Borane dimethyl sulfide complex

sc-252505

Material Safety Data Sheet

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

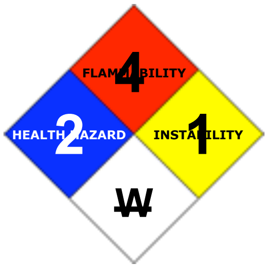
PRODUCT NAME

Borane dimethyl sulfide complex

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA



SUPPLIER

Company: Santa Cruz Biotechnology, Inc.

Address:

2145 Delaware Ave
Santa Cruz, CA 95060

Telephone: 800.457.3801 or 831.457.3800

Emergency Tel: **CHEMWATCH: From within the US and Canada: 877-715-9305**

Emergency Tel: **From outside the US and Canada: +800 2436 2255 (1-800-CHEMCALL) or call +613 9573 3112**

PRODUCT USE

Water-soluble borane reducing agent.

SYNONYMS

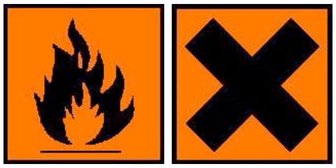
C2-H9-B-S, (CH3)2S.BH3, "methyl sulfide, compd. with borane (1:1)", "dimethylsulfide borane"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability:	4		
Toxicity:	2		
Body Contact:	2		
Reactivity:	1		
Chronic:	2		

Min/Nil=0
Low=1
Moderate=2
High=3
Extreme=4



CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

Contact with water liberates extremely flammable gases.
Irritating to eyes.
Extremely flammable.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ Accidental ingestion of the material may be damaging to the health of the individual.
■ Borate poisoning causes nausea, vomiting, diarrhea and pain in the upper abdomen. Often persistent vomiting occurs, and there may be blood in the feces. There may also be weakness, lethargy, headache, restlessness, tremors and convulsions. All borates cause similar effects; the lethal dose is over 30 grams. Poisoning initially stimulates the central nervous system before causing depression, as well as disturbing the digestive system, causing skin eruptions, and damage to the liver and kidneys. Borate is mostly eliminated from the body via the kidneys.

EYE

■ There is evidence that material may produce eye irritation in some persons and produce eye damage 24 hours or more after instillation. Severe inflammation may be expected with pain. There may be damage to the cornea. Unless treatment is prompt and adequate there may be permanent loss of vision. Conjunctivitis can occur following repeated exposure.

SKIN

■ The material is not thought to be a skin irritant (as classified using animal models). Temporary discomfort, however, may result from prolonged dermal exposures. Good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting.
■ Skin contact with the material may damage the health of the individual; systemic effects may result following absorption.
■ Open cuts, abraded or irritated skin should not be exposed to this material.
■ Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED

■ The material is not thought to produce respiratory irritation (as classified using animal models). Nevertheless inhalation of vapors, fumes or aerosols, especially for prolonged periods, may produce respiratory discomfort and occasionally, distress.
■ Inhalation of vapors or aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual.
■ Prolonged exposure may cause headache, nausea and ultimately loss ofconsciousness.
■ Inhalation toxicity of the inorganic boranes has been described extensively. Generally, central nervous system and respiratory effects are prominent. Accidental exposure of workers to pentaborane(9), has produced signs and symptoms consistent with central nervous system intoxication. Exposure to congeners of pentaborane is thought to produce similar effects. Tremors and convulsions have been reported following sufficiently large exposures to pentaborane(9). Lower concentrations have produced behavioural changes including loss of recent memory and may cause poor judgement to occur. Toxic signs in animals, in order of onset, were tremor, ataxia, convulsions and deaths, all deaths occurring within 24-hours of exposure. In dogs severe signs of toxicity were still observed at levels approximately one-half of the LC50 value though these were minimal; no signs were apparent at one-quarter LC50. A striking feature of animal experiments has been the high death rate whereas amongst exposed workers and even hospitalised workers, several have died or were left permanently disabled. Species differences appear to reside in metabolic differences in man and rodents. Symptoms of acute decaborane exposure include loss of coordination, convulsions, weakness, tremor, hyperexcitability, and narcosis. Toxic effects are also produced in the liver and kidney. Several of the CNS effects recorded in animals (incoordination, tremor and convulsive seizures) are seen in decaborane-exposed plant operators. Onset of symptoms may be delayed (24-48 hours) with mild exposures producing headache, dizziness and nausea; more severe exposures produce muscle spasm (which regresses within 24 hours). Dizziness and fatigue may persist for up to three days. Rabbits exposed to decaborane, for up to 6 hours at 56 ppm, died from effects that included convulsive seizures. Diborane produces toxic bronchopulmonary effects. Overexposure by humans, to diborane, produces a sensation of chest-tightness leading to diaphragmatic pain, shortness of breath, cough and occasionally, nausea. Nervous system intoxication may also occur. Respiratory distress in dogs and rabbits is followed by a slight fall in blood pressure, increased activity of the intestinal smooth muscle and an increase and subsequent diminution of cortical activity. These findings are consistent with anoxia (oxygen starvation). The primary effect of diborane poisoning is the production of pulmonary oedema which is the result of local irritation. This, in turn, is produced by an exothermic hydrolysis reaction which results in the diborane decomposing into other toxic species. Other inorganic boranes are expected to produce similar effects. Pneumonitis is often encountered in human poisoning gas by diborane. Bradycardia occurs late in the intoxication, followed by ventricular fibrillation or the disappearance of ventricular activity, and death.

