

PROGRAM DIRECTIVE

Program Directive A-159

Issued May 1, 1991

Revised June 28, 2017

SUBJECT: Formaldehyde - Enforcement Procedures for Occupational Exposure to Formaldehyde.

AFFECTED CODES/

DIRECTIVES: 1910.1048, Formaldehyde
<http://osha.oregon.gov/OSHArules/div2/div2Z-1048-formaldehyde.pdf>

PURPOSE: This instruction provides uniform inspection procedures and guidelines when conducting inspections and issuing citations for workers potentially exposed to formaldehyde.

SCOPE: This instruction applies to all Oregon OSHA.

REFERENCES:

1. Field Inspection Reference Manual (FIRM)
2. OSHA Instruction CPL-02-02-052 - CPL 2-2.52, Enforcement Procedure for Occupational Exposure to Formaldehyde

ACTION: This directive will be followed whenever inspections are conducted on operations with formaldehyde exposure.

BACKGROUND: On December 4, 1987, OSHA revised its standard for formaldehyde (29 CFR 1910.1048). This reduced the 8-hour time weighted average (TWA) exposure limit for formaldehyde from 3 parts per million (ppm) to 0.75 ppm. The peak allowable exposure of 10 ppm was revoked and the 5 ppm ceiling was reduced to 2 ppm TWA measured over a 15 minute period (short-term exposure limit) (STEL). Employers must also conduct exposure monitoring, offer medical surveillance to exposed employees, and supply protective equipment and clothing as needed. The employer may need to establish emergency procedures, provide clean-up of spills, and install emergency showers and eyewash facilities. Employee training on the hazards of formaldehyde and on the formaldehyde standard must be conducted. Training is reinforced by labels and safety data sheets (SDS) required by the Hazard Communication Standard (HCS) (1910.1200).

- A. On March 2, 1988, OSHA announced in the Federal Register partial approval by the Office of Management and Budget of information collection requirements under the formaldehyde

standard. All parts of the standard were approved except for paragraphs (m)(1)(i) through (m)(4)(ii), concerning hazard communication. In addition, a start-up date for updating the written materials in the training program was added to paragraph (p).

- B. On November 8, 1988, OSHA announced in the Federal Register approval of information collection requirements for paragraph (m)(1)(i) through (m)(4)(ii). A delay start-up date was specified for these provisions along with a clarification of the labeling provisions. In the interim, OSHA sought comments on a petition for administrative stay of the warning label requirements.
- C. On November 22, 1988, OSHA announced in the Federal Register a further extension of the start-up date for compliance with the newly approved hazard communication provisions.
- D. On December 13, 1988, OSHA announced in the Federal Register an administrative stay of paragraphs (m)(1)(i) through (m)(4)(ii) for a period of 9 months. This stay has been extended to December 11, 1990. The effect of the administrative stay will be the continued enforcement of the Hazard Communication Standard with respect to formaldehyde.
- E. On July 13, 1989, OSHA published in the Federal Register a correction and technical amendments notice. Table 1 of paragraph (g), Respiratory Protection, was modified so that the entry for Type C respirators specifies pressure demand or continuous flow type, with full facepiece, hood, or helmet. The notice also clarifies paragraph (g)(2)(ii) by substituting a performance standard, "adequate to protect against formaldehyde exposure" (based on protection factors), for an erroneous reference to Table 1. Paragraph (o), Recordkeeping, was amended to incorporate a reference to 1910.1020, the access to medical records standard.
- F. On June 9, 1989, the U.S. Court of Appeals (District of Columbia circuit) handed down its decision regarding the challenge by the United Auto Workers (UAW) and Amalgamated Clothing and Textile Workers Union (ACTWU) to the formaldehyde standard. OSHA was directed to reconsider its finding of insignificant risk at 1 ppm and its failure to include a requirement for medical removal protection (MRP). OSHA petitioned the court to review its decision regarding MRP; this petition was denied on September 22, 1989.

**OCCUPATIONAL
EXPOSURE TO
FORMALDEHYDE:**

- A. Formaldehyde Uses. Formaldehyde is a reactive chemical with many uses.
1. The major consumers of formaldehyde are the manufacturers of compressed wood products. Formaldehyde is consumed in resins that are used as glues in the production of particleboard, plywood, and fiberboard. These wood products in turn are used in the construction, furniture, and mobile home manufacturing industries.
 2. The plastics industry is the second largest user of formaldehyde based resins. Molding compounds containing melamine, phenolic, or acetyl resins are capable of releasing formaldehyde when subjected to heat and/or pressure in the molding process. The final product, however, contains little free formaldehyde and has little potential for depolymerization, so that potential exposure to formaldehyde from use of the plastic product is minimal. Typical of plastics made from formaldehyde based resins are lawn and garden equipment, plumbing fixtures, melamine tableware, and electrical insulation parts.
 3. Formaldehyde releasing resins are used to add wrinkle free and durable press characteristics to synthetic and natural fiber textiles. These resins leave residual formaldehyde in the product which can result in exposure to formaldehyde in the apparel industry. A dimethyloldihydroxyethylene - urea (DMDHEU) based resin system is most commonly used.
 4. Formaldehyde bearing resins are used in the coating industry primarily as modifiers in alkyd and acrylic coating systems. Urea formaldehyde resins are used in clear coating for wood furniture, primer coats for automobiles, baked enamels for appliances, and can coatings. Melamine formaldehyde resins are generally used where outdoor exposure or contact with detergents require improved chemical resistance. Melamine formaldehyde resins also have some application where corrosion resistance is important.
 5. Paper products may be treated with formaldehyde derivatives (e.g., melamine- or urea formaldehyde) to add a desired finish or wet strength quality. Melamine resins can be inactivated by a high sulfate concentration, and this problem is overcome by addition of excess formaldehyde.
 6. Formaldehyde is an important constituent of embalming and preserving fluids because it performs two essential functions, disinfection and preservation. In mortuaries,

embalming fluids may be injected in concentrated form to preserve the organs in the visceral and thoracic cavities. Arterial fluids are prepared by diluting the concentrate and are injected into the arterial system through a hose. Formaldehyde's properties as a tissue preservative also account for its use in anatomy, histology, and pathology laboratories.

