

**Formaldehyde Standard Operational Procedure**  
**Grice Marine Laboratory**  
**College of Charleston**

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## **Introduction**

After extensive public review and deliberation on May 27, 1992, the Occupational Safety and Health Administration (OSHA) established the Formaldehyde Standard 29 CFR 1910.1048 which governs the use of formaldehyde in the work place. Established as a carcinogen by the EPA in 1987, this standard was developed because employees were not being protected from occupational exposure under the existing standards, the OSHA Hazard Communication (Haz Com) Standard and the OSHA Laboratory Standard. The Haz Com Standard (29 CFR 1910.1200) says that employees have a “right to know” about the chemical hazards in their workplace. Communication of these hazards is conveyed through the use of a written plan, labeling, material safety data sheets (MSDSs), and employee training. The OSHA Laboratory Standard (29 CFR 1910.1450) protects employees from hazardous chemicals such as carcinogens, reproductive toxins, and acutely hazardous materials. Protection is first accomplished through the use of engineering controls and work practices followed by the use of the appropriate personal protective equipment (PPE). The formaldehyde standard reduced the permissible exposure limit (PEL) and required exposure monitoring. It created mandatory medical surveillance if the monitoring meets or exceeds the action level. Communication and training requirements were also defined.

This document establishes the Grice Marine Laboratory’s written compliance program and is applicable to any work activity or potential personnel exposure of formaldehyde ( $\geq 0.1\%$ ) in order to ensure safe handling of the chemical.

### ***What is Formaldehyde?***

Formaldehyde (HCHO) is a colorless, polymerizable gas at room temperature with a noticeable and pungent odor. Classified as a volatile organic compound, it is widely used in industry as a fertilizer, biocide, corrosion inhibitor and embalming fluid. It is pervasive in the building industry used as a sterilizing agent and preservative in foam insulation, particle board and plywood. Commonly known as formalin in laboratory settings, 100% Formalin is a 34-38% solution of gas formaldehyde in water, stabilized with a 10-15% solution of methanol. Formalin is also used as a disinfectant and preservative for biological tissues.

### ***Health Effects of Formaldehyde***

Formaldehyde is an irritant and a sensitizing agent that can cause allergy symptoms at very low levels. It is normally present in air at low levels of approximately 0.06 ppm. Levels of 0.1 ppm can result in acute health effects, but sensitive individuals may show symptoms at lower doses. The likelihood and severity of acute health effects may increase with each exposure. Acute inhalation effects of formaldehyde include irritation of the eyes, nose, and throat.

Respiratory distress may result in coughing, wheezing, chest pains, and asthma attacks. Other effects depending on the mode of exposure may include insomnia, headaches, depression, memory loss, dizziness, fatigue, nausea, diarrhea, or rashes. Chronic effects from formaldehyde exposure include genetic mutations and cancer. Menstrual disorders and secondary sterility has occurred in women as a result of chronic exposure. See Appendix A for exposure chart of reported symptoms by routes of exposure.

If an individual has an acute exposure to formaldehyde and begins to show symptoms, usually removing that individual from the exposure will allow for recovery without any persisting effects. It is chronic exposure to small doses of formaldehyde that is a major cause for study and concern. The effects of exposure to differing concentrations vary from one individual to another, but here is a general guide:

Reported Health Effect Formaldehyde Concentration, ppm

Odor Threshold 0.05-1.0  
Eye Irritation 0.01-2.0 \*  
Irritation of the upper respiratory system 1.0-3.0  
Unable to tolerate prolonged exposures 4.0-5.0  
Severe respiratory symptoms 10.0-20.0  
Serious injury to respiratory tract >50.0  
Death >100.0

Source: American Conference of Governmental Industrial Hygienists, Inc.:  
Documentation of the Threshold Limit Value Exposure Indices, Sixth Edition,  
Volume I, pp. 664-688.

\*The low concentration of 0.01 was observed in the presence of other pollutants that may have acted synergistically.

## **Formaldehyde Standard Operating Procedure**

Formaldehyde is a substance known to possess hazardous characteristics requiring specific handling, usage, storage, monitoring, labeling, and disposal methods. The OSHA Formaldehyde Standard requires the Grice Marine Laboratory to prepare a specific policy in order to provide employees who are using, or have the potential of being exposed to formaldehyde, with more precise and protective guidelines (in addition to those set forth under the Hazard Communication Standard).