CHRONIC HEALTH EFFECTS

■ Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.
Borate can accumulate in the testes and deplete germ cells and cause withering of the testicles, according to animal testing. Hair loss, skin inflammation, stomach ulcer and anemia can all occur. Repeated swallowing or inhalation irritates the stomach, causes a loss of appetite, disturbed digestion, nausea and vomiting, red rash, dry skin and mucous membranes, reddening of the tongue, cracking of the lips, inflamed conjunctiva, swelling of the eyelids and kidney injury. Prolonged ingestion causes effects to the reproductive system in both males and females.

Rats exposed to pentaborane(9) for 5 hours/day, 5 days/week for up to 4 weeks at 3 ppm (calculated) exhibited hyperexcitability, tremors, and decreased body weight. Repeated exposures at 1 ppm for 4 weeks produced loss of body weight, diminished activity and amongst rabbits, ataxia. At 0.2 ppm monkeys were apathetic, anorexic and appeared anaesthetised. There was progressive incoordination, hindlimb immobility and muscle tremor in both nonhuman primates and dogs. Repeated exposure to decaborane by various routes produces toxic effects intermediate between the more toxic pentaborane and less toxic diborane. All routes of entry produce significant disability with skin absorption in rats and rabbits producing central nervous system effects more prominent than those produced by single exposures. Recovery from these effects may take several days (against a few hours for diborane). Daily inhalation exposures of 5-6 hours, for up to 6 months at 4.5 ppm, were fatal to rabbits after only a few exposures, dog and monkey (4-15 exposures), mice (10-100 exposures) and rats (135+ exposures). Performance decrements, in various types of operant behaviors, is apparent in monkeys following injection of 3-6 mg/kg. Workers exposed to decaborane may be expected to exhibit decline in tasks requiring continuous motor behaviour or a series of discriminations. Chronic effects of diborane exposure include respiratory distress. Prolonged exposure to low concentrations cause headache, vertigo, chills and sometimes, fever. Daily 6-hour exposures at 7 ppm proved fatal in dogs (10-25 exposures) and rats (7-113 exposures). Although pulmonary changes could not be substantiated, the repeated respiratory insult was thought to be the underlying cause of death. Dogs developed signs of respiratory infection, probably secondary to respiratory irritation resulting from hydrolysis of the molecule.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
borane/ dimethylsulfide complex	13292-87-0	>98

Section 4 - FIRST AID MEASURES

SWALLOWED

■

- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- Observe the patient carefully.
- Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
- Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink.
- Seek medical advice.

EYE

■ If this product comes in contact with the eyes:

- Wash out immediately with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- If pain persists or recurs seek medical attention.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

■ If skin contact occurs:

- Immediately remove all contaminated clothing, including footwear
- Flush skin and hair with running water (and soap if available).
- Seek medical attention in event of irritation.