7. Formaldehyde based chemicals are used in textile waterproofing, as accelerators in the production of rubber products, and in photographic developing. Foundries use formaldehyde based resins in molds in the production of ferrous and non ferrous goods.
8. Formaldehyde is used in the production of industrial chemicals including pentaerythritol, 1,4 butenediol, and trimethyl propane.
9. Some detergents, fertilizers, explosives and abrasive products are also manufactured with formaldehyde. Because formaldehyde is an effective bactericide, it is contained in cosmetic products, shampoos, and hair sprays. It is used in the manufacture of some pharmaceutical products and germicides, and it is used to clean dialysis equipment.

B. Formaldehyde Exposure.

1. Formaldehyde exposure can occur in three ways:
 - a. Exposure to liquid or solid formaldehyde (para formaldehyde) and the accompanying vapors;
 - b. Exposure to formaldehyde during primary processing of formaldehyde resins and other chemicals manufactured from formaldehyde; and
 - c. Exposure to formaldehyde released from products that contain formaldehyde based resins.
2. Occupational exposure to formaldehyde occurs during heat and/or pressure processing of products made from or including formaldehyde bearing resins. Examples of such exposures include the pressing of wood products, extrusion or injection molding of plastics, heat setting of pleats on apparel, and casting of molds in foundry processes.
3. Occupational exposures to formaldehyde occur when a finished product contains residual formaldehyde or when hydrolysis, the chemical break down of formaldehyde gas prompted by warm and humid work environments, occurs. The EPA has described this phenomenon as

"pseudoconsumptive use" of formaldehyde; i.e., chemical identity is changed but not irreversibly. Examples of "pseudoconsumptive" uses are: (1) ureaformaldehyde resins in fiberboard, particleboard, plywood, laminates, ureaformaldehyde foams and insulation products, molding compounds, and protective coatings; (2) ureaformaldehyde concentrates used to produce time release fertilizers; and (3) hexamethyl enetetramine.

C. Operations. Specific operations that cause employee exposure to formaldehyde include:

1. Formaldehyde transfer operations,
2. Reactor or vessel cleaning,
3. Fugitive emissions in chemical plants,
4. Exposure to articles that have been treated with formaldehyde based resins before curing,
5. Exposure to articles containing cured resins during transit from curing operations to storage or further processing,
6. Exposure to stored articles containing cured resins, and
7. The application of formaldehyde based resins.

NOTE: Short term exposures occur during batch operations such as mixing and during periodic cleaning and maintenance activities. Concentrated formaldehyde solutions (37% or greater) are often diluted for sale or use by chemical distributors or end users, such as hospitals. In addition, short term exposures occur in mortuaries and laboratories (anatomy, histology, pathology, environmental testing, and school biology).

HEALTH EFFECTS:

Based on the best available evidence in the agency's record on formaldehyde, OSHA determined that formaldehyde is gene toxic, showing properties of both a cancer initiator and promoter. When inhaled, formaldehyde is a carcinogen in rats. In humans, formaldehyde exposure has been associated with cancers of the lung, nasopharynx and oropharynx, and nasal passages.

- A. Formaldehyde is highly irritating to the upper respiratory tract and eyes. Concentrations as low as 0.1 to 2 ppm may irritate the eyes, nose, and throat of some individuals. Concentrations of 3 to 5 ppm cause tearing of the eyes, and the severity of the effects become intolerable to some persons. Concentrations of 10 to 20 ppm cause difficulty in breathing, burning of the nose and throat, coughing, and heavy tearing of the eyes. Concentrations over 25 ppm can cause severe respiratory tract injury that can lead to pulmonary edema and pneumonitis. A concentration of 100 ppm is regarded as

immediately dangerous to life or health (IDLH) for formaldehyde.

For information purposes, the NIOSH Pocket Guide, 2004 Edition, sets the IDLH at 20 ppm.

The NIOSH Pocket Guide IDLH document reports "that exposure to 10 to 20 ppm produces almost immediate eye irritation and a sharp burning sensation of the nose and throat which may be associated with sneezing, difficulty in taking a deep breath, and coughing; recovery is prompt from these transient effects [Kodak 1936-1960]. It has been estimated that exposure for 5 to 10 minutes to 50 to 100 ppm might cause serious injury to the lower respiratory passages [Kodak 1936-1960]. The following exposure-effect data has also been reported: most subjects experience irritation of the eyes, nose, and throat at 1 to 3 ppm; many subjects cannot tolerate prolonged exposures to 4 to 5 ppm; and difficulty in breathing was experienced at 10 to 20 ppm [IARC 1982]. In a summary of health effects data, upper airway irritation and increased nasal airway resistance were reported at 0.1 to 25 ppm and lower airway and chronic pulmonary obstruction at 5 to 30 ppm [NRC 1981]."