While all students are not necessarily employees, many of our students do work directly for the college. For this reason, this policy will apply to everyone (faculty, staff, visiting scientists, graduate and undergraduate students) with the potential for exposure to formaldehyde. Students in a classroom setting must be made aware of the chemical health and safety hazards for formaldehyde. They should be provided with information and equipment to protect themselves from the hazards. Student training must be provided by the instructor prior to formaldehyde use in the classroom.

### ***Employee Responsibility***

The success of this Formaldehyde Standard Operating Procedure (FSOP) depends upon the cooperation of employees at risk for exposure to formaldehyde. Employees must notify the lab manager and receive the proper training before beginning work with formaldehyde. Employees should consult the material safety data sheets (MSDSs) before handling any hazardous chemicals. Employees are required to use engineering controls, work place practices and wear the appropriate personal protective equipment that have been established to protect their health and safety. Active employee participation in the FSOP will result in the continued protection of employees from formaldehyde-related illnesses and injuries at Grice Marine Laboratory.

This policy applies to all occupational exposures to formaldehyde, i.e. formaldehyde gas, its solutions (formalin, etc.), and materials that release formaldehyde.

### ***Supervisory Responsibilities***

Laboratory supervisors and department heads are responsible for ensuring compliance with all elements of the FSOP and reporting any suspected employee exposure to the environmental health and safety officer (EHSO). The supervisor must ensure that proper training and monitoring has taken place prior to any individual working with formaldehyde. Initial training and monitoring must be scheduled with and documented by the lab manager. The laboratory supervisor or teaching instructor is required to make the MSDS readily available

for the user to review physical and health hazard information. The laboratory supervisor or teaching instructor will ensure the proper PPE is readily available to the user and that all PPE is in proper working order prior to use.

### ***Labeling***

The laboratory supervisor must list formaldehyde as an irritant and potential carcinogenic hazard on the laboratory door sign and properly secure all areas containing formaldehyde. The teaching instructor, laboratory supervisor or department head will assure all containers containing formalin or formaldehyde bear labels with the following hazard warnings:

- Health Rating: 3-Severe
- Flammability Rating: 2-Moderate
- Reactivity Rating: 2-Moderate
- Contact Rating: 3-Severe
- Potential Carcinogen

### ***Designated/ Regulated Areas***

If the concentration of airborne formaldehyde could exceed either the time weighted average (TWA) or short term exposure limit (STEL), the environmental health and safety officer (EHSO) will assist the laboratory supervisor in establishing regulated areas. The EHSO will advise in posting all entrances and access ways with signs bearing the following information: Danger, Formaldehyde Irritant and Potential Cancer Hazard, AUTHORIZED PERSONNEL ONLY.

The laboratory supervisor will limit access to regulated areas and allow only authorized persons who have been trained in recognizing the hazards of formaldehyde to enter.

Any contract labor working in or around such regulated areas must be told about the access restrictions and locations of such areas by the laboratory supervisor.

### ***Availability of Reference Materials***

The MSDS, provided by the manufacturer when a chemical is initially purchased, will be used as a reference to communicate the possible hazards of exposure; it lists signs and symptoms of exposure, first aid measures, exposure controls (personal protective equipment, engineering, and work practice controls), toxicological information, etc. A copy of all MSDSs will be maintained in the Grice Conference Room (106), on the Grice website and on the Dell computer's desktops in the computer lab (room 106). Information on formaldehyde can also

be found from other sources such as a chemical dictionary, the Merck Index, Chemical Abstracts, etc.

### ***Permissible Exposure Limits (PELs)***

OSHA established permissible exposure limits to ensure worker safety. Formaldehyde PELs are as follows:

**Time Weighted Average (TWA)** - No employee shall be exposed to airborne concentrations of formaldehyde which exceed 0.75 ppm for an 8 hour work period.

**Short Term Exposure Limit (STEL)** - No employee is to be exposed to an airborne concentration of formaldehyde which exceeds 2 ppm in any 15 minute period.

**Action Level** - No employee shall be exposed at or above the action level of 0.5 ppm over an 8 hour work period, without action being taken to determine and reduce exposure levels.

In the event of an emergency where the PELs may be exceeded, the area should be evacuated. The lab manager or director, the EHSO and Public Safety should be contacted immediately. Current contact numbers can be located on the orange emergency posters in every room of the Grice Marine Laboratory. Clearance from the ESHO or Public Safety must be given to personnel before they can reenter the area.

