State of Alaska
Department of Labor
Division of Labor Standards and Safety

DOSH Program Directive 91-2

Date: January 15, 1991

To: All OSH Compliance Staff

From: Richard Arab, Deputy Director

Subject: Enforcement Procedures for Occupational Exposure to Formaldehyde

A. Purpose. This Program Directive (PD) provides uniform inspection procedures and guidelines to be followed when conducting inspections and issuing citations for workers potentially exposed to formaldehyde.

B. Directives Affected: None

C. Background. On June 19, 1988, Alaska OSH revised its standard for formaldehyde (04.0307, Subchapter 4). This reduced the 8-hour time weighted average (TWA) exposure limit for formaldehyde from 3 parts per million (ppm) to 1 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 The peak allowable exposure of 10 ppm was revoked and the 5 ppm ceiling was reduced to 2 ppm TWA measured over a 15 minute period (short-term exposure limit) (STEL).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 for 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 material safety data sheets (MSDS) required by the Hazard Communication Standard (HCS) (Subchapter 15).

1. On August 8, 1990, the State revised its formaldehyde standard to make a few corrections and editorial changes. This revision did not result in any substantial changes to the requirements set out in 04.0307.

D. Occupational Exposure to Formaldehyde.

1. Formaldehyde Uses. Formaldehyde is a reactive chemical with many uses.

a. The major consumers of formaldehyde are the manufacturers of compressed wood products. Formaldehyde is consumed in resins that are used as glue in the production of particleboard, plywood, and fiberboard. These wood products in turn are used in the construction, furniture, and mobile home manufacturing industries.

b. 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 t 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 form formaldehyde-based resins are lawn and garden equipment, plumbing fixtures, melamine tableware, and electrical insulation parts.

c. 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 dimethyloldihydroxyethyleneuraea (DMDHEU) - based resin system is most commonly used.

d. Formaldehyde-bearing resins are used in the coating industry primarily as modifiers in alkyd and acrylic coating systems. Unrea-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.

e. 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.

f. 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.

g. 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.

h. Formaldehyde is used in the production of industrial chemicals including pentaerythritol, 1, 4-butenediol, and trimethyl-o-propane.

i. 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.

2. Formaldehyde Exposure.

a. Formaldehyde exposure can occur in three ways:

(1) Exposure to liquid or solid formaldehyde (paraformaldehyde) and the accompanying vapors;

(2) Exposure to formaldehyde during primary processing of formaldehyde resins and other chemicals manufactured from formaldehyde; and

(3) Exposure to formaldehyde released from products that contain formaldehyde-based resins.

b. Occupational exposures to formaldehyde occur 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.

c. Occupational exposures to formaldehyde occur when a finished product contains residual formaldehyde or when hydrolysis--that is, the chemical break-down of formaldehyde-containing materials to produce 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) hexamethylenetetramine.

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

   a. Formaldehyde transfer operations,

   b. Reactor or vessel cleaning,

   c. Fugitive emissions in chemical plants,

   d. Exposure to articles that have been treated with formaldehyde-based resins before curing,

   e. Exposure to articles containing cured resins during transit from curing operations to storage or further processing,

   f. Exposure to stored articles containing cured resins, and

   g. 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).

H. Health Effects. Based on the best available evidence in the agency's record on formaldehyde, Alaska OSH determined that formaldehyde is genetoxic, showing properties of both a cancer initiator and promoter. When inhaled, formaldehyde is a carcinogen in rates. In humans, formaldehyde exposure has been associated with cancers of the lung, nasopharynx and oropharynx, and nasal passages.

1. 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 becomes 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.

2. 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.

3. 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.

4. 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.