"The revised NIOSH IDLH for formaldehyde is 20 ppm based on acute inhalation toxicity data in humans [IARC 1982; Kodak 1936-1960; NRC 1981]. Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for formaldehyde at concentrations above 0.016 ppm."

- B. Some persons have developed asthma or bronchitis following exposure to formaldehyde; usually a single exposure to high concentrations of formaldehyde as the result of an accidental spill appeared responsible for the onset of symptoms.
- C. Formalin (37% formaldehyde) is a skin irritant and sensitizer. Formalin solutions splashed in the eye have resulted in blindness. Less concentrated solutions can also injure the eyes and skin. The severity of the effect depends on the concentration of formaldehyde in solution and whether the affected tissue is flushed with water immediately after the accidental splash. Contact with formalin causes a white discoloration, pain, drying, cracking, and scaling of the skin. Prolonged and repeated contact can cause numbness and a hardening or "tanning" of the skin.
- D. Previously exposed persons may react to exposure with an allergic eczematous dermatitis or hives. Employees in industries where there is direct skin contact with formaldehyde releasing resins (e.g., textiles) tend to have a higher than normal incidence of dermatitis. When patch tested, these persons sometimes show sensitization to formaldehyde.

**CLARIFICATIONS OF
THE FORMALDEHYDE
STANDARD 29 CFR 1910.1048:**

A. Paragraph (a) Scope and Application.

1. Formaldehyde refers solely to the chemical defined by chemical Abstracts Services Registry Number 50- 00- 0. This chemical is formaldehyde gas which, per se, is not available commercially. Most exposures are to formaldehyde gas which is emitted at various concentrations from numerous products made from formaldehyde bearing resins. Various mixtures of formaldehyde, water, and alcohol (sometimes referred to as "formalin") are also included in CAS #50 00 0. Paraformaldehyde, a solid polymeric form of formaldehyde, also serves as a source of formaldehyde gas.
2. The formaldehyde standard applies to all occupational exposures to formaldehyde. This includes general industry, agriculture, and by cross reference, maritime and construction.

Oregon OSHA has jurisdiction over employee exposures to pesticides and Oregon Department of Agriculture (ODA) has the responsibility to ensure that labels and distribution of pesticides are in compliance with Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) rules based on a Memo of Understanding with ODA. The scope of the formaldehyde standard is not affected in most cases by the laboratory standard. The laboratory standard, 1910.1450, specifically does not apply to formaldehyde use in histology, pathology, and human or animal anatomy laboratories; however, if formaldehyde is used in other types of laboratories which are covered by the laboratory standard the employer needs to comply with 1910.1450.

B. Paragraph (c) Permissible Exposure Limit. Where there are measurable concentrations of other regulated contaminants which affect the same body systems as formaldehyde. The Air Contaminants Standard, OAR437-002-0382(4)(b)(i), contains a formula for additive and synergistic effects which proportionally reduces the PEL of each regulated toxic element of the multiple exposure. Paragraph OAR437-002-0382(4)(b)(i) requires employers to meet these adjusted PELs where there is an exposure to a mixture of air contaminants regulated by Subpart Z.

1. When documenting a violation, review the feasibility of abatement methods and identify the shared target organ effects of the co contaminants. The body system primarily

affected by formaldehyde is the respiratory system (upper and lower). The immune system may also be affected. Formaldehyde is a sensitizer which provokes an IgE, immunoglobulin, mediated response. Appendix E of this instruction contains guidance for calculating the adjusted PELs and SAEs (sampling and analytical errors). The adjusted PEL should apply only to enforcement of paragraphs (c), Permissible Exposure Limit and (f), Methods of Compliance. The STEL and AL should not be adjusted for mixtures for compliance evaluations.

- C. Paragraph 1910.1048(d), Exposure Monitoring. Paragraph 1910.1048(d) of the formaldehyde standard requires employers to determine their employees' exposure to formaldehyde. Communication of the hazards associated with formaldehyde is governed by the requirements of paragraph 1910.1048(m), Hazard Communication. If any mixture or solution present in the workplace contains 0.1 percent or more of formaldehyde, or if materials capable of releasing formaldehyde into the workplace air result in employees being exposed to formaldehyde at concentrations reaching or exceeding 0.1 ppm, hazard communication requirements apply. The HCO/SCO should verify the employee exposure via bulk or air samples.
1. Objective Data. The exposure determination must consist of actual measurements unless the employer can produce objective data under 1910.1048 (d)(1)(ii) to document that no employee will be exposed to formaldehyde at concentrations exceeding the 0.5 ppm (TWA) action level (AL), or the 2 ppm STEL under foreseeable conditions of use. Industry wide studies or generic exposure estimates may be a source of objective data; however, the use of such data must accurately characterize actual employee exposures. For exposures less than the AL or STEL, area samples may also be used as the basis for exposure determinations, if they represent those exposures.
 2. Medical Complaints. Regardless of employee exposure, if an employee reports signs or symptoms of respiratory or dermal conditions associated with formaldehyde exposure, the employer must promptly monitor the affected employee's exposure, 1910.1048(d)(2)(iii).
 3. Exception. If mixtures of solutions composed of 0.1 percent or less of formaldehyde are used, employee exposure is below 0.1 ppm, and there are no employee health complaints then an employer should not be cited for not monitoring. (See 1910.1048(d)(1))
 4. Repeat Monitoring. If there is a change in production, equipment, process, personnel, or control measures, which

may result in a new or additional exposure to formaldehyde, the initial monitoring must be repeated. For example, apparel manufacturers and other producers/users of formaldehyde resin finished fabrics may need to repeat initial determinations with different fabric lots.