INHALED

■

- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital, or doctor.

NOTES TO PHYSICIAN

■ for pentaborane(9) intoxication:

Pentaborane(9) forms a nonvolatile hydrolysis intermediate in the bloodstream of rats with the evolution of molecular hydrogen. Histidine seems to stabilize the intermediate and its disappearance seems to be enzymatically mediated. Hyperglycemia, apparently caused by the action of this intermediate, may result in nervous tissue disability and thus produces the CNS response noted in experimental intoxication. Pentaborane resembles decaborane in producing CNS problems. The toxicity of decaborane may involve inhibition of pyridoxal phosphate-requiring enzymes (three decarboxylases and one transaminase) which produce noradrenaline (norepinephrine), dopamine and serotonin in rat brain and histamine in several rat tissues. This is thought to be mediated by the non-enzymatic formation of B10H13- anion from decaborane which reduces phosphate. Methylene blue, a stable oxidizing agent, infused into rabbits, continuously for two days, produced a vastly improved survival rate in animals injected with potentially lethal doses of decaborane. An impressive feature of methylene blue therapy was the prevention of brain and heart noradrenaline depletion following decaborane intoxication. Respiratory stimulants (atropine), depressants (pentabarbital) and adrenal stimulatory agents (cortisone), did not appear to be effective in experimental diborane poisonings. Methylene blue therapies have had some success.

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG):	Not available
Upper Explosive Limit (%):	Not available
Specific Gravity (water=1):	0.801
Lower Explosive Limit (%):	Not available

EXTINGUISHING MEDIA

■ DO NOT USE WATER, CO2 OR FOAM ON SUBSTANCE ITSELF

For SMALL FIRES:

- Dry chemical, soda ash or lime.

For LARGE FIRES:

- DRY sand, dry chemical, soda ash;
- OR withdraw and allow fire to burn itself out.

FIRE FIGHTING

■

- Alert Emergency Responders and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear full protective clothing plus breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Consider evacuation (or protect in place)
- DO NOT use water on fires.

CAUTION: If only water available, use flooding quantities of water or withdraw personnel.

- DO NOT allow water to enter containers.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with flooding quantities of water from a protected location until well after fire is out.
- If safe to do so, remove undamaged containers from path of fire.
- If fire gets out of control withdraw personnel and warn against entry.
- Equipment should be thoroughly decontaminated after use.
- Fight fire from a protected position or use unmanned hose holders or monitor nozzles.
- Withdraw immediately in case of rising sound from venting safety devices or discolouration of tanks.
- ALWAYS stay away from tank ends.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

■

- May ignite on contact with air, moist air or water.
- May react vigorously or explosively on contact with water.
- May decompose explosively when heated or involved in fire.
- May REIGNITE after fire is extinguished.
- Gases generated after contact with water or moist air may be poisonous, corrosive or irritating.
- Gases generated in fire may be poisonous, corrosive or irritating.
- Containers may explode on heating.
- Runoff may create multiple fire or explosion hazard.

Combustion products include: carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NOx), sulfur oxides (SOx), other pyrolysis products typical of burning organic material.

FIRE INCOMPATIBILITY

■ Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids,chlorine bleaches, pool chlorine etc. as ignition may result.

- Keep dry
- NOTE: May develop pressure in containers; open carefully. Vent periodically.

PERSONAL PROTECTION

Glasses:
Chemical goggles.
Gloves:
Respirator:
Type A Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

■

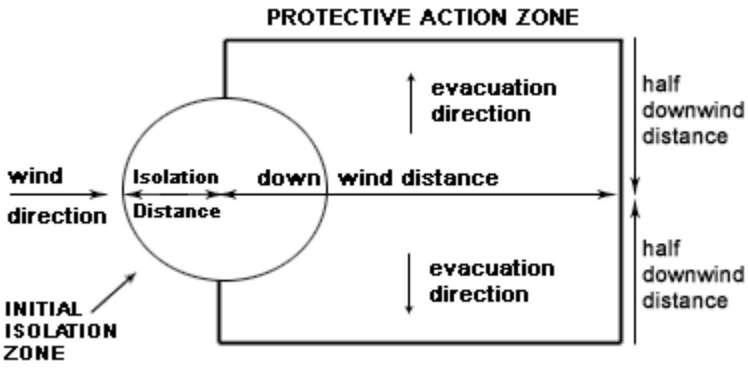
- Material from spill may be contaminated with water resulting in generation of gas which subsequently may pressure closed containers.
- Hold spill material in vented containers only and plan for prompt disposal.
- Eliminate all ignition sources.
- Cover with DRY earth, sand or other non-combustible material.
- Then cover with plastic sheet to minimize spreading and to prevent exposure to rain or other sources of water.
- Use clean, non-sparking tools to collect absorbed material and place into loosely-covered metal or plastic containers ready for disposal.
- Wear gloves and safety glasses as appropriate.

