

**NIOSH**

CRITERIA FOR A  
RECOMMENDED STANDARD.....

OCCUPATIONAL  
EXPOSURE TO

VINYL ACETATE

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE  
Public Health Service  
Center for Disease Control  
National Institute for Occupational Safety and Health

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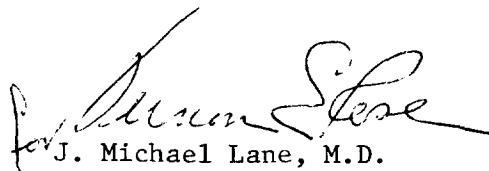
## PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and provide for the safety of workers occupationally exposed to an ever-increasing number of potential hazards. The National Institute for Occupational Safety and Health (NIOSH) evaluates all available research data and criteria and recommends standards for occupational exposure. The Secretary of Labor will weigh these recommendations along with other considerations, such as feasibility and means of implementation, in promulgating regulatory standards.

NIOSH will periodically review the recommended standards to ensure continuing protection of workers and will make successive reports as new research and epidemiologic studies are completed and as sampling and analytical methods are developed.

The contributions to this document on vinyl acetate by NIOSH staff, other Federal agencies or departments, the review consultants, the reviewers selected by the Society of the Plastics Industry, Inc., the American Academy of Occupational Medicine, the American Academy of Industrial Hygiene, and Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, are gratefully acknowledged.

The views and conclusions expressed in this document, together with the recommendations for a standard, are those of NIOSH. They are not necessarily those of the consultants, the reviewers selected by professional societies, or other Federal agencies. However, all comments, whether or not incorporated, have been sent with the criteria document to the Occupational Safety and Health Administration for consideration in setting the standard. The review consultants and the Federal agencies which received the document for review appear on pages v and vi.



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The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for the development of the criteria and recommended standard for vinyl acetate. Alfred N. Milbert, Ph.D., and Jerry LR Chandler, Ph.D., of this Division served as criteria managers. SRI International developed the basic information for consideration by NIOSH staff and consultants under contract CDC-99-74-31.

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## I. RECOMMENDATIONS FOR A VINYL ACETATE STANDARD

NIOSH recommends that employee exposure to vinyl acetate in the workplace be controlled by adherence to the following sections. The recommended standard is designed to protect the health and provide for the safety of employees for up to a 10-hour workshift, 40-hour workweek, over a working lifetime. Compliance with all sections of the standard should prevent adverse effects of vinyl acetate on the health of workers and provide for their safety. Sufficient technology exists to permit compliance with the recommended standard. Although NIOSH considers the workplace environmental limit to be a safe level based on current information, the employer should regard it as the upper boundary of exposure and make every effort to maintain exposures as low as possible. The standard will be subject to review and revision as necessary.

Vinyl acetate,  $\text{CH}_3\text{COOCH}=\text{CH}_2$ , is a liquid at room temperature and is easily vaporized. Synonyms for vinyl acetate include: acetic acid, vinyl ester; acetic acid, ethenyl ester; vinyl A monomer; ethenyl ethanoate; and Vy Ac. "Occupational exposure to vinyl acetate" is defined as exposure to airborne vinyl acetate at concentrations above one-half the recommended ceiling limit. Exposure to airborne vinyl acetate at concentrations at or below one-half the recommended ceiling limit will require adherence to the following Sections only: Sections 1(b), 2(a,c,d), 3, 4, 5, 6, 7, and 8(a,c).

The recommended standard is based on data indicating that vinyl acetate vapor at concentrations below 250 mg/cu m is a primary irritant to the upper respiratory tract and eyes, and that the liquid may irritate skin to the point of vesiculation. The irritations reported have all been reversible, and there are no known residual systemic effects.

### Section 1 - Environmental (Workplace Air)

#### (a) Concentrations

Exposure to vinyl acetate in the workplace shall be controlled so that employees are not exposed at concentrations greater than 15 milligrams per cubic meter of air, or 4 parts per million parts of air, measured as a ceiling concentration in samples collected during any 15-minute period.

#### (b) Sampling and Analysis

Workroom air samples shall be collected and analyzed as described in Appendix I, or by any other methods at least equivalent in accuracy, precision, and sensitivity.

