ventilated area such as a chemical fume hood. Collect small spills with absorbent material and place the waste into properly labeled containers for disposal as hazardous chemical waste. Always wear gloves, eye protection, and a laboratory coat when cleaning up a small spill. If you feel that respiratory protection is necessary, are uncertain as to how to proceed or for larger spills (such as a spill of one liter or more), immediately call the Office of Environmental Health & Safety's emergency line by dialing 785-3555. Trained emergency personnel will respond immediately to control and clean up the spill. In the event of a large spill, do not touch spilled material but do shut off any nearby ignition sources and do whatever is possible to increase the ventilation of the area (turn on chemical fume hood, open window) if this can be done without placing you at risk. You should then cordon off the spill area and deny entry except for emergency responders.

Spill Reporting and Waste Disposal: Yale University must comply with EPA rules regarding the clean-up of toxic waste and notify state and local authorities, if required. Please notify the Office of Environmental Health & Safety of any formaldehyde spills, and they will notify the appropriate agencies if required. Yale University must dispose of waste containing formaldehyde in accordance with applicable local, state, and Federal law and in a manner that minimizes exposure of employees at the site and of the clean-up crew. Liquid wastes should be collected in glass or heavy plastic jugs or bottles, and solid and semi-solid (e.g., contaminated paper towels used in cleaning up a small spill) placed and sealed in double plastic bags. Label all waste containers with the University's Hazardous Chemical Waste Disposal Form and call the Office of Environmental Health & Safety (785-3551) to arrange a waste pick-up.

MONITORING AND MEASUREMENT PROCEDURES

Monitoring Requirements: If your work with formaldehyde is anticipated to exceed either the 0.5 ppm action level or the 2 ppm STEL, an evaluation will be performed to properly characterize your exposure. This may be performed by actually sampling the formaldehyde levels in your immediate work area,

performing detailed calculations to estimate airborne exposure levels, or by using monitoring data obtained from “representative employees” performing similar work with formaldehyde. If monitoring is required, you may be asked to wear a sampling device to collect formaldehyde. This device could be a passive badge, a sorbent tube attached to a pump, or an impinger containing liquid. You should perform your work as usual, but inform the person who is conducting the monitoring of any difficulties you are having wearing the device and any changes or deviations from your usual work routine.

Monitoring Techniques: OSHA’s only requirement for selecting a method for sampling and analysis is that the method(s) accurately evaluate the concentration of formaldehyde in employees’ breathing zones. At Yale University, we use a variety of approved sampling methods, including NIOSH 2016, NIOSH 3500, and passive dosimeters. The appropriate monitoring method and technique will be determined by the Industrial Hygienist performing the monitoring.

Notification of Results: If monitoring is performed, you will be notified of the results in writing within 15 days.

PROTECTIVE EQUIPMENT AND CLOTHING

Personal protective equipment (PPE) and clothing must be worn on all skin surfaces which could come into contact with formalin. This equipment or clothing must be fabricated from materials impervious to formaldehyde if you handle formaldehyde solutions of 1% or more. Types of equipment or clothing that may be required include: gloves, aprons, disposable coveralls, and eye protection. If you are required to change into whole-body chemical protective clothing (such as a disposable coverall), your supervisor must provide a change room for your privacy and for storage of your normal clothing. It is the employer’s responsibility to supply necessary protective equipment and clothing to employees at no cost.

Protective Gloves: Gloves fabricated from butyl or neoprene rubber, nitrile or polyvinylchloride are impervious to formalin. A variety of styles are available in different thicknesses to accommodate any task. If you require help identifying a glove that does not interfere with your work, contact the Office of Environmental Health & Safety.

Eye Protection: If you might be splashed in the eyes with formalin, it is essential that you wear goggles, safety glasses with side shields, or a faceshield to protect the eyes.

Respiratory Protection: Given the typically dilute concentrations and low volumes of formaldehyde handled on campus, coupled with local exhaust devices such as fume hoods, the potential for over-exposure to most formaldehyde users is very small. Nevertheless, there are operations and circumstances where a respirator may be needed to prevent over-exposure. In the event you need to wear a respirator, you must be enrolled in the University’s respiratory protection program. This program ensures that the proper respirator has been selected, that it fits correctly, and that you are physically capable of wearing it.

ENTRY INTO ATMOSPHERES IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH)

Enter areas where the formaldehyde concentration might be 100 ppm or more only with complete body protection including self-contained breathing apparatus with a full face piece operated in a positive pressure demand mode. This equipment is essential to protect your life and health under such extreme conditions. It is highly unlikely that this type situation would develop in the laboratory setting, and is mentioned here primarily for emergency responders.

