

Occupational Health Guideline for Camphor (Synthetic)

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: $C_{10}H_{16}O$
- Synonyms: 2-Camphanone; synthetic camphor; gum camphor; laurel camphor
- Appearance and odor: Colorless, glassy solid with a penetrating, characteristic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for camphor is 2 milligrams of camphor per cubic meter of air (mg/m^3) averaged over an eight-hour work shift (*Federal Register*, Vol. 43, No. 237, pp. 57601-03, 8 December 1978).

HEALTH HAZARD INFORMATION

• Routes of exposure

Camphor can affect the body if it is inhaled, comes in contact with the eyes, nose, throat, or skin, or is swallowed.

• Effects of overexposure

1. *Short-term Exposure:* Camphor may cause eye irritation, sore throat, nausea, vomiting, headache, and dizziness. It may also cause confusion, excitement, irrational behavior, and convulsions. A person may have a fever, bluish lips, pale face, and become unconscious. It may also affect the kidneys.

2. *Long-term Exposure:* Repeated overexposure to camphor may cause a loss of the sense of smell.

3. *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 camphor.

• Recommended medical surveillance

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

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from camphor exposure.

—Convulsive seizures: Camphor is a central nervous system stimulant. Those with pre-existing convulsive disorders may be at increased risk.

—Eye disease: Camphor is reported to be a mild eye irritant. Those with pre-existing eye disease may be at increased risk.

—Skin disease: Because camphor is a rubefacient, those with pre-existing skin disorders may be more susceptible to exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of camphor might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

—Kidney disease: Although camphor is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with possible impairment of renal function.

—Liver disease: Although camphor is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

Camphor is mainly a local irritant. Overexposure to camphor produces irritation of the eyes and nose, with risk of loss of sense of smell. Very large exposures affect

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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the central nervous system, resulting in nausea, vomiting, dizziness, agitation, and convulsions. Camphor may be either oxidized to carbonyl derivatives or conjugated with glucuronic acid. Most of the absorbed camphor and its metabolites are excreted by the kidneys. Complete recovery from overexposure is usually within 48 hours.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
 1. Molecular weight: 152
 2. Boiling point (760 mm Hg): 207.4 C (405 F)
 3. Specific gravity (water = 1): 1.00
 4. Vapor density (air = 1 at boiling point of camphor): 5.3
 5. Melting point: 180 C (356 F)
 6. Vapor pressure at 20 C (68 F): 0.18 mm Hg
 7. Solubility in water, g/100 g water at 20 C (68 F): 0.12
 8. Evaporation rate (butyl acetate = 1): Less than 1
- **Reactivity**
 1. Conditions contributing to instability: Heat
 2. Incompatibilities: Contact with oxidizing materials, especially chromic anhydride, may form explosive mixtures.
 3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving camphor.
 4. Special precautions: None
- **Flammability**
 1. Flash point: 66 C (150 F) (closed cup)
 2. Autoignition temperature: 466 C (871 F)
 3. Flammable limits in air, % by volume: Lower: 0.6; Upper: 3.5
 4. Extinguishant: Foam, dry chemical, carbon dioxide
- **Warning properties**
 1. Odor Threshold: The following odor thresholds have been reported for camphor: 16 ppm (Summer); 0.018 and 1.6 ppm (May). According to an unpublished report of the Pennsylvania Department of Health, at camphor concentrations ranging from 35 to 194 mg/m³, anosmia occurs in approximately one hour.
 2. Eye Irritation Level: Grant reports that "camphor may be expected to be somewhat irritating on contact with the eye, but no serious injuries have been reported from it. An instance of industrial exposure to camphor vapors resulted in several cases of superficial keratitis with temporary loss of corneal epithelium, but mixed with the camphor vapor were formaldehyde and acetic acid, which may have been responsible for the injuries." Sax also reports that camphor is a local irritant. No quantitative information is available, however.
 3. Other Information: According to the *Documentation of TLV's*, camphor causes nose irritation. The permissible exposure limit of 12 mg/m³ "is proposed to prevent irritation of the eyes and nose and anosmia."
 4. Evaluation of Warning Properties: Through its

odor camphor can be detected at concentrations near the permissible exposure limit. For the purposes of this guideline, camphor is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• Eight-Hour Exposure Evaluation

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).

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of camphor. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Method

Sampling and analyses may be performed by collection of camphor vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure camphor may be used. An analytical method for camphor is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

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 solid camphor or liquids containing camphor.
- If employees' clothing may have become contaminated with solid camphor, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with solid camphor or liquids containing camphor should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of camphor from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the camphor, the person performing the operation should be informed of camphor's hazardous properties.
- Non-impervious clothing which becomes contaminated with solid camphor or liquids containing camphor should be removed promptly and not reworn until the camphor is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where solid camphor or liquids containing camphor may contact the eyes.

SANITATION

- Skin that becomes contaminated with solid camphor or liquids containing camphor should be promptly washed or showered with soap or mild detergent and water to remove any camphor.
- Eating and smoking should not be permitted in areas where solid camphor or liquids containing camphor are handled, processed, or stored.
- Employees who handle solid camphor or liquids containing camphor 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 camphor may occur and control methods which may be effective in each case:

Operation	Controls
Use during mixing and blending of cellulose nitrate for photographic film	Local exhaust ventilation; personal protective equipment
Use during preparation and loading of explosives and devices	Natural ventilation; local exhaust ventilation; personal protective equipment
Use during mixing and liberation during packaging of cosmetics (perfume); during mixing and canning of embalming fluid	Local exhaust ventilation; personal protective equipment
Liberation during preparation and packing of pharmaceuticals	Local exhaust ventilation
Use during mixing and liberation during packaging of moth and insect repellants; during mixing of disinfectants	Local exhaust ventilation; personal protective equipment
Use as a catalyst or chemical intermediate in manufacturing of cumene and sulfuryl chloride	Local exhaust ventilation; personal protective equipment
Use in mixing and blending of certain lacquers and varnishes; during preparation and packaging of certain foods and tobacco	Local exhaust ventilation; personal protective equipment
Liberation during spray application of certain lacquers and varnishes	Process enclosure with local exhaust ventilation; personal protective equipment
Liberation during brush application of certain lacquers and varnishes; during embalming procedures	Local or general dilution ventilation

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 camphor dust or solution get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If camphor dust or solution gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If solid camphor or liquids containing camphor penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. When there is evidence of skin irritation, get medical attention as soon as possible.

• Breathing

If a person breathes in large amounts of camphor, 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 camphor has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• 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 camphor 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:

Camphor may be disposed of:

1. By making packages of camphor in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
2. By dissolving camphor 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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RESPIRATORY PROTECTION FOR CAMPHOR (SYNTHETIC)

Condition	Minimum Respiratory Protection* Required Above 2 mg/m ³
Vapor Concentration	
200 mg/m ³ or less	A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust and mist filter(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust and mist filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 200 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. Any escape self-contained breathing apparatus.

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