## Section 2 - Medical

Medical surveillance shall be made available as outlined below to all employees subject to occupational exposure to vinyl acetate.

(a) Preplacement examinations shall include at least:

(1) Comprehensive medical and work histories, with special emphasis directed to evidence of any preexisting eye, respiratory, or skin disorders.

(2) Physical examination giving particular attention to the upper respiratory tract, eyes, and skin.

(3) A judgment of the employee's ability to use positive pressure air-supplied respirators.

(b) Periodic examinations shall be made available at least annually, except as otherwise determined by the responsible physician, and shall include:

(1) Interim medical and work histories.

(2) Physical examination as outlined in paragraph (a)(2) of this section.

(c) Applicants or employees found during examinations to have medical conditions that could be directly or indirectly aggravated by exposure to vinyl acetate, eg, chronic irritation of the respiratory tract, chronic inflammatory conditions of the skin, or chronic eye irritation, shall be counseled on the increased risk of impairment of their health from working with the compound.

(d) Pertinent medical records for all employees subject to exposure to vinyl acetate in the workplace shall be retained for at least 30 years after termination of employment. Records of environmental exposures applicable to an employee shall be included in that employee's medical records. These records shall be made available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employer, and of the employee or former employee.

## Section 3 - Labeling and Posting

All labels and warning signs shall be printed both in English and in the predominant language of non-English-reading workers. Employees unable to read the labels and signs provided shall receive information regarding hazardous

areas and shall be informed of the instructions printed on labels and signs.

(a) Labeling

Each container of vinyl acetate shall carry, in a readily visible location, a label which bears the trade name of the product, if appropriate, and information on its known effects on human health. The name and pertinent information shall be arranged as in the example below.

VINYL ACETATE  
(Trade Name)

DANGER! EXTREMELY FLAMMABLE  
MAY POLYMERIZE VIOLENTLY IF HEATED  
MAY CAUSE SKIN AND EYE IRRITATION

Keep away from heat, sparks, and open flame.  
Keep container closed when not in use.  
Use only with adequate ventilation.  
Avoid prolonged or repeated breathing of vapor.  
Avoid prolonged or repeated contact with skin.  
Ground metal containers when emptying or filling.

FIRST AID: In case of contact of liquid with eyes or skin, flush with copious amounts of water. Wash clothing before reuse.

SPILL OR LEAK: Contain the product within an area and flush with water spray. Vinyl acetate will float on water and create a fire hazard.

FIREFIGHTING: In case of fire, use foam, dry chemical, carbon dioxide, or water spray.

(b) Posting

(1) The following warning sign shall be posted in readily visible locations at or near all entrances to areas where vinyl acetate is manufactured, used, or stored.

VINYL ACETATE

DANGER! EXTREMELY FLAMMABLE  
MAY POLYMERIZE VIOLENTLY IF HEATED  
MAY CAUSE SKIN AND EYE IRRITATION

Keep away from heat, sparks, and open flame.  
Use only with adequate ventilation.  
Avoid prolonged or repeated breathing of vapor.

(2) If the use of respirators is permissible in accordance with Section 4 (c), the following statement shall be displayed in addition to the sign required in Section 3(b):

RESPIRATORY PROTECTION REQUIRED IN THIS AREA

Section 4 - Personal Protective Clothing and Equipment

Engineering controls shall be used when needed to keep concentrations of airborne vinyl acetate at or below the recommended ceiling limit and to minimize skin and eye contact. In addition, protective equipment and clothing shall be provided to employees when necessary.

(a) Eye Protection

Employers shall provide chemical safety goggles or face shields (8-inch minimum) with goggles and shall ensure that employees wear this protective equipment during any operation in which there is the likelihood of exposure to liquid vinyl acetate. Eye protective devices shall be selected, used, and maintained in accordance with 29 CFR 1910.133.

(b) Protective Clothing

Employees shall wear appropriate protective clothing, including gloves, aprons, suits, and boots, when needed, to prevent skin contact with liquid vinyl acetate.

