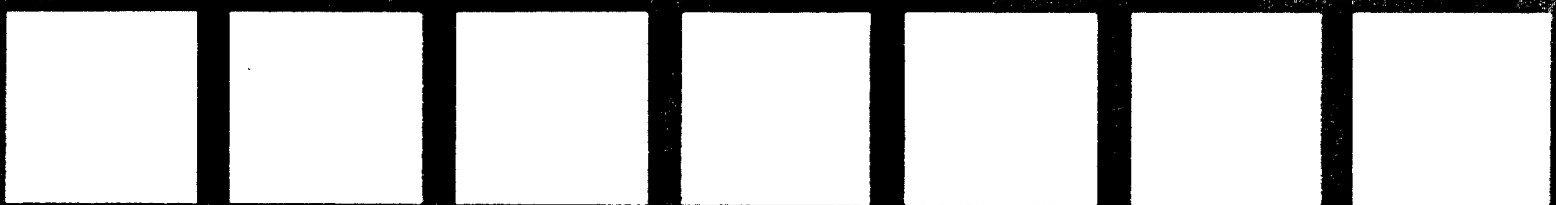


NIOSH

**criteria for a recommended standard
occupational exposure to**

CARBARYL



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service / Center for Disease Control

National Institute for Occupational Safety and Health

criteria for a recommended standard....

**OCCUPATIONAL EXPOSURE
TO
CARBARYL**



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SEPTEMBER 1976

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CRITERIA DOCUMENT
RECOMMENDATIONS FOR AN OCCUPATIONAL
EXPOSURE STANDARD FOR CARBARYL

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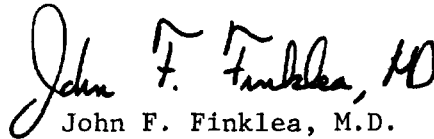
PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards at their workplace. The National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices, to provide relevant data from which valid criteria for effective standards can be derived. Recommended standards for occupational exposure, which are the result of this work, are based on the health effects of exposure. The Secretary of Labor will weigh these recommendations along with other considerations such as feasibility and means of implementation in developing regulatory standards.

It is intended to present successive reports as research and epidemiologic studies are completed and as sampling and analytical methods are developed. Criteria and standards will be reviewed periodically to ensure continuing protection of the worker.

I am pleased to acknowledge the contributions to this report on carbaryl by members of my staff and the valuable constructive comments by the Review Consultants on Carbaryl, by the ad hoc committees of the Society for Occupational and Environmental Health and the American Medical Association, and by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine. The NIOSH recommendations for standards are not

necessarily a consensus of all the consultants and professional societies that reviewed this criteria document on carbaryl. Lists of the NIOSH Review Committee members and of the Review Consultants appear on the following pages.

A handwritten signature in black ink that reads "John F. Finklea, MD". The signature is written in a cursive style with a large initial "J" and "F".

John F. Finklea, M.D.
Director, National Institute for
Occupational Safety and Health

The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standard for carbaryl. The Division review staff for this document consisted of Howard L. McMartin, M.D., and Keith H. Jacobson, Ph.D., with Clara H. Williams, Ph.D. (consultant).

Stanford Research Institute developed the basic information for consideration by NIOSH staff and consultants under contract No. CDC-99-74-31. Gamil Debbas, Ph.D. had NIOSH program responsibility and served as criteria manager.

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I. RECOMMENDATIONS FOR A CARBARYL STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to carbaryl in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of employees for up to a 10-hour work shift, 40-hour workweek, over a working lifetime. Compliance with all sections of the standard should therefore prevent adverse effects of carbaryl on the health and safety of employees. The recommended standard is measurable by techniques that are valid, reproducible, and available to industry and government agencies. Sufficient technology exists to permit compliance with the recommended standard. The criteria and standard will be subject to review and revision as necessary.