5. Sampling Methods. As long as the method selected for sampling and analysis meets the criteria for precision and accuracy set out in the formaldehyde standard, the employer is free to choose from many methods available for monitoring exposure to formaldehyde.
 - a. Among the methods available are the chromotropic acid method, which relies on use of a midget impinger; gas chromatographic methods, which collect formaldehyde in a specially prepared tube; passive diffusion badges; and handheld monitors.
 - b. Appendix A to this instruction summarizes information submitted to the formaldehyde docket on passive and direct reading devices for the measurement of formaldehyde. Limitations, where known, are also given.

D. Paragraph 1910.1048(h), Protective Equipment and Clothing. This section addresses the selection and maintenance of protective equipment and clothing, including aprons, goggles, face shields, and suits. The HCO/SCO should evaluate potential formaldehyde hazards and use professional judgment in enforcing the general requirements of OAR437-002-0134 that are incorporated into the formaldehyde standard by reference. Violations of these general requirements should be cited under 1910.1048(h). Some PPE requirements are specified by the formaldehyde standard, and violations of these requirements should be cited under 1910.1048(h)(1). OAR437-002-0134 is contained in Division 2, Subdivision I. However, paragraph 1910.1048(h) should be used in preference to Division 2/I.

1. Solutions containing greater than 1 percent formaldehyde are damaging to the skin and severely damaging to the eyes. Consequently, protective equipment adequate to prevent contact with such solutions must be provided to employees, and the equipment must be kept in good condition and free of formaldehyde contamination.
2. Some solids that release formaldehyde and solutions that contain less than 1 percent formaldehyde can also pose a hazard to employees. Paragraph 1910.1048(h) requires the employer to provide protective clothing or equipment, as needed, in accordance with the general standards for protective equipment and clothing (OAR437-002-0134) to

prevent contact with irritating or sensitizing materials.

3. Formaldehyde gas poses little hazard from dermal contact, although there are a few reports in the literature that indicate sensitization from high airborne concentrations. At the IDLH concentration, the standard requires whole body protection, essentially equivalent to Level A protection, to prevent potential sensitization.
4. Butyl and nitrile glove materials provide the greatest permeation protection. Greater thickness of other materials (natural rubber, PVC, polyethylene) may be suitable for shorter immersion periods, but gloves may have to be changed more frequently due to degradation. All these materials are generally suitable for splash protection. Appendix B to this instruction summarizes the permeation data available for formaldehyde. Barrier creams are not regarded as effective protection for formaldehyde, since there is no data demonstrating their efficacy.

E. Paragraph 1910.1048(i), Hygiene Protection.

1. Emergency Showers. Because of the severe dermal effects that can occur when employees have skin contact with concentrated solutions of formaldehyde and because of the relative irreversibility of dermal sensitization to formaldehyde, the employer is required to provide conveniently located quick drench showers for employees who become splashed with solutions of 1 percent or greater formaldehyde as the result of equipment failure, improper work practices, or other emergencies. Whether or not the employee is wearing protective clothing does not affect the need for quick drench showers since the employee must be able to remove PPE splashed with formaldehyde in a safe manner. The availability of emergency showers should also help to lower any potentially serious inhalation hazard when an employee has been splashed with a formaldehyde solution.
2. Eye Wash Facilities. Liquid formaldehyde can also cause severe damage to the eyes. Thus, the standard requires employers to provide appropriate eye wash facilities within the immediate work area for emergency use by any employee whose eyes are splashed with solutions containing 0.1 percent or more of formaldehyde.
3. The degree of sophistication of the emergency shower or eyewash station varies with the size of the potential splash. The use of portable units or hand held fixtures should be carefully evaluated. Such use should be limited to small spills (generally less than 8 oz.), provided that all possible affected body parts can be flushed continuously for 15

minutes. (For this reason, bottle type eyewashes are not acceptable.) See Program Directive A-63, Eyewash and Safety Showers.

- F. Paragraph 1910.1048(k), Emergencies. Paragraph 1910.1048(k) ensures that the employer will prepare for any situation where equipment fails or containers spill or rupture that would result in an uncontrolled release of formaldehyde and could result in injury or loss of life. If such circumstances could occur in an accident, the employer must establish procedures for evacuation and access to emergency medical care, obtain needed equipment for evacuation and reentry into the area, and establish procedures for equipment repair, spill cleanup, decontamination, and waste disposal. Paragraph 1910.1048(k) violations should be grouped with any applicable violations under 1910.120. The threshold quantity for formaldehyde for evaluation of catastrophic potential is 500 lbs.
1. There is not a specific exposure level that triggers the emergency provisions. When determining if there is a need to provide for emergencies, the employer should consider whether employees' lives or health could be jeopardized in the worst reasonably predictable accident (i.e., the worst outcome of any possible scenario) unless employees are promptly evacuated from the area.
 2. A 30 minute exposure to 100 ppm is potentially fatal and pulmonary edema has been seen after exposures of 50 ppm. These levels can be generated by relatively small spills (a pint or less), even in ventilated areas.
- G. Paragraph 1910.1048(1), Medical Surveillance.
1. The provisions of paragraph 1910.1048(1) establish an approach to medical surveillance based on an employee's exposure potential.
 - a. All persons who are required to wear respirators as the result of their formaldehyde exposure must fill out a medical disease questionnaire, such as the optional form contained in Appendix D to the formaldehyde standard, on an annual basis. (Note: The employer is required to administer the questionnaire, a process which is required to be under the supervision of a licensed physician, and involves assisting the employee as necessary to complete the questionnaire.) These persons must be offered a physical examination and a pulmonary function test at least every year.