(c) Respiratory Protection

(1) The use of respirators to achieve compliance with the recommended exposure limit is permitted only:

(A) During the time required to install or test the necessary engineering controls.

(B) During performance of nonroutine maintenance or repair activities, during work in confined spaces, or during emergencies when the concentration of airborne vinyl acetate may exceed the recommended environmental limit.

(2) When use of a respirator is permitted, it shall be selected and used in accordance with the following requirements:

(A) Employers shall establish and enforce respiratory protective programs meeting the requirements of 29 CFR 1910.134.

(B) Employers shall provide respirators in accordance with Table I-1 and shall ensure that employees use the respirators provided when necessary. The respiratory protective devices provided in conformance with Table I-1 shall be those approved by NIOSH and the Mine Safety and Health Administration as specified under 30 CFR 11.

(C) Respirators specified for use in higher concentrations of airborne vinyl acetate may be used in atmospheres of lower concentrations.

(D) Employers shall ensure that respirators are adequately cleaned and maintained and that employees are instructed and drilled at least annually in the proper use and testing for leakage of respirators assigned to them.

(E) Respirators shall be easily accessible, and employees shall be informed of their locations.

#### Section 5 - Informing Employees of Hazards from Vinyl Acetate

(a) All new and present employees working in areas where occupational exposure to vinyl acetate may reasonably be expected to occur shall be informed of the hazards of such employment, relevant symptoms of overexposure, appropriate emergency procedures, and conditions and precautions for the safe use and handling of vinyl acetate, including the information prescribed in paragraph (b) of this section. Employees shall be advised of the availability of this information.

(b) Employers shall institute a continuing education program, conducted by persons qualified by experience or training, to ensure that all employees have current knowledge of job hazards, proper maintenance, and cleanup methods. The instructional program shall include oral and written descriptions of the general nature of the environmental and medical surveillance procedures and of the advantages to the employee of participating in these surveillance procedures.

(c) Required information shall be recorded on the "Material Safety Data Sheet" shown in Appendix II or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

TABLE I-1

## RESPIRATOR SELECTION GUIDE FOR VINYL ACETATE

Concentration	Respirator Type Approved under Provisions of 30 CFR 11
Less than or equal to 140 mg/cu m	Type C supplied-air respirator with half-mask facepiece operated in pressure-demand mode
Less than or equal to 1,400 mg/cu m	(1) Gas mask with full facepiece and chin-type organic vapor canister (maximum service life, 2 hr) (2) Gas mask with full facepiece and chest- or back-mounted organic vapor canister (3) Type C supplied-air respirator with full facepiece operated in positive pressure mode (4) Self-contained breathing apparatus with full facepiece operated in positive pressure mode
Less than or equal to 14,000 mg/cu m	(1) Type C supplied-air respirator with half-mask or full facepiece operated in continuous-flow, pressure-demand, or other positive pressure mode (2) Type C supplied-air respirator with hood, helmet, or suit operated in continuous-flow mode
Greater than 14,000 mg/cu m	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode (2) Combination Type C supplied-air respirator with full facepiece operated in pressure-demand mode and with auxiliary self-contained air supply
Emergency (entry into area of unknown concentration)	Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode

## Section 6 - Work Practices

### (a) Engineering Controls

All electrical equipment shall meet the requirements of 29 CFR 1910 for hazardous locations. Ventilation systems, if used, shall be designed to prevent the accumulation or recirculation of vinyl acetate in the workplace environment and to effectively maintain safe levels of vinyl acetate in the breathing zones of employees. Exhaust ventilation systems discharging to outside air shall conform with applicable local, state, and Federal air pollution regulations and shall not constitute a hazard to employees or to the general population. Ventilation systems shall be regularly maintained and cleaned to ensure effectiveness, which shall be verified by at least annual airflow measurements. Results of such airflow measurements shall be recorded and such records kept for at least 1 year.

### (b) Confined Spaces

(1) Entry into confined spaces, such as tanks, pits, and process vessels, shall be controlled by a permit system. Permits shall be signed by an authorized employer representative and shall certify that preparation of the confined space, precautionary measures, and personal protective equipment are adequate and that precautions have been taken to ensure that prescribed procedures will be followed.