ENGINEERING CONTROLS

Ventilation, especially a laboratory fume hood, is the most widely applied engineering control method for limiting laboratory employee's exposure to formaldehyde. There are two distinct types of ventilation - local exhaust and general (mechanical) exhaust.

Local Exhaust: Local exhaust ventilation (e.g., laboratory fume hood) is designed to capture airborne contaminants as near to their point of generation as possible. To protect you, the direction of contaminant flow must always be toward the local exhaust system inlet and away from you. Laboratory hoods should have a face velocity of 100 fpm \pm 20%. These hoods are tested annually by the Office of Environmental Health & Safety.

General (Room or Dilution) Exhaust: General exhaust ventilation works by diluting the concentration of workplace contaminants by introducing fresh outside air into the work area. The effectiveness of this kind of ventilation depends on the number of room or laboratory air changes per hour, and the locations and generation rates of formaldehyde vapors.

Work Practices: Work practices and administrative procedures are an important part of a control system. Always work with formaldehyde in a manner that minimizes the potential for skin exposure and releases into the air. If you are asked to perform a task in a certain manner to limit your exposure to formaldehyde, it is extremely important that you follow these procedures. Where possible, always handle formaldehyde solutions in a laboratory hood or other source of local exhaust. Never mouth pipette, and do not heat or stir formaldehyde solutions at the open bench. Keep containers closed except when manipulating them, and perform transfers and dilutions of stock solutions in a laboratory hood.

MEDICAL SURVEILLANCE

Medical surveillance helps to protect employees' health by identifying potential reversible health problems early. If your exposure has been identified as potentially exceeding the action limit or STEL, you will be required to participate in the formaldehyde medical surveillance program. This program, which is available at no expense to you and at a reasonable time and place, will be offered at the time of your initial assignment and once a year afterward as long as your exposure remains above these limits. However, even if your exposure is below these levels, you should inform your employer if you have or develop any signs and medical symptoms that you suspect are related to your formaldehyde exposure.

The formaldehyde medical surveillance program includes:

- (a) A medical disease questionnaire.
- (b) A physical examination if the physician determines this is necessary.

The physician must collect all information needed to determine if you are at increased risk from your exposure to formaldehyde. At the physician's discretion, the medical examination may include other tests, such as a chest x-ray, to make this determination. At Yale University, all medical surveillance is performed by the Employee Health Physician. After a medical examination the examining physician will provide Yale University with a written opinion which includes any special protective measures recommended and any restrictions on your exposure. The physician must inform you of any medical conditions you have which would be aggravated by exposure to formaldehyde. An employee can find out more about the medical surveillance program by contacting Employee Health at 2-0071. All records from your medical examinations, including disease surveys, must be retained by Yale and one is made available to you by making a request in writing to the Employee Health Department.

Medical Surveillance - Emergencies: If you are exposed to formaldehyde in an emergency (such as a spill) and develop signs or symptoms associated with acute toxicity from formaldehyde exposure, Yale must provide you with a medical examination as soon as possible. This medical examination will include all steps necessary to stabilize your health. You may be kept in the hospital for observation if your symptoms are severe to ensure that any delayed effects are recognized and treated.

Appendix E:

Formaldehyde Training Fact Sheet

FORMALDEHYDE

Previous monitoring and evaluations of your work area have identified the potential for low level exposures to formaldehyde. The Yale University Formaldehyde Safety Program provides a detailed description of the safety, training, and medical surveillance requirements for staff exposed to different levels of this chemical. This bulletin provides you with on-going information about the hazards associated with formaldehyde, means for protecting yourself and procedures to follow during various emergencies. Should you have any further questions, please contact Yale Environmental Health & Safety at 203-785-3550.

Formaldehyde is used in research and clinical support laboratories throughout Yale University. Any solution containing greater than 0.1% formaldehyde is considered a formaldehyde solution and is classified as a carcinogen. Anyone working with formaldehyde where potential exposures may exceed 0.1ppm must be trained annually in accordance with OSHA's formaldehyde standard (29CFR1910.1048). This standard is available from the EHS office and at OSHA's web site at www.osha.gov.

OSHA has assigned the following exposure limits for formaldehyde:

8-hr permissible exposure limit (PEL): 0.75ppm

8-hr action limit (AL): 0.5ppm

15-minute short-term exposure limit (STEL): 2ppm

Initial exposure monitoring has been conducted in your area to determine whether these limits are exceeded. To date, no areas regularly exceed these levels, and therefore full program compliance has not been required. However, periodic monitoring is performed to ensure that exposure levels remain below all applicable limits. If at any point exposures in your work area were in excess of any of these limits, a full formaldehyde compliance program, including medical surveillance, continued exposure monitoring, establishment of regulated areas, and a respiratory protection program would be required to be in place for your area.

