

Occupational Health Guideline for Carbaryl (Sevin (R))*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_{12}H_{11}NO_2$
- Synonyms: 1-Naphthyl N-methylcarbamate; alpha-naphthyl N-methylcarbamate
- Appearance: Colorless solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for carbaryl is 5 milligrams of carbaryl per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended a permissible exposure limit of 5 mg/m^3 averaged over a work shift of up to 10 hours per day, 40 hours per week. The NIOSH Criteria Document for Carbaryl should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Carbaryl can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

• Effects of overexposure

Exposure to carbaryl may cause small pupils, watering of the eyes, excessive discharge from the nose, mouth watering, sweating, abdominal cramps, nausea, vomiting, diarrhea, shaking, a blue color of the skin, and convulsions. Concentrated solutions on the skin may cause irritation and systemic intoxication. Carbaryl, when given to several species of pregnant animals, has caused defects in their offspring.

• Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to carbaryl.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to carbaryl at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory system, cardiovascular system, and central nervous system should be stressed. The skin should be examined for evidence of chronic disorders.

—Urinalysis: Carbaryl may cause kidney damage. A urinalysis should be performed to include, at a minimum, specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

—Medical warning: Employees should be informed of animal studies showing reproductive effects resulting from exposure to carbaryl. Exposure should be minimized during pregnancy.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

Carbaryl (Sevin) dust is a short-acting anticholinesterase agent, with the important characteristic of rapid reversibility of enzyme inhibition. It inactivates cholinesterase, resulting in the accumulation of acetylcholine at synapses in the nervous system, at neuromuscular junctions of the skeletal and smooth muscles, and secretory glands. Signs and symptoms of overexposure may include miosis, blurred vision, lacrimation, excessive nasal discharge or salivation, sweating, abdominal cramps, nausea, vomiting, diarrhea, tremor, cyanosis, and convulsions. The rapid reversibility of cholinesterase inhibition by carbamates such as carbaryl is of significance in monitoring exposure: measurements of

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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this enzyme are likely to give clinically misleading values in the normal range of activity and will not reflect the true magnitude of exposure; carbaryl is also rapidly metabolized, which further diminishes the severity of its effect. A single dose of 250 mg (approximately 2.8 mg/kg) ingested by an adult man resulted in moderate poisoning; after 20 minutes, there was sudden onset of abdominal pain followed by profuse sweating, lassitude, and vomiting; one hour after ingestion, and following a total of 3 mg atropine sulfate, the subject felt better and completely recovered after another hour. In a study of 59 workers exposed to concentrations ranging from 0.23 to 31 mg/m³ during a 19-month period, there were no signs or symptoms of anticholinesterase activity; in the most heavily exposed workers, relatively large amounts of 1-naphthol (a metabolite of carbaryl) were excreted in the urine, and the blood cholinesterase activity was slightly depressed. It was concluded that an excretion level of total (free plus conjugated) 1-naphthol significantly above 400 ug/100 ml of urine indicates absorption and metabolism of carbaryl. On the skin, concentrated solutions may cause irritation and systemic intoxication. Carbaryl administered orally during organogenesis was teratogenic in guinea pigs at a dose of 300 mg/kg and in beagle dogs at a dose of 25 mg/kg. The dog has been shown to metabolize carbaryl differently from other animal species, which may explain the anomalous teratogenicity. Of 60 male mongrel rats given 30 mg/kg orally twice weekly, 12 were alive after 22 months of treatment; 2 of the 12 had fibrosarcomata, 1 had a polymorphonuclear sarcoma, and 1 had an osteosarcoma with numerous metastases; of 48 rats receiving 20 mg in a paraffin pill implanted subcutaneously, 10 were alive after 22 months, and 2 of the 10 had fibrosarcomata; 46 of 48 control animals were alive in the eleventh month when a fibrosarcoma was discovered in 1 rat; although not stated, there were apparently no further deaths or tumors in control rats during the 22 months of the study.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 201.2
2. Boiling point (760 mm Hg): Decomposes
3. Specific gravity (water = 1): 1.23
4. Vapor density (air = 1 at boiling point of carbaryl): Not applicable
5. Melting point: 142 C (288 F)
6. Vapor pressure at 20 C (68 F): 0.005 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.004
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen, methylamine, and carbon monoxide) may be released in a fire involving carbaryl.

4. Special precautions: None

• Flammability

1. Flash point: Data not available
2. Minimum ignition temperature: Data not available
3. Minimum explosive concentration: Data not available
4. Extinguishant: Water

• Warning properties

1. Odor Threshold: The American National Standards Institute states that carbaryl is "essentially odorless."

2. Eye Irritation Level: Grant states that "splash contact of an insecticide liquid containing both carbaryl and dimethoate in one patient on two different occasions caused transient injury of the corneal epithelium and much swelling of the lids, but recovery was rapid and complete. This suggests that carbaryl is not particularly dangerous to the eye."

3. Evaluation of Warning Properties: No quantitative data are available relating warning properties to air concentrations of carbaryl. The concentration in saturated air at 20 C could present a significant exposure relative to the permissible exposure.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of carbaryl on a filter, followed by colorimetric analysis. An analytical method for carbaryl is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to

be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with carbaryl or liquids containing carbaryl.

- If employees' clothing may have become contaminated with carbaryl, employees should change into uncontaminated clothing before leaving the work premises.

- Non-impervious clothing which becomes contaminated with carbaryl should be removed promptly and not reworn until the carbaryl is removed from the clothing.

- Clothing contaminated with carbaryl should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of carbaryl from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the carbaryl, the person performing the operation should be informed of carbaryl's hazardous properties.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where carbaryl or liquids containing carbaryl may contact the eyes.

SANITATION

- Skin that becomes contaminated with carbaryl should be promptly washed or showered with soap or mild detergent and water to remove any carbaryl.

- Eating and smoking should not be permitted in areas where solid carbaryl is handled, processed, or stored.

- Employees, including those in agricultural operations, who handle carbaryl or liquids containing carbaryl should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to carbaryl may occur and control methods which may be effective in each case:

Operation

Use as a pesticide and acaricide for field crops, fruit, vegetables, ornamentals, livestock, poultry, pets, domestic dwellings, medical facilities, schools, commercial and industrial areas, urban and rural outdoor areas, and sewage treatment plants

Formulation and manufacture of carbaryl

Controls

Personal protective equipment

Process enclosure; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If carbaryl or liquids containing carbaryl get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If carbaryl or liquids containing carbaryl get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If carbaryl or liquids containing carbaryl penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. Get medical attention immediately.

• Breathing

If a person breathes in large amounts of carbaryl, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When carbaryl or liquids containing carbaryl have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and

know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

- If carbaryl is spilled, the following steps should be taken:

1. Ventilate area of spill.

2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

- Waste disposal methods:

Carbaryl may be disposed of:

1. By making packages of carbaryl in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

2. By dissolving carbaryl in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 12, 1976.

RESPIRATORY PROTECTION FOR CARBARYL (SEVIN (R))

Condition	Minimum Respiratory Protection* Required Above 5 mg/m ³
Particulate or Vapor Concentration	
50 mg/m ³ or less	Any supplied-air respirator.** Any self-contained breathing apparatus.**
250 mg/m ³ or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
625 mg/m ³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 625 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**If an employee informs his employer that he is experiencing eye irritation from carbaryl while wearing a half- or quarter-mask respirator, the employer should provide an equivalent respirator with a full facepiece, helmet, or hood.