(2) Confined spaces that have contained vinyl acetate shall be cleaned with water, purged with air, thoroughly ventilated, inspected, and tested for oxygen deficiency and for the presence of vinyl acetate and any other known or suspected contaminants. Every effort shall be made to prevent inadvertent release of vinyl acetate into confined spaces in which work is in progress. Vinyl acetate supply lines shall be disconnected or blocked off before and while such work is in progress.

(3) If the concentration of vinyl acetate in the confined space exceeds the recommended environmental limit, respiratory protective equipment is required for entry.

(4) No employee shall enter any confined space that does not have an entryway large enough to admit an employee wearing safety harness, lifeline, and appropriate respiratory equipment as specified in Section 4(c).

(5) Confined spaces shall be ventilated while work is in progress to keep the concentration of vinyl acetate at or below the recommended limit, to keep the concentration of other contaminants below dangerous levels, and to prevent oxygen deficiency.



(6) Anyone entering a confined space shall be kept under observation from the outside by another properly trained and protected worker. An additional supplied-air or self-contained breathing apparatus with safety harness and lifeline shall be located outside the confined space for emergency use. The person entering the confined space shall maintain continuous communication with the standby worker.

(c) Emergency Procedures

Emergency plans and procedures shall be developed for all work areas where there is a potential for exposure to vinyl acetate. They shall include those specified below and any others considered appropriate for a specific operation or process. Employees shall be instructed in the effective implementation of these plans and procedures.

(1) Plans shall be developed for obtaining emergency medical care and for the transportation of injured workers. A sufficient number of employees shall be trained in first aid so that assistance is available immediately when necessary.

(2) Spills of vinyl acetate shall be cleaned up immediately. Spill areas shall be posted and secured. All sources of ignition shall be eliminated. Only authorized personnel, adequately protected and properly trained, shall be permitted to enter the area to shut off sources of vinyl acetate. If sufficient drainage to suitable collection basins is available, the spilled liquid can be hosed away with large quantities of water. A water spray can be used to knock down vapors. Because vinyl acetate floats on water, spills shall not be allowed to enter public sewers or drains in amounts that could result in explosion or fire hazards.

(3) The collected runoff shall be either recovered or destroyed by chemical degradation or burning, in accordance with applicable Federal, state, and local regulations. If a vacuum system is used to remove spilled vinyl acetate, there shall be no sources of ignition in the vicinity and appropriate flashback-prevention devices shall be provided and maintained in proper operating condition.

(d) Storage

Vinyl acetate shall be stored at temperatures less than 100 F (37.8 C) in well-ventilated areas and kept away from ignition sources such as heat and direct sunlight. No heating apparatus capable of exceeding 80% of the autoignition temperature of vinyl acetate (427 C) shall be used in vinyl acetate storage areas. The Federal standard for the storage and handling of flammable liquids is contained in 29 CFR 1910.106. The storage of vinyl

acetate in glass containers should be avoided. Vinyl acetate shall not be stored in the same areas as oxidizing agents or other incompatible chemicals. Containers of vinyl acetate shall be kept tightly closed when not in use and shall be stored so as to minimize accidental ruptures and spills.

(e) Handling and General Work Practices

(1) Before maintenance work is undertaken on equipment or systems, sources of vinyl acetate shall be disconnected and blocked off.

(2) Employees who experience skin contact with liquid vinyl acetate shall wash or shower to remove vinyl acetate from the skin. Contaminated clothing shall be removed and either cleaned before reuse or discarded. Uncleaned, contaminated clothing shall be stored in a container that is impervious to vinyl acetate. Personnel who clean contaminated clothing shall be informed of the hazards involved and be provided with guidelines on how to handle such clothing safely.

(3) Smoking and the carrying of matches, lighters, or other instruments of ignition shall be prohibited in all vinyl acetate work areas.

(4) Waste material contaminated with vinyl acetate shall be disposed of in ways that pose no hazard to employees. Disposal methods must conform with applicable local, state, and Federal regulations and must not constitute a hazard to the surrounding population or to the environment.

Section 7 - Sanitation

(a) The preparation, storage, dispensing (including vending machines), or consumption of food shall be prohibited in vinyl acetate work areas.