I. Clarifications of the Formaldehyde Standard (04.0307, Subchapter 4).

1. Paragraph (a) Scope and Application.

a. 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.

b. The formaldehyde standard applies to all occupational exposures to formaldehyde. This includes general industry, and by cross-reference, maritime and construction. The only exceptions to this coverage occur where the Occupational Safety and Health Act does not give OSHA jurisdiction over employees. Examples include pesticide applicators who are covered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), public employees in States without OSHA-approved occupational safety and health State plans, and unincorporated businesses with no employees. The scope of the formaldehyde standard is not affected in most cases by the laboratory standard. The laboratory standard, 04.0308, 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 04.0308.

2. Paragraph (c) Permissible Exposure Limit. Where there are measurable concentrations of other regulated contaminants which affect the same body

systems as formaldehyde, citations should be issued per the Compliance Manual, Chapter IV, C.6.c. This manual cites 04.0101(d)(2) of the Air Contaminants standard for use in cases where there are potential additive and synergistic effects. The Air Contaminants standard, 04.0101(d)(2)(H), contains a formula which has the effect of proportionally reducing the PEL of each regulated toxic element of the multiple exposure. As an example, if a woodshop worker has an exposure to wood dust measured at 2.5 mg/m^3 TWA, which represents 50% of the PEL of 5 mg/m^3, then the PEL for formaldehyde (1 ppm TWA) would be reduced by 50%, resulting in a PEL for a concurrent formaldehyde exposure of 0.5 ppm. Paragraph 04.0307(d)(2)(A) requires employers to meet these adjusted PELs where there is an exposure to a mixture of air contaminants regulated by Subchapter 4. 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 F contains guidance for calculating the adjusted PELs and SAEs (sampling and analytical errors). The adjusted PEL should apply only to enforcement of paragraphs 04.0307(c)(C), Permissible Exposure Limit and 04.0307(f), Methods of compliance. The STEL and AL should not be adjusted for mixtures for compliance evaluations.

3. Paragraph (d), Exposure Monitoring. Paragraph (d) of the formaldehyde standard requires employers to determine their employees' exposure to formaldehyde 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. The CSHO should verify the employee exposure via bulk or air samples.

   a. Objective Data. The exposure determination must consist of actual measurements unless the employer can produce objective data 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.

b. Medical Complaints. Regardless of employees exposure level, if there are employee health complaints, the employer is required to take action to determine employee exposure.

c. Exception. If mixtures or 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 04.0307(d)(1)(B)(i).)

d. 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 shall 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.

e. 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 chose from many methods available for monitoring exposure to formaldehyde.

(1) Among the methods available are the chromotrophic 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.

(2) Appendix A to this PD summarizes information submitted to the formaldehyde docket on passive and direct reading devices for the measurement of formaldehyde. Limitations, where known, are also given.

4. Paragraph (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 CSHO should evaluate potential formaldehyde hazards and use professional judgment in enforcing the general requirements of 01.0401 and 01.0402 GSC which are incorporated into the formaldehyde standard by reference. Violations of these general requirements should be cited under 04.0307(h). Some PPE requirements are specified by the formaldehyde standard, and violations of these requirements should be cited under 04.0307(h)(1).

a. 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 repair and free of formaldehyde contamination.

b. Some solids that release formaldehyde and solutions that contain less than 1-percent formaldehyde can also pose a hazard to employees. Paragraph (h)(1)(B) requires the employer to provide protective clothing or equipment, as needed, in accordance with the general standards for protective equipment and clothing (01.0401 and 01.0402 GSC) to prevent contact with irritating or sensitizing materials.

c. 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.

d. Butyl and nitrile glove materials provide the greatest permeation protection. Greater thicknesses of other materials (natural rubber, PVC, polyethlyene) 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.

5. Paragraph (i), Hygiene Protection.

a. 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.

b. 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.

c. The degree of sophistication of the emergency shower and/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.) Appendix C of this PD contains specific (nonmandatory) evaluation criteria for emergency showers and eyewashes.

