Boron trifluoride tetrahydrofuran complex

sc-252510

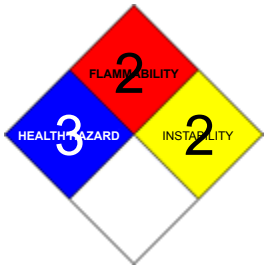
Material Safety Data Sheet

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
Boron trifluoride tetrahydrofuran complex

STATEMENT OF HAZARDOUS NATURE
CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA


SUPPLIER
Santa Cruz Biotechnology, Inc.
2145 Delaware Avenue
Santa Cruz, California 95060
800.457.3801 or 831.457.3800

EMERGENCY
ChemWatch
Within the US & Canada: 877-715-9305
Outside the US & Canada: +800 2436 2255
(1-800-CHEMCALL) or call +613 9573 3112

SYNONYMS
"BF3 · THF"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability	1		
Toxicity	3		
Body Contact	4		
Reactivity	2		
Chronic	2		

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

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

In use, may form flammable/explosive vapour-air mixture.
May form explosive peroxides.
Causes severe burns.
Risk of serious damage to eyes.
Toxic danger of serious damage to health by prolonged exposure through inhalation.
Toxic by inhalation and if swallowed.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ Toxic effects may result from the accidental ingestion of the material; animal experiments indicate that ingestion of less than 40 gram may be fatal or may produce serious damage to the health of the individual.
■ Ingestion of acidic corrosives may produce burns around and in the mouth, the throat and oesophagus. Immediate pain and difficulties in swallowing and speaking may also be evident. Swelling of the epiglottis may make it difficult to breathe which may result in suffocation. More severe exposure may result in vomiting blood and thick mucus, shock, abnormally low blood pressure, fluctuating pulse, shallow respiration and clammy skin, inflammation of stomach wall, and rupture of oesophageal tissue. Untreated shock may eventually result in kidney failure. Severe cases may result in perforation of the stomach and abdominal cavity with consequent infection, rigidity and fever. There may be severe narrowing of the oesophageal or pyloric sphincters; this may occur immediately or after a delay of weeks to years. There may be coma and convulsions, followed by death due to infection of the abdominal cavity, kidneys or lungs.
■ Not normally a hazard due to physical form of product.
■ Considered an unlikely route of entry in commercial/industrial environments.
■ Ingestion of tetrahydrofuran may not, in itself, produce internal injury, however, contaminating levels of furan, present in certain grades of commercial product, may produce liver and kidney injury exacerbated by the intake of alcoholic beverages.

EYE

■ The material can produce severe chemical burns to the eye following direct contact. Vapours or mists may be extremely irritating.
■ If applied to the eyes, this material causes severe eye damage.
■ Direct eye contact with acid corrosives may produce pain, tears, sensitivity to light and burns. Mild burns of the epithelia generally recover rapidly and completely. Severe burns produce long-lasting and possibly irreversible damage. The appearance of the burn may not be apparent for several weeks after the initial contact. The cornea may ultimately become deeply opaque resulting in blindness.
■ The application of a 20% aqueous solution of tetrahydrofuran to rabbit eyes produced irritation.

SKIN

■ The material can produce severe chemical burns following direct contactwith the skin.
■ The material may cause severe inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterised by redness, swelling and blistering.
■ Skin contact with the material may damage the health of the individual; systemic effects may result following absorption.
■ Skin contact with acidic corrosives may result in pain and burns; these may be deep with distinct edges and may heal slowly with the formation of scar tissue.
■ Fluorides are easily absorbed through the skin and cause death of soft tissue and erode bone. Healing is delayed and death of tissue may continue to spread beneath skin.
■ Open cuts, abraded or irritated skin should not be exposed to this material.
■ Contact of the skin with liquid hydrofluoric acid (hydrogen fluoride) may cause severe burns, erythema, and swelling, vesiculation, and serious crusting. With more serious burns, ulceration, blue-gray discoloration, and necrosis may occur. Solutions of hydrofluoric acid, as dilute as 2%, may cause severe skin burns.
■ 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.
■ Skin contact with tetrahydrofuran may produce smarting and reddening of the skin and after prolonged exposures; skin inflammation may result because the substance removes skin oils (has a degreasing effect).