- b. All persons who are exposed to formaldehyde at concentrations between the action level and the 1 ppm TWA limit (but not over the STEL) must be given the opportunity to participate in a medical surveillance program on an annual basis by filling out a medical disease questionnaire. If an employee exposed between the action level and the 1 ppm TWA limit is showing signs and symptoms that may be formaldehyde related, the employer must administer to the employee a medical disease questionnaire without delay. If the physician determines, on the basis of the medical disease questionnaire, that it is necessary to examine the employee, the employee would then be sent to the physician for further examination.
 - c. If exposures are less than 0.5 ppm but the employee is showing signs and symptoms that may be formaldehyde related, the employee must be evaluated via a medical disease questionnaire, and further surveillance would be conducted on the basis of the physician's determination, as it is for concentrations between 0.5 and 1 ppm.
- 2. Paragraph 1910.1048(1)(3)(ii) requires the physician to make a determination, based on evaluation of the medical disease questionnaire, as to whether additional medical surveillance specified in paragraph 1910.1048(1)(4); i.e., a medical examination, is necessary to ensure the employee is not being placed at increased risk of material impairment of health from exposure to formaldehyde. In some cases, the physician will require additional information from the medical examinations before a final written opinion can be given. When the physician does not require additional information to reach a determination about the employee's health, the determination made in paragraph 1910.1048(1)(3)(ii) must be provided to the employer in writing, and a copy given to the employee within 15 days of its receipt by the employer.
 - 3. Emergencies pose a very different situation from routine surveillance. If the employer has determined that an emergency situation could occur, then there must be a prior arrangement with a physician or hospital to ensure that any employee acutely exposed to formaldehyde in an emergency receives proper medical intervention, as required by paragraph 1910.1048(k). The emergency plan must also specify what information should be given to

emergency care providers, per the requirements of paragraph 1910.1048(1)(6), and how it is to be transmitted.

- H. Paragraph 1910.1048(m), Hazard Communication. Communication of formaldehyde hazards is established in paragraph 1910.1048(m). Employers must develop, implement, and maintain a written hazard communication program for formaldehyde exposures in the workplace describing how requirements for labels and other forms of warning, material safety data sheets, employee information and training will be met.
- I. Paragraph 1910.1048(n), Employee Information and Training.
 - 1. All employees exposed to formaldehyde at concentrations at or above 0.1 ppm or to solutions containing greater than 0.1 percent or more of formaldehyde must receive initial training upon hire and whenever a new exposure to formaldehyde is introduced into the work area.
 - 2. All employees exposed at or above the action level or the STEL must be trained annually.
 - 3. Training for formaldehyde must cover all applicable requirements contained in paragraph 1910.1048(n)(3) of the formaldehyde standard. The training provisions of paragraph 1910.1048(n) are to be cited rather than the HCR information and training requirements if the employee is covered by 1910.1048(n).
 - 4. Appendix A to the formaldehyde standard provides general information which is appropriate for a training program. This outline would need to be supplemented by plant specific information.
- J. Paragraph 1910.1048(p), Dates. Since all dates in this section have passed, all paragraphs are in effect for all industries. Appendix C to this instruction gives specific effective dates by paragraph.
- K. Supplement Information. Appendix D to this instruction summarizes the formaldehyde standard triggering events.

**INSPECTION
PROCEDURES:**

The following procedures must be followed in addition to the guidance in the FIRM and OTIS Forms Manual.

- A. Authorization to Review Limited Medical Information. Appropriate qualified compliance personnel are authorized to review medical disease questionnaires and medical opinions

mandated by the formaldehyde standard under the limitations and procedures in Oregon OSHA PD A-266.

1. Qualified compliance personnel are industrial hygienists or professionals with training in medical disciplines.
2. This authorization is pursuant to 1913.10 (b)(6) (available from the Oregon SHA Resource Center).

B. Recording in OTIS. The following must be recorded in “Related/Optional” for all inspections where employee exposure to formaldehyde is investigated:

<u>Type</u>	<u>ID</u>	<u>Value</u>
S	26	Form

EFFECTIVE

DATE: This directive is effective immediately and will remain in effect until cancelled or superseded.

History: Issued 5-1-1991 Revised 2-15-1992, 10-21-1993, 6-26-2000, 8-16-2005, 10-1-2013, and 6-28-2017

Appendix A

Passive and Direct Reading Devices¹

COMPANY: Air Quality Research (415-644-2097).

PRODUCT NAME: Passive Formaldehyde Kit (PF-20).

METHOD OF COLLECTION: Bisulfite coated glass fiber filter.

DETECTION: Chromotropic acid.

SENSITIVITY: 0.1 ppm for 8 hours; .5 ppm for 15 minutes.

INTERFERENCES: Low humidity may cause adverse effects.

COMMENTS: Manufacturer claims the PF-20 monitor will operate in a humidity range of 20 to 90% RH. Face velocities must be greater than 25 cm/s during sampling.

COMPANY: Assay Technology (415-424-9947).

PRODUCT NAME: Chem Chip (TM).