MAJOR SPILLS

■

- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.
- Wear full protective clothing and breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water courses.
- No smoking, naked lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.
- Absorb or cover spill with sand, earth, inert material or vermiculite and cover with white mineral oil.
- Collect recoverable product into labeled containers for recycling.
- Collect residues and seal in labeled drums for disposal.
- Wash spill area with detergent and water.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using.
- If contamination of drains or waterways occurs as a result of the above actions, advise emergency services.

PROTECTIVE ACTIONS FOR SPILL



From IERG (Canada/Australia)	
Isolation Distance	-
Downwind Protection Distance	-

From US Emergency Response Guide 2000 Guide No guide found.

FOOTNOTES

1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.

2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.

3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.

4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.

5 Guide No guide found. is taken from the US DOT emergency response guide book.

6 IERG information is derived from CANUTEC - Transport Canada.

ACUTE EXPOSURE GUIDELINE LEVELS (AEGL) (in ppm)

AEGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

■

- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of overexposure occurs.
- Use in a well-ventilated area.
- Avoid contact with moisture.
- Avoid smoking, naked lights or ignition sources.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately and before re-use
- Use good occupational work practice.
- Observe manufacturer's storing/handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
- Containers, even those that have been emptied, may contain explosive vapors.
- Do NOT cut, drill, grind, weld or perform similar operations on or near containers.

RECOMMENDED STORAGE METHODS

■ Glass container.

For low viscosity materials and solids: Drums and jerricans must be of the non-removable head type. Where a can is to be used as an inner package, the can must have a screwed enclosure. For materials with a viscosity of at least 2680 cSt. (23 deg. C):

- Removable head packaging and
- cans with friction closures may be used.

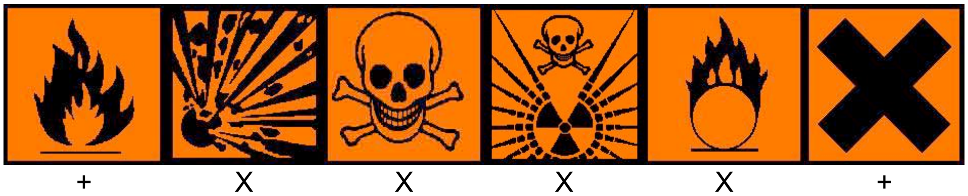
Where combination packages are used, there must be sufficient inert absorbent material to absorb completely any leakage that may occur, unless the outer packaging is a close fitting molded plastic box and the substances are not incompatible with the plastic. All combination packages for Packing group I and II must contain cushioning material.

STORAGE REQUIREMENTS

■ FOR TANKS:

- The tanks must be pressure vessels designed to an approved standard.
- The liquid inlet and outlet openings on the tanks must be provided with remote shut-off valves which close automatically in the event of fire.
- Precaution has been taken in the design and operation of the tanks to prevent the entry of moisture into the tanks.
- If two or more tanks are located in the same spill compound, the compound must be constructed so that any spillage is drained to a catchment are located at a sufficient distance from all tanks to ensure that the tanks will not be affected by a fire in the catchment area.
- The tanks and spill collection compounds should be at least 30 meters from tanks containing other dangerous goods where dangerous goods are stored or processed.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS



X: Must not be stored together
O: May be stored together with specific preventions
+: May be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³	Peak ppm	Peak mg/m³	TWA F/CC	Notes
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)	borane/ dimethylsulfide complex (BORON AND COMPOUNDS)		0.01						

MATERIAL DATA

BORANE/ DIMETHYLSULFIDE COMPLEX:

■ Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.