Health Effects

Formaldehyde has been shown to be a nasal and lung carcinogen, and is highly irritating to the skin, eyes, and respiratory system. Direct skin contact can cause white discoloration, and drying, cracking, or scaling. Prolonged and repeated contact can cause numbness and hardening of the skin.

Formaldehyde vapors can cause tearing of the eyes and burning of the nose and throat. It is also a skin sensitizer, and may cause allergic dermatitis or hives on previously exposed persons. Any of these symptoms should be immediately reported to your supervisor and/or Yale Health.

Engineering Controls

Local exhaust ventilation is the most effective means for controlling exposure where the potential for inhalation of formaldehyde vapors exists. The exhaust must draw the vapors away from the breathing zone and be exhausted to the outside. Since the odor threshold for formaldehyde ranges from 0.2-0.8 ppm, no formaldehyde odor should be present with the use of effective ventilation.

Personal Protective Equipment

Personal protective equipment (PPE) must be worn to prevent any contact of unprotected skin with formaldehyde. Nitrile exam-style gloves are recommended for most laboratory-scale work with formaldehyde. Utility-grade nitrile or butyl rubber gloves over exam-style gloves are required for larger scale work with formaldehyde when direct contact with formaldehyde is more likely to occur. Safety glasses must always be worn when working with hazardous materials, and tight-fitting chemical goggles should be worn to protect the eyes from splashes and from formaldehyde vapors. A face shield should be worn as necessary for splash protection. A laboratory coat, apron, or gown is also required to protect the clothes and body from contact with formaldehyde.

Respiratory protection for formaldehyde is required if the exposures are anticipated to exceed OSHA's exposure limits. Anyone who wears a respirator must first be medically cleared and properly trained and fit-tested by EHS in accordance with the University's Respiratory Protection Program.

Spills and Emergencies

Small Incidental Spills that occur during the course of ordinary work can be cleaned up by area staff, providing that respiratory protection is not required for the cleanup. Work from the perimeter inwards, and absorb spilled liquid with paper towels or absorbent. Collect absorbed material into heavy plastic bags, and seal and label them for collection as hazardous chemical waste. If you feel at all uncomfortable, follow the procedure for large spills. It is not considered to be a small spill if respiratory protection is needed.

Large spills and any incident that causes a potential over-exposure should immediately be communicated to emergency responders. Leave the area and summon emergency assistance by dialing 911 from any telephone.

A copy of Yale University's Formaldehyde Program has been distributed to all affected departments and is also available at ehs.yale.edu.

Appendix F:

Anatomical Dissection Fact Sheet

(posted in Anatomical Dissection Labs and
distributed to all first year medical students by Surgery/Anatomy)

Safety in the Dissection Laboratory

Introduction

Anatomical dissection is one of the most exciting and memorable experiences for first-year medical students, and carries with it the tradition of medicine. Although performed for centuries, several aspects of dissection pose hazards that need to be recognized. Besides the obvious toxicity of the chemicals used to preserve cadavers, dissection also involves handling sharp surgical instruments and bone fragments that can cause lacerations and punctures, and contact with human tissue, even when “fixed” with preservative, may carry a risk (albeit low) of pathogenicity. This Fact Sheet is designed to provide medical students and staff with basic information about dissection and discuss practical methods for minimizing risks.

Chemical Hazards

Embalming has long been the method of choice for preserving cadavers. Embalming fluids are water-based solutions that typically contain alcohol, glycerin, phenol, and formaldehyde. These chemicals can impact the body by any route of exposure (inhalation, ingestion, skin contact, percutaneous inoculation). Although dermal exposures can play a role in sensitizing certain individuals, the inhalation of formaldehyde vapor poses the most significant hazard because of its high vapor pressure and known toxicity.

Formaldehyde exposures during anatomical dissection have been extensively characterized by many regulatory and advisory agencies, and here at Yale University by the Office of Environmental Health & Safety. Dissection exposures to formaldehyde have declined markedly over the past decade as a result of procedural and infrastructure improvements, i.e., using embalming fluid with a smaller amount of formaldehyde, changing cadaver handling protocols, and increasing room and local exhaust ventilation.