DETECTION: Colorimetric (Furpald procedure).

SENSITIVITY: 0.1 ppm for 8 hours; 0.3 ppm for 15 minutes.

INTERFERENCES: Other aldehydes but less interference with higher molecular weights.

COMMENTS: Good for the STEL according to manufacturer's literature. Interferences of other aldehydes would cause a problem in certain industries such as embalming where glutaraldehyde may also be present.

COMPANY: Crystal Diagnostic (617-933-4114).

PRODUCT NAME: AirScan (TM).

METHOD OF COLLECTION: Chemical reaction.

DETECTION: Visible.

SENSITIVITY: 0.1 ppm 8 Hr.; STEL (see comments).

INTERFERENCES: Possibly humidity but not definite.

COMMENTS: The company states their monitors are sensitive enough for the STEL if the badge is allowed to develop for several hours. The results on the humidity interference were inconclusive.

COMPANY: CEA Instrument, Inc. (201-664-2300).

PRODUCT NAME: Model 555.

METHOD OF COLLECTION: Direct Reading Instrument.

DETECTION: Colorimetric (pararosaniline).

SENSITIVITY: 0.01 ppm continuous reading.

INTERFERENCES: Temperature can cause a problem; other aldehydes.

COMMENTS: A review article states that there is a long equilibration time and calibration must be done often. Interferences of other aldehydes would cause a problem in certain industries such as embalming where glutaraldehyde may also be present.

COMPANY: CEA Instrument, Inc. (201-664-2300).

PRODUCT NAME: TGM 555.

METHOD OF COLLECTION: Direct Reading Instrument.

DETECTION: Colorimetric (pararosaniline).

SENSITIVITY: 0.003 ppm continuous reading.

INTERFERENCES: Temperature can cause a problem; other aldehydes.

COMMENTS: Modification of Model 555. Need to average the continuous readout for STEL.

Interferences of other aldehydes would cause a problem in certain industries such as embalming where glutaraldehyde may also be present.

COMPANY: Dosimeter Corporation (513-489-8100).

PRODUCT NAME: Model F-3.

METHOD OF COLLECTION: Cellulose sponge containing a sorbent

DETECTION: Visual with a comparator badge.

SENSITIVITY: 0.03 ppm for 4 hours.

INTERFERENCES: None listed.

COMMENTS: Manufacturer's stated sensitivity would make it adequate for STEL.

COMPANY: DuPont.

PRODUCT NAME: Pro-Tek C-60 (TM).

METHOD OF COLLECTION: Modified 1% bisulfite.

DETECTION: Colorimetric (Chromotropic acid).

SENSITIVITY: 0.12 ppm for 8 hours; 1 ppm for 15 minutes.

INTERFERENCES: Phenol, ethanol and other alcohols but in concentrations 8 times and 15 times, respectively.

COMMENTS: Not good for STEL. The interferences of phenol and ethanol may cause problems in certain industries such as plywood manufacturing.

COMPANY: Envirotech Services, Inc. (608-643-4755).

PRODUCT NAME: ETS Dosimeter (TM).

METHOD OF COLLECTION: Organic acid on polycarbonate sponge.

DETECTION: Colorimetric (Purpald procedure).

SENSITIVITY: 0.01 ppm for 8 hours.

INTERFERENCES: Other aldehydes.

COMMENTS: Not good for the STEL. Interferences are other aldehydes which would cause a problem in certain industries such as embalming where glutaraldehyde may also be present.

COMPANY: Foxboro Analytical (203-853-1616).

PRODUCT NAME: Miran-1A.

METHOD OF COLLECTION: Direct Reading Instrument.

DETECTION: Infrared Spectrophotometer.

SENSITIVITY: 1 ppm continuous reading.

INTERFERENCES: Any compound which has an absorbance at 3.58 micrometers (C-Ia stretch). Possibly any aliphatic hydrocarbon may interfere.

COMMENTS: Need to average the continuous readout for STEL or TWA.

COMPANY: MDA Scientific, Inc.

PRODUCT NAME: Lion Formaldemeter.

METHOD OF COLLECTION: Direct Reading Instrument.

DETECTION: Electrochemical.

SENSITIVITY: 0.3 ppm.

INTERFERENCES: Compounds that are easily oxidized such as methanol, phenol, ethanol and formic acid.

COMMENTS: Not useable for STEL due to the short sampling time (approx. 20 seconds) and the time delay for the electrochemical cell to return to zero would prevent rapid sequential measurements.

COMPANY: Sensidyne (813-530-3602).

PRODUCT NAME: 91L.

METHOD OF COLLECTION: Detector tube.

DETECTION: Visible color indication.

SENSITIVITY: 0.2-5 ppm.

INTERFERENCES: Aldehydes, acid gases and ketones.

COMMENTS: The tube has the sensitivity for the STEL but taking a continuous 15-minute sample would be difficult. The number of interferences may lead to a problem.

COMPANY: 3M (612-733-8029).

PRODUCT NAME: 3721 (TM).

METHOD OF COLLECTION: Bisulfite impregnated pad.

DETECTION: Colorimetric (Chromotropic acid).

SENSITIVITY: 0.1 ppm for 8 hours.

INTERFERENCES: Manufacturer claims phenol is not an interference since the monitor has a low collection efficiency for phenol.

COMMENTS: Not good for the STEL. Sampling for longer than 16 hours in low humidity may make it unusable.

COMPANY: Kem Medical (800-553-0330).

