

Occupational Health Guideline for Decaborane

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: $B_{10}H_{14}$
- Synonyms: None
- Appearance and odor: Colorless solid with a pungent odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for decaborane is 0.05 part of decaborane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 0.3 milligram of decaborane per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- Routes of exposure
Decaborane 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
 1. *Short-term Exposure:* The onset of symptoms from exposure to decaborane may be delayed until one or two days after exposure has occurred. Headache, nausea, lightheadedness, drowsiness, nervousness, lack of coordination, and tremors may occur. In more severe cases muscle spasms and convulsions may be produced. In animals impairment of liver and kidney function has occurred.
 2. *Long-term Exposure:* Prolonged exposure to low concentrations of decaborane may cause headache, fatigue,

drowsiness, inability to concentrate, and lack of coordination.

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 decaborane.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to decaborane 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. Persons with a history of convulsive disorders would be expected to be at increased risk from exposure. Examination of the nervous system, liver, and kidneys should be stressed.

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

- **Summary of toxicology**

Decaborane dust or vapor affects the nervous system and causes signs of both hyperexcitability and narcosis. Exposure of rabbits to 56 ppm for 6 hours was fatal; effects included dyspnea, coarse movements of the head, weakness, rigid hindquarters, absence of eye reflexes, and convulsive seizures. In dogs repeatedly given oral doses of 3 mg/kg, the effects on the central nervous system were not pronounced, but there was damage to the liver and kidneys. In humans the onset of symptoms is frequently delayed for 24 to 48 hours after exposure; dizziness, headache and nausea are common; other symptoms of mild intoxication include lightheadedness, drowsiness, incoordination, and fatigue; more severe intoxication results in tremor, localized muscle spasms and convulsive seizures. Muscle spasms usually subside after 24 hours, while light-headedness and fatigue may remain for up to 3 days. Effects on the

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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eyes or skin of humans have not been reported; mice exposed to 26 ppm for 4 hours exhibited corneal opacity. Decaborane may impair the sense of smell.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 122.3
2. Boiling point (760 mm Hg): 213 C (416 F) (extrapolated)
3. Specific gravity (water = 1): 0.94
4. Vapor density (air = 1 at boiling point of decaborane): 4.2
5. Melting point: 99.7 C (211.5 F)
6. Vapor pressure at 25 C (77 F): 0.05 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble; reacts slowly to form hydrogen gas
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: Heat above 170 C (338 F) causes decomposition and pressure.
2. Incompatibilities: Contact with oxidizers may cause fires and explosions. Mixtures of decaborane and halogenated compounds will explode when subject to shock. Contact with water causes slow formation of flammable hydrogen gas that may collect in enclosed areas.
3. Hazardous decomposition products: Toxic gases and vapors (such as boron oxide smoke) may be released in a fire involving decaborane.
4. Special precautions: Decaborane will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 80 C (176 F) (closed cup)
2. Autoignition temperature: 149 C (300 F)
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Carbon dioxide, dry chemical

• Warning properties

1. Odor Threshold: According to Browning, decaborane has "an intense, bitter chocolate-like odor." Baskin, however, states that "odor cannot be relied upon for detection."
2. Eye Irritation Level: The ILO states that decaborane produces "marked irritation of the skin and mucous membranes, causing necrotic changes, serious conjunctivitis with ulceration, and corneal opacification." Deichmann and Gerarde report that "vapor concentration (of boranes) below the levels harmful on inhalation are not irritating to the eyes." Information is not available concerning the threshold of eye irritation.
3. Evaluation of Warning Properties: No quantitative data are available relating warning properties to air concentrations of decaborane. For the purposes of this guideline, decaborane is treated as a material with poor warning properties.

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

At the time of publication of this guideline, no measurement method for decaborane had been published by NIOSH.

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 skin contact with liquid decaborane or liquids containing decaborane, where skin contact may occur.
- If employees' clothing may have become contaminated with decaborane, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with decaborane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of decaborane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the decaborane, the person performing the operation should be informed of decaborane's hazardous properties.

- Where exposure of an employee's body to decaborane or liquids containing decaborane may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with decaborane should be removed immediately and not reworn until the decaborane is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where decaborane or liquids containing decaborane may contact the eyes.

SANITATION

- Skin that becomes contaminated with decaborane should be immediately washed or showered with soap or mild detergent and water to remove any decaborane.
- Workers subject to skin contact with decaborane or liquids containing decaborane should wash with soap or mild detergent and water any areas of the body which may have contacted decaborane at the end of each work day.
- Eating and smoking should not be permitted in areas where decaborane or liquids containing decaborane are handled, processed, or stored.
- Employees who handle decaborane or liquids containing decaborane 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 decaborane may occur and control methods which may be effective in each case:

Operation	Controls
Use as a reducing agent in chemical synthesis; use as a component or additive for high-energy fuel and rocket propellants; use in manufacture of polymers; an olefin polymerization catalyst	Process enclosure; personal protective equipment
Use as a vulcanizing agent in the rubber industry in manufacture of synthetic rubber	Process enclosure; 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 decaborane or liquids containing decaborane 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. Contact lenses should not be worn when working with this chemical.

- **Skin Exposure**

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

- **Breathing**

If a person breathes in large amounts of decaborane, 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 decaborane or liquids containing decaborane 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 decaborane 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:**

Decaborane may be disposed of:

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

Condition	Minimum Respiratory Protection* Required Above 0.3 mg/m ³
Vapor or Particulate Concentration	
0.5 ppm (3 mg/m ³) or less	Any supplied-air respirator. Any self-contained breathing apparatus.
2.5 ppm (15 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.
20 ppm (120 mg/m ³) or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 20 ppm (120 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. Any escape self-contained breathing apparatus.

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

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of decaborane; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 20 ppm (120 mg/m³), an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