OSHA (USA) concluded that exposure to sensory irritants can:

- cause inflammation
- cause increased susceptibility to other irritants and infectious agents
- lead to permanent injury or dysfunction
- permit greater absorption of hazardous substances and
- acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

PERSONAL PROTECTION




Consult your EHS staff for recommendations

EYE

■

- Safety glasses with side shields.
- Chemical goggles.
- Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. DO NOT wear contact lenses.

HANDS/FEET

■ Wear chemical protective gloves, eg. PVC.

Wear safety footwear or safety gumboots, eg. Rubber.

Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).

- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
- Contaminated gloves should be replaced.

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

OTHER

■

- Overalls.
- Eyewash unit.
- Barrier cream.
- Skin cleansing cream.
- Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.
- For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets), non sparking safety footwear.

RESPIRATOR

■ Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Breathing Zone Level ppm (volume)	Maximum Protection Factor	Half-face Respirator	Full-Face Respirator
1000	10	A-1	-
1000	50	-	A-1
5000	50	Airline*	-
5000	100	-	A-2
10000	100	-	A-3
	100+		Airline* *

* - Continuous Flow ** - Continuous-flow or positive pressure demand.

The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required.

Use appropriate NIOSH-certified respirator based on informed professional judgement. In conditions where no reasonable estimate of exposure can be made, assume the exposure is in a concentration IDLH and use NIOSH-certified full face pressure demand SCBA with a minimum service life of 30 minutes, or a combination full facepiece pressure demand SAR with auxiliary self-contained air supply. Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

ENGINEERING CONTROLS

■ Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator. Correct fit is essential to obtain adequate protection an approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.
Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:	Air Speed:
solvent, vapors, degreasing etc., evaporating from tank (in still air).	0.25-0.5 m/s (50-100 f/min.)
aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation)	0.5-1 m/s (100-200 f/min.)
direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)	1-2.5 m/s (200-500 f/min.)
grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).	2.5-10 m/s (500-2000 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favorable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Liquid.

State	Liquid	Molecular Weight	75.97
Melting Range (°F)	Not available	Viscosity	Not Available
Boiling Range (°F)	Not available	Solubility in water (g/L)	Reacts
Flash Point (°F)	64.994	pH (1% solution)	Not available
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapour Pressure (mmHG)	Not available
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	0.801
Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	>1
Volatile Component (%vol)	Not available	Evaporation Rate	Not available

APPEARANCE

Colourless liquid with unpleasant smell; moisture sensitive.

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

■

- May heat spontaneously
- Identify and remove sources of ignition and heating.
- Incompatible material, especially oxidizers, and/or other sources of oxygen may produce unstable product(s).
- Avoid sources of water contamination (e.g. rain water, moisture, high humidity).
- Avoid contact with oxygenated solvents/ reagents such as alcohols.

STORAGE INCOMPATIBILITY

■

- Reacts with metals producing flammable / explosive hydrogen gas
- Reacts slowly with water.

- CAUTION contamination with moisture will liberate explosive hydrogen gas, causing pressure build up in sealed containers.

Segregate from alcohol, water.

- Avoid oxidizing agents, acids, acid chlorides, acid anhydrides.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

BORANE/ DIMETHYLSULFIDE COMPLEX

TOXICITY AND IRRITATION

■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY	IRRITATION
	Eye (rabbit): 100 mg - SEVERE