PRODUCT NAME: 8510 Vapor-Trak.

METHOD OF COLLECTION: Moistened chemical pad.

DETECTION: Colorimetric (Chromotropic acid).

SENSITIVITY: 0.02 ppm (8 hours); 0.64 ppm (15 min.).

INTERFERENCES: None listed but colorimetric methods usually have some interferences.

COMMENTS: Manufacturer's material states that humidity should not be a problem but if it does cause a problem then the exposure would be underestimated. They do state that 20% RH did not cause a problem. That RH is probably at room temperature.

COMPANY: Air Technology Labs, Inc. (209-435-3545).

PRODUCT NAME: Passive Bubbler.

METHOD OF COLLECTION: 3-methyl-1-2-benzothiazolinone hydrazone hydrochloride (MBTH) solution.

DETECTION: Colorimetric.

SENSITIVITY: 0.2 ppm for 8 hours. 0.8 ppm for 15 minutes.

INTERFERENCES: Other aliphatic aldehydes.

COMMENTS: Device is a passive liquid sampler that is independent of humidity effects.

This is a summary of information from the formaldehyde docket on passive and direct reading devices. It is not a comprehensive list of all available devices. For further information contact the OSHA Salt Lake City Laboratory. Oregon OSHA compliance officers can contact the Oregon OSHA laboratory for assistance.

Appendix B

Summary of Published Permeation Data

THICK RATE (mm)	GENERIC MATERIAL (minutes)	BREAKTHROUGH (ug/cm2/min)	STEADY STATE COMMENTS
.28-.60	Nitrile	>360 to >1260	
.23	Vitron	>960	
	Chemrel	>480	Suit Material
.08	Silver Shield	>360	Glove only
.43	Butyl	>240 to >960	>240=mixture
	PE/Tyvek	>360 to >480	
.07	PE/EVOH/PE	>240	35C
	Swedish Teflon	>180	
.05	CPE	>180	
.38-.74	Neoprene	120 to >480	<90 to <900
.16-.46	Natural Rubber	4 to >480	10 to 900
.60	Viton/neoprene	>60	
	Neo + Nat Rub	35	<600
	Nitrile-PVC	30	<9.50
.50	PVA	6 to >240	Degrades, no water BkTh for mixtures
.15-.51	PVC	4 to >480	<10 to <900

Appendix C

Startup Dates

- a. The following provisions were triggered as of February 2, 1988, (formaldehyde standard paragraphs):
- (a) Scope and application.
 - (b) Definitions.
 - (c) Permissible Exposure Limit (PEL). The intent was to have no employees exposed above the PEL by February 2, 1988, (53 FR 46290, December 4, 1988).
 - (e) Regulated areas. Signs restricting entry to authorized personnel must be placed at the entry to all areas where either PEL is exceeded. An exception is when exposures are over a new PEL but below the old PEL's and the employer did not have adequate sampling data to comply with these requirements. Since the startup date for monitoring was August 2, 1988, (except for laboratories) no exception should be given after this date.
 - (g) Respiratory protection. In general, these provisions were not triggered until November 2, 1988. They could be cited in the interim, however, if the employer had knowledge for at least 3 months that employees were exposed above a new PEL.
 - (h) Protective equipment and clothing.
 - (i) Hygiene protection.
 - (j) Housekeeping.
 - (1) 1910.1048(1)(ii) and (1)(5) Medical Surveillance. Emergency or when employees develop signs and symptoms of overexposure to formaldehyde. Because any formaldehyde-bearing products are dermal hazards and because of individual hypersensitivity to formaldehyde, signs or symptoms of overexposure may occasionally occur even though airborne levels are below the PELs.
 - (k) Recordkeeping.
- b. The following provisions are scheduled to be in effect as follows, formaldehyde standard paragraphs 1910.1048:
- (d) Exposure monitoring ... August 2, 1988.
 - (f) Methods of compliance ... February 2, 1989.
 - (g) Respiratory protection ... As soon as possible but no later than November 2, 1988.
 - (k) Emergencies ... August 2, 1988.
 - (l) Medical surveillance (except (1)(1)(ii) and (1)(5) . August 2, 1988.
 - (n) Employee information and training ... April 4, 1988.
- c. Formaldehyde use in histology, pathology, and human or animal anatomy laboratories (including teaching laboratories) have the same effective dates as described above. All other laboratories had a delayed initial effective date of January 1, 1989, except for 1910.1048(c) – Permissible exposure limits – which was triggered February 2, 1988. All startup dates for other laboratories are triggered after the effective date; e.g., exposure determination is to be completed by 6 months after January 1, 1989.

Appendix D

Formaldehyde Standard Triggering Events

Part I. Airborne Levels

- A. Below AL and STEL But Above .1 ppm.
 - 1. Exposure Determination 1910.1048(d)(1)(i).
 - 2. Recordkeeping 1910.1048(o).
 - 3. Training (initial) 1910.1048(n)(1).
 - 4. Medical Surveillance for Signs and Symptoms 1910.1048(l)(1)(ii).

- B. Above AL or STEL.
 - 1. Initial Monitoring 1910.1048(d)(2).
 - 2. Periodic Monitoring 1910.1048(d)(3)(i).
 - a. At or Above AL ... Every 6 months 1910.1048(d)(3)(ii).
 - b. At or Above STEL ... Once a year 1910.1048(d)(3)(iii).
 - 3. Medical Surveillance 1910.1048(l)(1)(i).
 - 4. Training (annual) 1910.1048(n)(2).
 - 5. Applicable provisions in A. above.