(b) Employees who handle vinyl acetate or equipment contaminated with vinyl acetate shall be instructed to wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

Section 8 - Monitoring and Recordkeeping Requirements

(a) Industrial Hygiene Surveys

Employers shall determine by industrial hygiene survey whether there is exposure to airborne vinyl acetate at concentrations greater than one-half the recommended ceiling limit. Records of these surveys, including the basis for any conclusion that concentrations of airborne vinyl acetate are at or below

one-half the recommended limit, shall be kept. Surveys shall be repeated at least annually and as soon as possible after any process change likely to result in increased concentrations of airborne vinyl acetate in the workplace. If it is determined that concentrations of airborne vinyl acetate are above one-half of the recommended ceiling limit, the following requirements shall apply:

(b) Personal Monitoring

(1) A program of personal monitoring shall be instituted to identify and measure, or permit calculation of, the exposure of each employee subject to exposure to vinyl acetate. Source and area monitoring may be used to supplement personal monitoring.

(2) In all personal monitoring, samples representative of the exposure to vinyl acetate in the breathing zone of the employee shall be collected. Procedures for sampling and analysis shall be in accordance with Section 1(b).

(3) For each determination of an occupational exposure concentration, a sufficient number of samples shall be collected to characterize employees' exposures during each workshift. Variations in work and production schedules and in employee locations and job functions shall be considered when deciding upon collection schedules.

(4) Each operation in each work area shall be sampled at least once every 6 months or as otherwise indicated by a professional industrial hygienist. If an employee is found to be exposed to vinyl acetate at concentrations above the recommended ceiling limit, control measures shall be initiated, the employee shall be notified of the exposure and of the control measures being implemented, and the exposure of the employee shall be measured at least once every week. Such monitoring shall continue until two consecutive determinations, at least 1 week apart, indicate that the employee's exposure is no longer in excess of the recommended limit. At that point, semiannual monitoring may be resumed. If such monitoring indicates that the employee's exposure no longer exceeds one-half of the recommended ceiling limit, personal monitoring may be discontinued.

(c) Recordkeeping

Records of environmental monitoring for each employee shall be retained for at least 30 years after the individual's employment has ended. These records shall include the name of the employee being monitored, duties performed and job locations within the worksite, dates and times of measurements, sampling and analytical methods used, number, duration, and

results of samples taken, concentrations of airborne vinyl acetate estimated from these samples, and the type of personal protection used, if any. Employees shall be able to obtain information on their own environmental exposures. These records shall be made available upon request to designated representatives of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, and of the employee or former employee.

## II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon that were prepared to meet the need for preventing impairment of health resulting from workplace exposure to vinyl acetate. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare under Section 20(a)(3) of the Occupational Safety and Health Act of 1970 to "...develop criteria dealing with toxic materials and harmful physical agents and substances which will describe exposure levels...at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

After reviewing data and consulting with others, NIOSH formalized a system for the development of criteria on which standards can be established to protect the health and to provide for the safety of employees exposed to hazardous chemical and physical agents. The criteria and recommended standard should enable management and labor to develop better engineering controls resulting in more healthful work environments. Simple compliance with the recommended standard should not be the final goal.

These criteria for a standard for vinyl acetate are part of a continuing series of criteria developed by NIOSH. The proposed standard applies to workplace exposure arising from the processing, manufacture, use, storage, and handling of vinyl acetate. The standard was not designed for the population-at-large, and any extrapolation beyond occupational exposures is not warranted. It is intended to (1) protect against impairment of health by vinyl acetate, (2) be measurable by techniques that are valid, reproducible, and available to industry and government agencies, and (3) be attainable with existing technology.

During the development of the recommended standard for occupational exposure to vinyl acetate, it became apparent that there are deficiencies in available information on (1) effects on humans and animals exposed to vinyl acetate at low levels for extended periods, (2) possible carcinogenic, mutagenic, teratogenic, or reproductive effects of vinyl acetate on animals and humans, (3) the utility of the electroencephalograph in estimating the toxic potential of vinyl acetate, and (4) sensitive analytical methods and direct-reading monitoring devices for airborne vinyl acetate.