### ***Training***

Formaldehyde training is required at the following times:

1. Initial training must be provided upon initial assignment to a job with the potential of formaldehyde exposure.
2. Training is required whenever new conditions or hazards are introduced.

The EHSO or the lab manager will offer training for workplace exposure to formaldehyde. The training must be repeated annually and must be documented.

Training for formaldehyde must address the following topics:

1. Contents of the OSHA Formaldehyde Standard, the Formaldehyde Standard Operating Procedure, and the MSDS.
2. Control measures such as safe work practices, engineering controls, and personal protective equipment.

3. A description of the potential health hazards associated with exposure to formaldehyde along with a description of the formaldehyde exposure signs and symptoms. See Appendix A.
4. Instructions to report immediately to the laboratory manager or department head with the development of any adverse signs or symptoms the employee suspects may be attributed to formaldehyde exposure.
5. A description of operations in the specific work area where formaldehyde is present and an explanation of the safe work practices appropriate for limiting exposure to formaldehyde in each job (Job Hazard Analysis).
6. The purpose for, proper use of, and limitations of personal protective equipment and clothing.
7. An explanation of the importance of engineering and work practice controls for employee protection and any necessary instruction in the use of such controls.
8. Instructions for the handling of small spills, emergencies and clean-up procedures. **See: Grice Safety Site “Chemical Spills”**  
<http://www.cofc.edu/~grice/resources/safety/spills.html>.

The laboratory supervisor, laboratory manager and department head will inform affected employees of the availability and location of written training materials and make these readily accessible to affected personnel. The EHSO will retain copies of the training materials and documentation of review by OSHA if requested.

### ***Control Measures***

The supervisor will institute safe work practices and engineering controls to reduce and maintain exposures to formaldehyde at or below the TWA and STEL.

### **Safe Work Practices**

All work with formalin solutions must be done in a certified chemical fume hood. If work cannot be done in a fume hood, the laboratory manager or EHSO must be contacted to take air measurements in order to assure that hazardous exposures to faculty, staff and students are prevented. Recommendations for protocol modification or protective equipment will be made based on the testing results. Examples of protocol modifications are:

- Use a different type of fixative.
- Use a smaller amount of formalin.
- Use a lower concentration of formalin and increase fixation time.
- Rinse or soak preserved specimens in fresh water prior to use.
- Minimize exposure time.

## Engineering Controls

1. Local exhaust ventilation or chemical fume hoods exhaust 100% of the air to the outside with no recirculation. Slot ventilation draws fumes to the back of the work space and away from the worker and then exhausts 100% to the outside.
2. An Emergency Shower is needed if there is a greater than or equal to 1% solution of formaldehyde in the working area.
3. An Emergency Eyewash is needed within immediate work area if 0.1% or greater solution of formaldehyde is present in the working area.
4. To minimize severity of spills, individual formaldehyde containers shall not exceed 5-gallon quantities for 10% formaldehyde. For 37% formaldehyde containers the largest quantity shall be one gallon.
5. All formaldehyde containing solutions must be stored in containers with air tight seals.

## Protective Equipment and Clothing

Laboratory supervisors, teaching instructors and department heads will comply with the provisions of 29 CFR 1910.32 and 20 CFR 1910.133. When protective clothing or equipment (PPE) is provided under these provisions, the laboratory supervisor or department head shall provide these protective devices at no cost to the employee and assure that the employee wears them. The standard requires use of protection for skin and eyes with liquids containing 1 percent or more of formaldehyde.

- EHSO will select protective clothing and equipment based upon the form of formaldehyde to be encountered, the conditions of use, and the hazard to be prevented.
- Gloves must be worn whenever formalin or tissues preserved and/or fixed with formaldehyde are handled. Latex gloves do not provide adequate protection against formaldehyde liquids. Butyl or nitrile gloves are recommended and should be worn if there is a potential for contact. Please note that all gloves are rated for specific time periods before the contaminant permeates or “breaks through” the glove material.
- Prevention of all contact with the eyes is critical. Safety glasses are always required when handling formaldehyde contaminated tissues. The use of goggles and/or face shield may be required if appropriate to the job task.

- Closed toes shoes must be worn at all times when working with formaldehyde.
- A lab coat or apron impervious to formaldehyde must be worn to prevent contact with the skin or body.