- C. Above TWA or STEL.
 - 1. Regulated Areas 1910.1048(e)(1).
 - 2. Methods of Compliance 1910.1048(f).
 - 3. Respiratory Protection 1910.1048(g).
 - 4. Applicable provisions are in A., B. above.

- D. Greater than 100 ppm.
 - 1. Full Body protection 1910.1048(h)(1)(iv).
 - 2. Applicable provisions are in A., B., and C. above.

Part II. Eye or Skin Contact.

- A. Greater than or Equal to 1% Formaldehyde Solution.
 - 1. PPE 1910.1048(h).
 - 2. Hygiene protection 1910.1048(i).
 - a. Change Rooms 1910.1048(i)(1).
 - b. Quick Drench Shower 1910.1048(i)(2).

- B. Greater than or Equal to .1% Formaldehyde Solution.
 - 1. Eye Wash Facilities 1910.1048(i)(3).

2. PPE 1910.1048(h).

C. Irritating or Sensitizing Formaldehyde Materials.

1. PPE 1910.1048(h)(1)(ii).
2. Change Rooms 1910.1048(i).

Part III. Liquid or Gas.

A. Housekeeping.

1. Leak Detection 1910.1048(j)(1).
2. Preventative Maintenance 1910.1048(j)(1).
3. Spill Clean-up 1910.1048(j)(2).

Part IV. Possibility of Emergency.

- A. Emergencies 1910.1048(k).
- B. Respiratory Protection 1910.1048(g)(iv).
- C. Medical Surveillance 1910.1048(l)(5).
- D. Training 1910.1048(n)(3)(vii).

Appendix E

Considering SAEs for Exposure to Mixtures

Often an employee is simultaneously exposed to a variety of chemical substances in the workplace. Synergistic toxic effects on a target organ are common for such exposures in many construction and manufacturing processes. This type of exposure can also occur when impurities are present in single chemical operations.

New permissible exposure limits (PELs) for mixtures, such as the recent welding fume standard (5 mg/m³), address the complex problem of synergistic exposures and their health effects. In addition, OAR 437-002-0382 contains a computational approach to assess exposure to a mixture. This calculation should be used when the components in the mixture pose a synergistic threat to worker health.

Whether using a single PEL or the mixture calculation, the sampling and analytical error (SAE) of the individual constituents must be considered before arriving at a final compliance decision. SAEs that provide a 95% confidence limit have been developed and are listed on each Oregon OSHA Laboratory report (most current SAEs). If there is no SAE listed in the report for a specific substance, call the Oregon OSHA Lab. If using detector tubes or direct-reading instruments, use the SAEs provided by the manufacturer. These SAEs can be pooled and weighted to give a control limit for the synergistic mixture. To illustrate this control limit, the following example using the mixture calculation is shown:

The mixture calculation is expressed as:

$$E_m = C_1/L_1 + C_2/L_2 + \dots + (C_n/L_n) \quad (1)$$

Where:

E_m = equivalent exposure for the mixture (E_m should be ≤ 1 for compliance)

C = concentration of a particular substance

L = PEL

As an example, an exposure to three different but synergistic substances:

Actual Concentration of

<u>Material</u>	<u>8-hr Exposure (ppm)</u>	<u>8-hr TWA PEL (ppm)</u>	<u>SAE</u>
Substance 1	500	1000	0.089
Substance 2	80	200	0.11
Substance 3	70	200	0.18

Using equation (1) above:

$$E_m = 500/1000 + 80/200 + 70/200 = 1.25$$

Since $E_m > 1$, an overexposure appears to have occurred; however, the SAE for each substance also needs to be considered:

$$\text{Exposure ratio (for each substance)} \quad Y_n = C_n/L_n$$

$$\text{Ration to total exposure} \quad R_1 = Y_1/E_m, \dots R_n = Y_n/E_m$$

The SAEs (95% confidence) of the substances comprising the mixture can be pooled by:

$$RS_t = [R_1)^2 \times (SAE_1)^2 + (R_2)^2 \times (SAE_2)^2 + \dots (R_n)^2 \times (SAE_n)^2]^{1/2}$$

The mixture Control Limit (CL) is equivalent to: $1 + RS_t$

If $E_m < CL$ then an overexposure has not been established at the 95% confidence level; further sampling may be necessary.

If $E_m > 1$ and $E_m > CL$ then overexposure has occurred (95% confidence).

Using the mixture data above:

$$Y_1 = 500/1000, \quad Y_2 = 80/200, \quad Y_3 = 70/200$$

$$Y_1 = 0.5, \quad Y_2 = 0.4, \quad Y_3 = 0.35$$

$$R_1 = Y_1/E_m = 0.4, \quad R_2 = 0.32, \quad R_3 = 0.28$$

$$RS_{t2} = (0.4)^2(0.089)^2 + (0.32)^2(0.11)^2 + (0.28)^2(0.18)^2$$

$$RS_t = (RS_{t2})^{1/2} = 0.071$$

$$CL = 1 + RS_t = 1.071$$

$$E_m = 1.25$$

Therefore, $E_m > CL$ and an overexposure has occurred within 95% confidence limits.

This calculation is also used when considering a PEL such as the one for total welding fumes. An executable computer program, which will calculate a control limit for any synergistic mixture is available. The program will run on any IBM compatible personal computer. For questions contact Rick Cee or Mike Shulsky from the OSHA Salt Lake City Laboratory.