The criteria and the recommended standard apply to any manufacturing, formulating, or applying operation in which carbaryl is produced, packaged, processed, mixed, blended, handled, or used, or where employees are otherwise potentially exposed. "Carbaryl" is the generic name for the 1-naphthyl ester of N-methylcarbamic acid or 1-naphthyl N-methylcarbamate. "Action level" is defined as one-half the recommended time-weighted average (TWA) environmental exposure limit for carbaryl. "Occupational exposure to carbaryl" is defined as exposure to airborne carbaryl at concentrations greater than the action level. Exposure to carbaryl at concentrations less than or equal to the action level shall not require adherence to the recommended standard, except for Sections 3, 4(a,b), and 7(b). If employees are potentially exposed to other chemicals, such as pesticide vehicles, diluents, or emulsifiers or other pesticides, provisions of any

applicable standards for such chemicals shall also be followed.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Occupational exposure to carbaryl shall be controlled so that no employee is exposed to carbaryl at concentrations greater than 5 mg/cu m in air determined as a TWA concentration for up to a 10-hour work shift, 40-hour workweek.

(b) Sampling and Analysis

Procedures for sampling and analysis of environmental samples shall be as provided in Appendices I and II, or by any methods shown to be at least equivalent in accuracy, precision, and sensitivity to the methods specified.

Section 2 - Medical

Medical surveillance shall be made available as outlined below to workers subject to occupational exposure to carbaryl.

Physicians responsible for workers who may be occupationally exposed to carbaryl shall be familiar with the information contained in Appendix III which describes the suggested treatment of intoxication by this compound.

(a) Medical examinations shall include:

- (1) An initial or interim work history.
- (2) A comprehensive initial or interim medical history to include at least any history of frequent headaches, dizziness, tightness in

the chest, dimness of vision, and difficulty in focusing eyes.

(3) A physical examination which shall be directed toward at least the cardiorespiratory system, central nervous system (CNS), vision, and kidneys. A complete urinalysis including microscopic examination shall be performed.

(4) Those workers with a history of glaucoma, cardiovascular disease, hepatic disease, renal disease, central nervous system (CNS) abnormalities, and those using anticholinergic drugs shall be counseled about working in jobs involving exposure to carbaryl. Workers shall be advised that a review of the available scientific data warrants consideration of possible effects of carbaryl on the reproductive system. Initial information based on experimental animal studies indicates possible effects on the developing fetus, as well as on other reproductive processes in both men and women. Female workers shall be further informed that the status of present toxicologic information does not necessarily indicate the need for avoiding exposure to carbaryl during pregnancy but suggests that appropriate steps be taken to minimize exposure wherever possible. In addition, nursing mothers who may be exposed to carbaryl shall be informed of the possibility that the baby may ingest the compound from the maternal milk and shall be counseled to minimize exposure in the workplace.

(5) Initial medical examinations shall be made available to all workers within 60 days of the promulgation of a standard based on these recommendations.

(6) Periodic examinations shall be made available on a yearly basis or at some other interval determined by the responsible physician.

(7) At the time of the preplacement examination, it is recommended that a preexposure baseline erythrocyte cholinesterase activity be determined.

(8) A judgment of the worker's physical ability to use negative or positive pressure respirators.

(b) Emergency first-aid services shall be established, under the direction of the responsible physician, to provide care to any worker acutely intoxicated by carbaryl (See Appendix III).

(c) Appropriate medical services and surveillance shall be provided to any worker with adverse health effects from exposure to carbaryl.

(d) Pertinent medical records shall be maintained for all workers occupationally exposed to carbaryl for at least 5 years after termination of employment. These records shall be available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employee or former employee, and of the employer.

Section 3 - Labeling and Posting

(a) Labeling

Containers of carbaryl shall bear the following label in addition to, or in combination with, labels required by other statutes, regulations, or ordinances:

CARBARYL

CAUTION!

HARMFUL IF INHALED, SWALLOWED, OR LEFT ON THE SKIN
NO SMOKING

Avoid breathing dust or spray mist.
Avoid contact with eyes, skin, and clothing.
Wash hands and face thoroughly before eating.
Wear long-sleeved work clothes.
Shower or bathe and change into clean clothing after work.

First Aid: On skin contact with carbaryl, wash with soap and water. On eye contact, flush eyes with copious amounts of water. If inhaled or swallowed, consult a physician.

Note to Physician: Carbaryl is a moderate, reversible cholinesterase inhibitor. Atropine sulfate is the antidote. Do not use pralidoxime chloride (2-PAM).