INHALED

■ Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce toxic effects.
■ The material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage.
■ The severity of effects of boron trifluoride depend on concentration and duration of exposure. Inhalation causes irritation of the throat, coughing and laboured breathing. High concentrations can cause fatal lung disease.
■ Overexposure to tetrahydrofuran by inhalation may result in irritation of the mucous membrane, and may produce coughing, chest pains, nausea, dizziness, headache and stupor. High concentrations affect the central nervous system. Animal testing showed concentrations greater than 2.5% causing anaesthaesia. There is low blood pressure and deep, rapid breathing. Other symptoms include low muscle tone and the loss of corneal reflexes, followed by coma and death.

■ Corrosive acids can cause irritation of the respiratory tract, with coughing, choking and mucous membrane damage. There may be dizziness, headache, nausea and weakness. Swelling of the lungs can occur, either immediately or after a delay; symptoms of this include chest tightness, shortness of breath, frothy phlegm and cyanosis. Lack of oxygen can cause death hours after onset.
■ Material is highly volatile and may quickly form a concentrated atmosphere in confined or unventilated areas. Vapour is heavier than air and may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure.

CHRONIC HEALTH EFFECTS

■ Toxic danger of serious damage to health by prolonged exposure through inhalation.
Toxic danger of serious damage to health by prolonged exposure through inhalation.
This material can cause serious damage if one is exposed to it for long periods. It can be assumed that it contains a substance which can produce severe defects. This has been demonstrated via both short- and long-term experimentation.
There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment.
Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.
There is some evidence from animal testing that exposure to this material may result in toxic effects to the unborn baby.
Boron trifluoride fumes strongly in moist air or on skin contact to form corrosive acids which can affect the kidneys. The long term effects are unknown. Repeated overexposure may cause drying of nose linings, nosebleed, tooth discolouration, asthma and lung inflammation.
Chronic explosure to sulfur dioxide (SO_2) particle complexes in polluted air can aggravate chronic disease, such as asthma, chronic pulmonary disease, and coronary artery disease. It is not clear what is the concentration level required to cause these effects. Although sulfur dioxide does not cause cancer by itself, it might act as a promotor in tumour growth when there was simultaneous exposure to arsenic. Animal testing showed that simultaneous exposure to benz(a)pyrene and sulfur dioxide increases the rate of cancer development compared to exposure to only one of the above substances.
Repeated or prolonged exposure to acids may result in the erosion of teeth, swelling and/or ulceration of mouth lining. Irritation of airways to lung, with cough, and inflammation of lung tissue often occurs. Chronic exposure may inflame the skin or conjunctiva.
Repeated exposure to tetrahydrofuran (THF) and related compounds has been associated with liver inflammation and fatty degeneration of the liver. Animal testing suggests that this group of compounds can cause liver damage, irritation of the skin and airway, metabolic imbalance, gynaecological disturbance, damage to the adrenal glands and may increase the rate of cancer.
Cyclic ethers can cause cancers, especially of the liver.
Extended exposure to inorganic fluorides causes fluorosis, which includes signs of joint pain and stiffness, tooth discolouration, nausea and vomiting, loss of appetite, diarrhoea or constipation, weight loss, anaemia, weakness and general unwellness. There may also be frequent urination and thirst. Redness, itchiness and allergy-like inflammation of the skin and mouth cavity can occur. The central nervous system may be involved.
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 anaemia 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. Animal testing revealed prolonged ingestion causes effects to the reproductive system in both males and females.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
boron trifluoride-tetrahydrofuran complex	462-34-0	>98
as		
boron trifluoride	7637-07-2	
tetrahydrofuran	109-99-9	
peroxide formation suppressor as		
sulfur dioxide	7446-09-5	0.5

Section 4 - FIRST AID MEASURES

SWALLOWED

- For advice, contact a Poisons Information Centre or a doctor at once.
- Urgent hospital treatment is likely to be needed.
- 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.
- Transport to hospital or doctor without delay.