Occupational exposure to formaldehyde is regulated by the Occupational Safety and Health Administration (OSHA), under 29 CFR 1910.1048 (“Formaldehyde Standard”). OSHA has established exposure limits based upon the duration of work with formaldehyde: an 8-hour time weighted average permissible exposure limit (PEL) of 0.75 ppm, and a short-term exposure limit (STEL, measured over 15 minutes) of 2 ppm. Based upon monitoring data collected during actual dissection work in the Yale Anatomy Department, students and staff have not been routinely over-exposed to formaldehyde, although the potential for overexposures does exist. Similar monitoring for phenol (its very low vapor pressure greatly minimizes volatilization) has shown airborne levels more than an order of magnitude below regulatory limits at all times. Besides formaldehyde and phenol, cadavers can also release other compounds that contribute to the general “odor” of the anatomy laboratory. These include the odors of tissues and fats, and various gaseous decomposition products - compounds that are often unpleasant but not identifiable as hazardous.

Exposure to chemicals during dissection is minimized through regular air monitoring to evaluate working conditions, maintaining high room air exhaust rates, proper operation of the ventilated anatomy tables, using personal protective equipment, and by following the Safety Guidelines for Anatomical Dissection.

Physical Hazards

The use of sharp surgical instruments as well as the handling of splintered bone or cartilage carries a risk of lacerations, cuts, and punctures. Minimize this risk by keeping equipment in good working condition, working methodically and consciously to avoid accidents, and following safe techniques demonstrated by instructors. Remember to collect disposable sharps in the puncture-resistant containers provided, and never try to retrieve a discarded instrument.

Biological Hazards

Formaldehyde-based embalming fluid has a long and well-documented history as an effective sterilant. Nevertheless, it is prudent to handle all human tissues, including embalmed cadavers, under “universal precautions.” Universal precautions are an approach to work that assumes, from the start, that the material handled could potentially be infectious. Minimize your potential exposure by following the instructor’s procedures, wear the appropriate personal protective equipment, never wear your dissection clothing elsewhere, and always wash your hands with soap and water when finished. Remember to be conscious of (and avoid) habits such as rubbing your eyes, chewing on pencils, or scratching your nose whenever working with human tissues, blood, blood products, or other potentially infectious materials.

For further information, please call the Department of Surgery (785-2814), Anatomy Coordinator (785-2813), or the Office of Environmental Health & Safety (785-3550).

Safety Guidelines for Anatomical Dissection

Never work alone in the anatomical (or any other) laboratory. Accidents can occur at any time, without warning, and your best assurance for help is a partner or nearby person.

Proper cadaver storage minimizes exposure to embalming fluid and helps preserve cadavers. Turn the ventilated cadaver tables to the “open” position after opening the cover, and be sure to turn the lever to the “closed” position when finished. Failure to turn the damper to the closed position will cause the cadaver to dry out.

Information about chemicals and other materials used in the anatomical dissection is available from the Anatomy Department and the Office of Environmental Health & Safety. These include Safety Data Sheets (SDS), copies of applicable health and safety standards, and detailed toxicological information. Safety Data Sheets are readily available at ehs.yale.edu.

Odors and chemical exposures The odor of embalmed cadavers is unpleasant, but exposures to formaldehyde and other chemicals are regularly monitored and have been generally found to be below regulatory and recommended limits. If you have an existing health condition, particularly respiratory, you may be more sensitive - notify your instructor as soon as possible.

Personal protective equipment (PPE) must be worn, including disposable or dedicated washable clothing (closed lab coat, scrubs), aprons, nitrile gloves, and safety glasses, goggles, or a faceshield. Based upon exposure monitoring, respirators are not required, although disposable charcoal-impregnated masks available from the Anatomy Department for those who may choose to wear a mask.

Sharps must be handled with care, and disposed in special, puncture-resistant containers provided. Never try to retrieve a disposed object as serious injury could result.

Good personal hygiene habits are essential. Change out of your clothing as soon as you are finished working, and deposit them in the appropriate container. Wash hands thoroughly with soap and water. During work, be conscious about your hands, and avoid any contact with other parts of your body, especially the face, eyes, and mouth.

Accidents and emergencies must be attended to immediately. In the event of direct skin or eye contact, flush the affected area with water for at least 15 minutes; in the event of a cut or puncture, apply first aid and wash the area with soap and water immediately. Notify your instructor for help in obtaining further medical assistance. Contact Yale Environmental Health & Safety for assistance in cleaning up spills.

Section 3. References

References are located at the Office of Environmental Health and Safety

- 1. Formaldehyde Data Monitoring Summary**
- 2. Formaldehyde Affected Populations/Job Titles**