Personal protective equipment can only be effective if the proper type is selected and properly used. A hazards assessment should be conducted to ensure the proper PPE is selected. It must be properly maintained and inspected. Damaged or defected PPE must be replaced. Mechanical ventilation equipment must be repaired and should not be used if working improperly.

## **Respiratory Protection**

Where engineering controls (fume or exhaust hoods) are not possible and the use of respirators is necessary to maintain exposure below the PEL or the STEL, the department must provide, at no cost to the employee, the proper respiratory protective equipment. Respirators must be selected and used in accordance with the requirements of the College of Charleston Respiratory Protection Program (contact EHS for additional information). Respirators are only to be used by trained and qualified employees. Annual fit testing, training, and a medical evaluation are required in order to wear a respirator for protection from formaldehyde exposures.

## ***Exposure Monitoring***

Unless working in a certified chemical fume hood, initial monitoring must be completed with all employees to establish that exposures are below the action level or STEL. Monitoring may be terminated if the results from two consecutive sampling periods, at least 7 days apart, indicate that the employee exposure is below the action level and STEL.

For potential exposures at or above the action level or STEL, routine air monitoring will be done every six months during the worst case conditions.

Additional monitoring will be conducted if any of the following conditions occur:

- signs and symptoms of formaldehyde exposure are experienced
- procedures could cause spills and splashes
- a problem with ventilation or fume hood operation is suspected
- the quantity and concentration of formaldehyde is increased
- the length of time exposed increases

## ***Medical Surveillance***

Medical requirements should be implemented under the following conditions:

- An employee has developed signs or symptoms associated with exposure to formaldehyde;
- An employee is involved in a spill, leak or other emergency/occurrence resulting in a possible over-exposure to formaldehyde;
- An employee is exposed to formaldehyde with concentration at or exceeding the action level;
- An employee is exposed to formaldehyde at concentration exceeding the STEL.

Medical surveillance must be conducted by a licensed physician and may include medical disease questionnaires and medical examinations.

Employee exposure and medical records required by this policy shall be provided upon request for examination and copying, to the subject employee or former employee, or to anyone having the specific written consent of the subject employee or former employee in accordance with 29 CFR 1910.20(a)-(c) and (g)-(i).

## ***Recordkeeping***

The following records must be maintained to meet the OSHA requirements:

- Training records of initial and annual training
- Exposure monitoring records
- Exposure records and determinations
- Medical surveillance information
- Respirator fit testing records

Exposure records must be maintained for at least 30 years. Medical records must be kept for the duration of employment plus 30 years. Only the most current respirator fit record must be on file.

## Appendix A: Potential Health Effects of Formaldehyde

| Route of Exposure                             | Acute Exposure   | Chronic Exposure  |
|---|--|---|
| Skin Contact                                  | May cause discoloration or burns to skin. May cause sensitization of the skin resulting in blisters on the eyelids, face, neck, scrotum and arms.  | May cause second degree burns, numbness, rash, fingernail damage, or sudden blistering of the skin. May cause dermatitis with symptoms appearing several years later, which include blistering on digital areas, wrists and other parts of the body.  |
| Eye Contact                                   | At lower concentrations (0.05-3ppm) may cause irritations, and blurred vision. At higher concentrations (4-20ppm) may cause severe damage to the eye, and possibly <b>blindness</b> .  | Effects depend on concentration and duration of exposure.   |
| Ingestion                                     | May cause burning, vomiting and diarrhea, abdominal pain, headache, vertigo, hypertension, convulsions, unconsciousness and coma. May cause damage to the liver, heart, brain, spleen, pancreas, kidney and Central Nervous System.  | May cause gastrointestinal irritation, vomiting and dizziness. Average <b>fatal dose</b> is 1-2 ounces of a 37% solution.   |
| Inhalation<br>Air Concentration<br>(0-100ppm) | (0-5ppm): May cause difficulty breathing, irritations and/or burning in the eyes, nose and throat.<br>(25-50ppm): May cause severe tissue damage and respiratory tract injury resulting in wheezing, headaches, nausea, vomiting and palpitations.<br>(50-100ppm): May cause pulmonary edema and/or <b>death</b> . | Some experience neuropsychological effects such as sleep disorders, irritability, altered sense of balance, mood alterations, and memory/concentration loss. Menstrual disorders and secondary sterility have occurred in women. May also lead to kidney injury, pulmonary sensitization and an <b>increased risk of cancer</b> (nose, accessory sinuses, nasopharyngeal, oropharyngeal). |