(b) Posting

The following sign shall be posted in a readily visible location at or near entrances to manufacturing and formulating areas containing carbaryl, and at other areas in which there is a risk of exposure:

CARBARYL

CAUTION!

HARMFUL IF INHALED, SWALLOWED, OR LEFT ON THE SKIN
NO SMOKING

Avoid breathing dust or spray mist.
Avoid contact with eyes, skin, and clothing.
Wash hands and face thoroughly before eating.
Wear long-sleeved work clothes.
Shower or bathe and change into clean clothing after work.

First Aid: On skin contact with carbaryl, wash with soap and water. On eye contact, flush eyes with copious amounts of water. If inhaled or swallowed, consult a physician.

Warning signs shall be printed in English and in the predominant language of non-English-reading employees, if any, unless employers use equally effective means to ensure that non-English-reading employees know the hazards associated with carbaryl and the areas in which there is exposure to carbaryl. Employers shall ensure that illiterate employees also know these hazards and the locations of these areas.

Section 4 - Personal Protective Equipment and Clothing

(a) Protective Clothing

Any employee whose work involves likely exposure of the skin to carbaryl or carbaryl formulations, eg, mixing or formulating, shall wear full-body coveralls or the equivalent, impervious gloves, ie, highly resistant to the penetration of carbaryl, impervious footwear, and, when there is danger of carbaryl coming in contact with the eyes, goggles or a face shield. Any employee engaged in field application of carbaryl shall be provided with, and required to wear, the following protective clothing and equipment: goggles, full-body coveralls, impervious footwear, and a protective head covering. Employees working as flaggers in the aerial application of carbaryl shall be provided with, and required to wear, full-body coveralls or waterproof rainsuits, protective head coverings, impervious gloves and impervious footwear.

(b) Eye Protection

Safety goggles and face shields, when required, shall conform to 29 CFR 1910.133.

(c) Respiratory Protection

Engineering controls shall be used when necessary to maintain

airborne carbaryl concentrations below the recommended workplace environmental limit. Compliance with the workplace environmental limit by the use of respirators is allowed only when airborne carbaryl concentrations are in excess of the workplace environmental limit because required engineering controls are being installed or tested, when nonroutine maintenance or repair is being accomplished, or during emergencies. When a respirator is thus permitted, it shall be selected and used in accordance with the following requirements:

(1) To determine the type of respirator to be used, the employer shall measure, when possible, the workplace air concentration of carbaryl initially and thereafter whenever process, worksite, climate, or control changes occur that are likely to increase the carbaryl concentrations. This requirement does not apply when only air-supplied positive pressure respirators are used. The employer shall ensure that no employee is exposed to carbaryl in excess of the recommended TWA environmental limit because of improper respirator selection, fit, use, or maintenance.

(2) Any employee applying carbaryl by aircraft shall be provided with, and required to carry in the aircraft, a respirator as specified in Table I-1.

(3) Employees working as flaggers shall wear appropriate respirators as specified in Table I-1 when exposure to an airborne carbaryl concentration above that specified in Section 1 is likely to occur. Respirators may also be worn during the time necessary to install or test the required engineering controls, for nonroutine operations at concentrations in excess of the recommended TWA environmental limit

resulting from maintenance or repair activities, or during emergencies when air concentrations of carbaryl may exceed the recommended TWA environmental limit.

(4) The employer shall establish and enforce a respiratory protective program meeting the requirements of 29 CFR 1910.134.

(5) The employer shall provide and ensure employee use of respirators approved under the provisions of 30 CFR 11 and in accordance with Table I-1, except during all agricultural applications of carbaryl in which the dust- or spray-applicator nozzle is directed upward when a chin-style respirator equipped with a full-face gas mask pesticide filter and canister shall be provided regardless of the environmental carbaryl concentration.

(6) Respirators specified for use in higher concentrations of carbaryl may be used in atmospheres of lower concentrations.

(7) The employer shall ensure that respirators are clean and adequately maintained and that employees are instructed on the use of respirators assigned to them.