■ The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:
BORANE/ DIMETHYLSULFIDE COMPLEX:
■ For boron and borates:
Environmental fate:
Boron is generally found in nature bound to oxygen and is never found as the free element. Atmospheric boron may be in the form of particulate matter or aerosols as borides, boron oxides, borates, boranes, organoboron compounds, trihalide boron compounds, or borazines. Borates are relatively soluble in water, and will probably be removed from the atmosphere by precipitation and dry deposition. The half-life of airborne particles is usually on the order of days, depending on the size of the particle and atmospheric conditions.
Boron readily hydrolyses in water to form the electrically neutral, weak monobasic acid boric acid (H_3BO_3) and the monovalent ion, $B(OH)_4^-$. In concentrated solutions, boron may polymerise, leading to the formation of complex and diverse molecular arrangements. Because most environmentally relevant boron minerals are highly soluble in water, it is unlikely that mineral equilibria will control the fate of boron in water. Boron was found to not be significantly removed during the conventional treatment of waste water. Boron may, however, be co-precipitated with aluminum, silicon, or iron to form hydroxyborate compounds on the surfaces of minerals.
Waterborne boron may be adsorbed by soils and sediments. Adsorption-desorption reactions are expected to be the only significant mechanism that will influence the fate of boron in water. The extent of boron adsorption depends on the pH of the water and the chemical composition of the soil. The greatest adsorption is generally observed at pH 7.5-9.0. the single most important property of soil that will influence the mobility of boron is the abundance of amorphous aluminum oxide. The extent of boron adsorption has also been attributed to the levels of iron oxide, and to a lesser extent, the organic matter present in the soil, although other studies found that the amount of organic matter present was not important. The adsorption of boron may not be reversible in some soils. The lack of reversibility may be the result of solid-phase formation on mineral surfaces and/or the slow release of boron by diffusion from the interior of clay minerals.
It is unlikely that boron is bioconcentrated significantly by organisms from water. A bioconcentration factor (BCF) relates the concentration of a chemical in the tissues of aquatic and terrestrial animals or plants to the concentration of the chemical in water or soil. The BCFs of boron in marine and freshwater plants, fish, and invertebrates were estimated to be <100. Experimentally measured BCFs for fish have ranged from 52 to 198. These BCFs suggest that boron is not significantly bioconcentrated.
As an element, boron itself cannot be degraded in the environment; however, it may undergo various reactions that change the form of boron (e.g., precipitation, polymerization, and acid-base reactions) depending on conditions such as its concentration in water and pH. In nature, boron in generally found in its oxygenated form. In aqueous solution, boron is normally present as boric acid and borate ions, with the dominant form of inorganic boron in natural aqueous systems as undissociated boric acid. Boric acid acts as an electron acceptor in aqueous solution, accepting an hydroxide ion from water to form $(B(OH)_4)$-ion. In dilute solution, the favored form of boron is $B(OH)_4$. In more concentrated solutions (>0.1 M boric acid) and at neutral to alkaline pH (6– 11), polymeric species are formed (e.g., $B_3O_3(OH)_4^-$, $B_5O_6(OH)_4^-$, $B_3O_3(OH)_5^{2-}$, and $B_4O_5(OH)_4^{2-}$)
Most boron compounds are transformed to borates in soil due to the presence of moisture. Borates themselves are not further degraded in soil. However, borates can exist in a variety of forms in soil . Borates are removed from soils by water leaching and by assimilation by plants.
The most appreciable boron exposure to the general population is likely to be ingestion of food and to a lesser extent in water. As boron is a natural component of the environment, individuals will have some exposure from foods and drinking water
Boron-containing salts (borates) are ubiquitous in the environment. Surface soil, unpolluted waterways and seawater all typically contain significant amounts of boron as borate. Boron is an essential micronutrient for healthy growth of plants, however, it can be harmful to boron sensitive plants in higher quantities. In some areas such as the American Southwest, boron occurs naturally in surface waters in concentrations that have been shown to be toxic to commercially important plants.
Based on the collected information regarding aquatic toxicity, boron is not regarded as dangerous to aquatic organisms. The concentration in treated municipal waste water is a factor 100 lower than the NOEC-value for Daphnia magna.
No quality criteria exist for the concentration of boron in soil and compost. Boron is added to farmland when sewage sludge is applied as a soil improving agent, but there is not sufficient data to evaluate its effect on soil organisms. Being an essential micro-nutrient, no adverse effects of boron are expected at low concentrations.
Ecotoxicity:
In aquatic environments low concentrations of borates generally promote the growth of algae, whereas higher concentrations inhibited algal growth. In a growth inhibition test with Scenedesmus subspicatus, an EC50 value of 34 mg B/l was determined. Boric acid toxicity in Daphnia 48 h-LC50 (static test) was found to be 95 mg B/l. In a separate study it was concluded that chronic effects of boron to Daphnia may occur at a concentration of > 10 mg/l.
The toxicity of boron in fish is often higher in soft water than in hard water. The acute toxicity of boron towards Danio rerio (96 h-LC50) has been determined to 14.2 mg B/l . In a fish early life stage test with rainbow trout NOEC levels of boron have been determined in the range between 0.009 and 0.103 mg B/l, whereas the EC50 ranged from 27 to 100 mg B/l dependent on the water hardness.