6. Paragraph (k), Emergencies. Paragraph (k) ensures that the employer will prepare for any situation where equipment failure, spill or rupture of containers, or failure of control equipment would result in an uncontrolled release of formaldehyde that could result in injury or loss of live. 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 (k) violations should be grouped with any applicable violations under Subchapter 10, Hazardous Waste Operations and Emergency Response Codes. The threshold quantity for formaldehyde for evaluation of catastrophic potential is 500 lbs.

a. 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.

b. 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.

7. Paragraph (1), Medical Surveillance.

a. The provisions of paragraph (1) establish an approach to medical surveillance based on an employee's exposure potential.

(1) 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 then be offered a physical examination and a pulmonary function test.

(2) 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 shoeing 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.

(3) 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.

b. Paragraph (1)(3)(B) requires the physician to make a determination, based on evaluation of the medical disease questionnaire, as to whether additional medical surveillance specified in paragraph (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 (1)(3)(B) must be provided to the employer in writing, and a copy given to the employee within 15 days of its receipt by the employer.

c. 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 (k). The emergency plan must also specify what information should be given to emergency care providers, per the requirements of paragraph (1)(6), and how it is to be transmitted.

8. Paragraph (m), Hazard Communication. Federal OSHA issued an administrative stay on the provisions of OSHA's Formaldehyde Standard set out in paragraphs 29 CFR 1910.1048 (m)(1)(i) through (m)(4)(i) until December 13, 1990. However, this stay does not affect Alaska's Formaldehyde Standard and therefore, CSHOs will enforce not only the provisions of Subchapter 15, Hazard Communication Code but the additional hazard communication requirements outline in subsection (m) of 04.0307 when employees are exposed to formaldehyde.

9. Paragraph (n), Employee Information and Training.

   a. All employees exposed to formaldehyde at concentrations at or above 0.1 ppm or to solutions contianing greater than 0.1 percent or more of formaldehyde must receive initial training upon hire.

   b. All employees exposed at or above the action level or the STEL must be trained annually.

   c. The administrativ estay onparagraph (m), Hazard Communication, does not affect the staatus of the trianing requirements under (n).

      (1) Training for formaldehyde must cover all aplicable requirements contained in paragraph (n)(3) of the new formaldehyde standard.

(2) Employees previously trained on formaldehyde's hazards under the Subchapter 15, Hazard Communication Code must be retrained in order to cover additional information contained in the new formaldehyde standard.

(3) Retraining and initial training for employees not previously covered by Subchapter 15, Hazard Communication Code must be provided as soon as possible once the employer has identified that they are exposed to formaldehyde. A reasonable amount of time should be given the employer to permit identification of affected employees and to obtain training materials. In no case should more than three months after completion of monitoring be permitted.

(4) The training provisions of paragraph (n) are to be cited rather than the Hazard Communication Code information and training requirements if the employee is covered by (n).

d. 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. In addition, the OSHA hazard recognition training program on formaldehyde may be of assistance to employers who need to train employees. The program includes information on the new standard but it is being revised to more fully reflect the changes.

10. Supplemental Information. Appendix D to this PD summarizes the formaldehyde standard triggering events.

E. Inspection Procedures. The following procedures shall be followed in addition to the guidance in the Compliance Manual, OTM, and IMIS Forms Manual.

1. Authorization to Review Limited Medical Information. Appropriately qualified compliance personnel are authorized to review medical disease questionnaires and medical opinions mandated by the fomaldehyde standard when the limitations and procedures in DOSH Program Directive 89-5 are followed.

a. Qualified compliance personnel are industrial hygienists or professionals with trainging in medical disciplines.

b. This authorization is pursuant to 8 AAC 61.270.

2. Recording in the IMIS. In addition to current instructions for completing the OSHA-1, as found in the IMIS Manual, the following shall be recorded in Item 42 for all inspections where employee exposure to formaldehyde is investigated for compliance with 04.0307 (Formaldehyde) and/or Subchapter 15 (HCS).

Type	ID	Value
N	16	Form