(8) Canisters shall be discarded and replaced with fresh canisters in accord with the manufacturer's recommendations or if the odor of the insecticide breaks through. Unused canisters shall be discarded and replaced when seals are broken, after 3 years if seals are unbroken, or as recommended by the manufacturer.

TABLE I-1

RESPIRATOR SELECTION GUIDE

Concentration	Respirator Type
50 mg/cu m or less	(1) Any supplied-air respirator* (2) Any self-contained breathing apparatus*
250 mg/cu m or less	(1) Any supplied-air respirator with a full facepiece, helmet, or hood (2) Any self-contained breathing apparatus with full facepiece
625 mg/cu m or less	Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode
Greater than 625 mg/cu m, or entry into and exit from unknown concentrations	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode (2) Combination respirator which includes Type C supplied-air respirator with full facepiece operated in pressure-demand mode and auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Firefighting	Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode
Emergency escape	(1) Any gas mask providing protection against organic vapors and particulates** (2) Any escape self-contained breathing apparatus

*If eye irritation occurs, a full facepiece respirator must be worn.

**Including pesticide respirators meeting the requirements of this class

Section 5 - Informing Employees of Hazards from Carbaryl

At the beginning of their employment in a carbaryl area, workers shall be informed of the hazards, relevant symptoms of overexposure, appropriate emergency procedures, and proper conditions and precautions for safety. The information shall be kept on file and shall be readily accessible to the worker at all places of employment where occupational exposure to carbaryl is likely.

Employers shall institute a continuing educational program to ensure that all workers have current knowledge of job hazards, proper maintenance procedures, and cleanup methods, and that they know how to use respiratory protective equipment and protective clothing correctly. Employees should be informed of the possible additive effects from taking anticholinesterase medication.

Information as required shall be recorded on the "Material Safety Data Sheet" shown in Appendix IV, or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

Section 6 - Work Practices

(a) Emergency Procedures

Emergency procedures shall be formulated in advance for all work areas where a reasonable potential for emergencies exists, and employees shall be instructed in their implementation.

(1) Procedures shall include prearranged plans for obtaining emergency medical care and for necessary transportation of injured workers.

(2) Approved eye, skin, and respiratory protection as

specified in Section 4 shall be used by personnel essential to emergency operations.

(3) Employees not essential to emergency operations shall be evacuated from exposure areas during emergencies. Perimeters of areas of hazardous exposures shall be delineated, posted, and secured.

(4) Personnel who have to shut off sources of carbaryl, clean up spills, and repair leaks shall be properly trained in such procedures and adequately protected against the attendant hazards.

(b) Engineering Controls

Engineering controls, such as process enclosure or local exhaust ventilation, shall be used when necessary to prevent airborne concentrations of carbaryl from exceeding the recommended TWA environmental limit. Ventilation systems shall be designed to prevent the accumulation or recirculation of carbaryl in the workplace and to remove carbaryl effectively from the breathing zones of exposed employees. Exhaust ventilation systems discharging to outside air must conform with applicable local, state, and federal air pollution regulations. Ventilation systems shall undergo regular preventive maintenance and cleaning to ensure maximum effectiveness, which shall be verified by periodic airflow measurements.

(c) Disposal

(1) Work areas, fixtures, equipment, etc, contaminated by carbaryl spills shall be cleaned promptly. Liquid carbaryl on floors shall be blotted with absorbing clay which, in turn, shall be removed with a sweeping compound. Dry forms of carbaryl shall be removed by vacuum cleaning, followed by thorough scrubbing of the exposed surfaces.

(2) Disposal of waste material shall conform to local, state, and federal regulations to prevent the exposure of humans and animals as well as the pollution of air and water.

(d) Agricultural Practice

(1) In work areas, including those related to agricultural application where dermal or eye contact with carbaryl may occur, the employer shall make readily available to the employees water, soap or detergent, towels, and extra personal protective equipment, including respirators and clothing as specified in Section 4.

(2) During agricultural use of carbaryl sprays or dusts, all individuals involved shall have available for use as necessary protective clothing (gloves, coveralls, head coverings, footwear) and shall use respiratory protective devices, safety goggles, and face shields as stated in Section 4.