■ DO NOT discharge into sewer or waterways.

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information
Ignitability characteristic: use EPA hazardous waste number D001 (waste code I)
Reactivity characteristic: use EPA hazardous waste number D003 (waste code R).

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.
¦ Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.
A Hierarchy of Controls seems to be common - the user should investigate:

- Reduction
- Reuse
- Recycling
- Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.
DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.
for small quantities: Cautiously make a 5% solution in water, venting because of the vigorous evolution of hydrogen gas. Acidify to pH 1 by adding 1M sulfuric acid dropwise. Acidification also produces vigorous evolution of hydrogen gas. Stand overnight and evaporate to dryness. Dispose of residue to land-fill (subject to local regulation).

- Recycle wherever possible.
- Consult manufacturer for recycling options or consult Waste Management Authority for disposal if no suitable treatment or disposal facility can be identified.
- Dispose of by: Burial in a licensed land-fill or Incineration in a licensed apparatus (after admixture with suitable combustible material)
- Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols:	G	Hazard class or Division:	4.3
Identification Numbers:	UN3399	PG:	I
Label Codes:	4.3, 3	Special provisions:	T13, TP2, TP7
Packaging: Exceptions:	None	Packaging: Non-bulk:	201
Packaging: Exceptions:	None	Quantity limitations: Passenger aircraft/rail:	Forbidden
Quantity Limitations: Cargo aircraft only:	1 L	Vessel stowage: Location:	D
Vessel stowage: Other:	40, 52		

Hazardous materials descriptions and proper shipping names:
Organometallic substance, liquid, water-reactive, flammable

Air Transport IATA:

ICAO/IATA Class:	4.3	ICAO/IATA Subrisk:	3
UN/ID Number:	3399	Packing Group:	I
Special provisions:	A3		
Cargo Only			
Packing Instructions:	409	Maximum Qty/Pack:	1 L
Passenger and Cargo		Passenger and Cargo	
Packing Instructions:	Forbidden	Maximum Qty/Pack:	Forbidden
Passenger and Cargo Limited Quantity		Passenger and Cargo Limited Quantity	

Packing Instructions:	-	Maximum Qty/Pack:	-

- Air transport may be forbidden if this material is flammable, corrosive or toxic gases may be released under normal conditions of transport.

Shipping Name: ORGANOMETALLIC SUBSTANCE, LIQUID, WATER-REACTIVE, FLAMMABLE *(CONTAINS BORANE/ DIMETHYLSULFIDE COMPLEX)

Maritime Transport IMDG:

IMDG Class:	4.3	IMDG Subrisk:	3
UN Number:	3399	Packing Group:	I
EMS Number:	F-G , S-N	Special provisions:	274
Limited Quantities:	0		

Shipping Name: ORGANOMETALLIC SUBSTANCE, LIQUID, WATER-REACTIVE, FLAMMABLE(contains borane/ dimethylsulfide complex)

Section 15 - REGULATORY INFORMATION

REGULATIONS

borane/ dimethylsulfide complex (CAS: 13292-87-0) is found on the following regulatory lists;
"Canada Non-Domestic Substances List (NDSL)","US DOE Temporary Emergency Exposure Limits (TEELs)","US Toxic Substances Control Act (TSCA) - Inventory"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

- Inhalation, skin contact and/or ingestion may produce health damage*.
- Cumulative effects may result following exposure*.

* (limited evidence).

Reasonable care has been taken in the preparation of this information, but the author makes no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. The author makes no representations and assumes no liability for any direct, incidental or consequential damages resulting from its use. For additional technical information please call our toxicology department on +800 CHEMCALL.

- Classification of the mixture and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.
A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

- The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

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