EYE

If this product comes in contact with the eyes

- Immediately hold eyelids apart and flush the eye continuously with 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.
- Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

If skin or hair contact occurs

- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.
- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre.
- Transport to hospital, or doctor.

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, without delay.
- Inhalation of vapours or aerosols (mists, fumes) may cause lung oedema.
- Corrosive substances may cause lung damage (e.g. lung oedema, fluid in the lungs).
- As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested.
- Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered.

This must definitely be left to a doctor or person authorised by him/her. (ICSC13719).

NOTES TO PHYSICIAN

■ Treat symptomatically.

For acute or short term repeated exposures to fluorides

- Fluoride absorption from gastro-intestinal tract may be retarded by calcium salts, milk or antacids.
- Fluoride particulates or fume may be absorbed through the respiratory tract with 20-30% deposited at alveolar level.
- Peak serum levels are reached 30 mins. post-exposure; 50% appears in the urine within 24 hours.
- For acute poisoning (endotracheal intubation if inadequate tidal volume), monitor breathing and evaluate/monitor blood pressure and pulse frequently since shock may supervene with little warning. Monitor ECG immediately; watch for arrhythmias and evidence of Q-T prolongation or T-wave changes. Maintain monitor. Treat shock vigorously with isotonic saline (in 5% glucose) to restore blood volume and enhance renal excretion.
- Where evidence of hypocalcaemic or normocalcaemic tetany exists, calcium gluconate (10 ml of a 10% solution) is injected to avoid tachycardia.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV)

Determinant	Index	Sampling Time	Comments
Fluorides in urine	3 mg/gm creatinine	Prior to shift	B, NS
	10mg/gm creatinine	End of shift	B, NS

B Background levels occur in specimens collected from subjects NOT exposed

NS Non-specific determinant; also observed after exposure to other exposures.

Following acute or short term repeated exposure to hydrofluoric acid

- Subcutaneous injections of Calcium Gluconate may be necessary around the burnt area. Continued application of Calcium Gluconate Gel or subcutaneous Calcium Gluconate should then continue for 3-4 days at a frequency of 4-6 times per day. If a "burning" sensation recurs, apply more frequently.
- Systemic effects of extensive hydrofluoric acid burns include renal damage, hypocalcaemia and consequent cardiac arrhythmias. Monitor haematological, respiratory, renal, cardiac and electrolyte status at least daily. Tests should include FBE, blood gases, chest X-ray, creatinine and electrolytes, urine output, Ca ions, Mg ions and phosphate ions. Continuous ECG monitoring may be required.
- Where serum calcium is low, or clinical, or ECG signs of hypocalcaemia develop, infusions of calcium gluconate, or if less serious, oral Sandocal, should be given. Hydrocortisone 500 mg in a four to six hourly infusion may help.
- Antibiotics should not be given as a routine, but only when indicated.
- Eye contact pain may be excruciating and 2-3 drops of 0.05% pentocaine hydrochloride may be instilled, followed by further irrigation

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV)

Determinant	Index	Sampling Time	Comments
1. Methaemoglobin in blood	1.5% of haemoglobin	During or end of shift	B, NS, SQ

B Background levels occur in specimens collected from subjects NOT exposed.

NS Non-specific determinant; Also seen after exposure to other materials

SQ Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG)	Not Applicable
Upper Explosive Limit (%)	Not Available
Specific Gravity (water=1)	1.268
Lower Explosive Limit (%)	Not Available

EXTINGUISHING MEDIA

- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.
- Water spray or fog - Large fires only.

FIRE FIGHTING

- Alert Fire Brigade and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Use fire fighting procedures suitable for surrounding area.
- Do not approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

When any large container (including road and rail tankers) is involved in a fire,
consider evacuation by 800 metres in all directions.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

WARNING In use may form flammable/ explosive vapour-air mixtures.