Section 7 - Sanitation Practices

(a) Employees working in areas where carbaryl is manufactured, processed, handled, or stored shall wash their hands before eating, drinking, smoking, or using restroom facilities during the work shift.

(b) No food or beverages shall be stored, prepared, or consumed in areas where carbaryl is manufactured, processed, handled, or stored.

(c) Contaminated clothing shall be removed before entering areas where food or beverages are consumed.

(d) Smoking shall be prohibited in areas where carbaryl is manufactured, processed, handled, or stored in unsealed containers.

(e) Employees should shower or bathe and change clothing after the workday.

Section 8 - Monitoring and Recordkeeping Requirements

Workers are not considered to have occupational exposure to carbaryl if airborne concentrations, as determined by an industrial hygiene survey conducted within 6 months of the promulgation of this recommended standard, do not exceed half the recommended TWA environmental limit, ie, action level. Surveys shall be repeated at least once every year and within 30 days after any process change likely to increase the airborne concentration of carbaryl. Records of these surveys, including the basis for concluding that airborne concentrations of carbaryl are at or below the action level, shall be maintained. If the survey indicates that airborne concentrations of carbaryl exceed the action level, then the following requirements apply:

(a) Personal Monitoring

(1) A program of personal monitoring shall be instituted to identify and measure, or permit calculation of, the exposure of all employees who are occupationally exposed to carbaryl. Interim monitoring of employee exposure to airborne concentrations of carbaryl shall be conducted at least every 6 months. If monitoring shows an employee's exposure to be above the recommended TWA environmental limit, the exposure of that employee shall be measured at least once every 30 days, control measures shall be initiated, and the employee shall be notified of the exposure and the control measures being implemented to correct the situation. Such monitoring shall continue until two consecutive samplings, at least a week apart, indicate that employee exposure no longer exceeds

the recommended TWA environmental limit specified in Section 1(a). Semi-annual monitoring may then be resumed.

(2) In all personal monitoring, samples of airborne carbaryl shall be collected which, when analyzed, will provide an accurate representation of the concentration of carbaryl in the air which the worker breathes.

(3) For each TWA determination, a sufficient number of samples shall be taken to characterize each employee's exposure during each work shift. Variations in work and production schedules shall be considered in deciding when samples are to be collected. The number of representative TWA determinations for an operation or process shall be based on the variations in location and jobs of employees in relation to that operation or process.

(b) Recordkeeping Procedures

Records shall be maintained for 5 years and shall include sampling and analytical methods, types of respiratory protective devices used, and TWA concentrations found. All employees shall have access to data on their environmental exposures. These records shall be available to the designated representatives of the Secretary of Labor and of the Secretary of Health, Education, and Welfare. Pertinent records of required medical examinations shall be maintained for at least 5 years after the worker's employment has ended, and shall be available to the designated medical representatives of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, of the employer, and of the employee or former employee.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational diseases arising from exposure to carbaryl. 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."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultation with others, formalized a system for the development of criteria upon which standards can be established to protect the health of employees from exposure to hazardous chemical and physical agents. Criteria and this recommended standard should enable management and labor to develop better engineering controls resulting in more healthful work practices and should not be used as a final goal.

These criteria for a standard for carbaryl are part of a continuing series being developed by NIOSH. The proposed standard applies only to the processing, manufacture, or use of carbaryl, or other workplace exposure to carbaryl, as applicable under the Occupational Safety and Health Act of 1970. 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 development of systemic and local effects, (2) be measurable by techniques that are valid, reproducible, and available

to industry and government agencies, and (3) be attainable with existing technology.

Carbaryl is an organic compound used as an insecticide. The principal acute hazards from worker overexposure to carbaryl are the effects of inhibition of the enzyme acetylcholinesterase. This inhibition produces symptoms such as headache, nausea, vomiting, abdominal cramps, and dimness of vision. Effects of prolonged exposure, if any, are not well understood. Research is needed in the following areas: (1) air sampling and analysis for carbaryl; (2) further investigation to clarify possible mutagenic, carcinogenic, and teratogenic effects of carbaryl; and (3) effects of long-term exposure to carbaryl on neuromuscular, CNS, reproductive, and renal functions.