- Combustible.
- Slight fire hazard when exposed to heat or flame.
- Acids may react with metals to produce hydrogen, a highly flammable and explosive gas.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- May emit acrid smoke and corrosive fumes.

Combustion products include carbon monoxide (CO), carbon dioxide (CO_2), hydrogen fluoride, metal oxides, other pyrolysis products typical of burning organic material.
Contains low boiling substance Closed containers may rupture due to pressure buildup under fire conditions.
May emit corrosive fumes.
WARNING Long standing in contact with air and light may result in the formation
of potentially explosive peroxides.

FIRE INCOMPATIBILITY

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

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

- Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
- Check regularly for spills and leaks.
- Clean up all spills immediately.
- Avoid breathing vapours and contact with skin and eyes.
- Control personal contact by using protective equipment.
- Contain and absorb spill with sand, earth, inert material or vermiculite.
- Wipe up.
- Place in a suitable, labelled container for waste disposal.

MAJOR SPILLS

- Clear area of personnel and move upwind.
- Alert Fire Brigade and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Consider evacuation (or protect in place).
- Stop leak if safe to do so.
- Contain spill with sand, earth or vermiculite.
- Collect recoverable product into labelled containers for recycling.

- Neutralise/decontaminate residue (see Section 13 for specific agent).
- Collect solid residues and seal in labelled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using.
- If contamination of drains or waterways occurs, advise emergency services.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- May form explosive peroxides on standing or following concentration by distillation.
- Review of stocks and testing for peroxide content by given tested procedures at 3-monthly intervals is recommended, together with safe disposal of peroxidic samples.

[Peroxide-containing residues can often be rendered innocuous by pouring into an excess of sodium carbonate solution].
Contains low boiling substance
Storage in sealed containers may result in pressure buildup causing violent rupture of containers not rated appropriately.

- Check for bulging containers.
- Vent periodically
- Always release caps or seals slowly to ensure slow dissipation of vapours
- DO NOT allow clothing wet with material to stay in contact with skin

The substance accumulates peroxides which may become hazardous only if it evaporates or is distilled or otherwise treated to concentrate the peroxides. The substance may concentrate around the container opening for example.
Purchases of peroxidisable chemicals should be restricted to ensure that the chemical is used completely before it can become peroxidised.

- A responsible person should maintain an inventory of peroxidisable chemicals or annotate the general chemical inventory to indicate which chemicals are subject to peroxidation. An expiration date should be determined. The chemical should either be treated to remove peroxides or disposed of before this date.
- The person or laboratory receiving the chemical should record a receipt date on the bottle. The individual opening the container should add an opening date.
- Unopened containers received from the supplier should be safe to store for 18 months.
- Opened containers should not be stored for more than 12 months.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- WARNING To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
- 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. Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer's storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

RECOMMENDED STORAGE METHODS

- Lined metal can, lined metal pail/ can.
- Plastic pail.
- Polyliner drum.
- Packing as recommended by manufacturer.
- Check all containers are clearly labelled and free from leaks.

For low viscosity materials

- 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) and solids (between 15 C deg. and 40 deg C.)

- Removable head packaging;
- Cans with friction closures and
- low pressure tubes and cartridges

may be used.
-
Where combination packages are used, and the inner packages are of glass, porcelain or stoneware, there must be sufficient inert cushioning material in contact with inner and outer packages unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.

STORAGE REQUIREMENTS

- Outside or detached storage is preferred.

Rotate all stock to prevent ageing. Use on FIFO (First In-First Out) basis.

- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storing and handling recommendations.

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 NIOSH Recommended Exposure Limits (RELs)	boron trifluoride-tetrahydrofuran complex ()					1	3		
Canada - Alberta Occupational Exposure Limits	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	2.8		
US ACGIH Threshold Limit Values (TLV)	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1			TLV® Basis LRT irr; pneumonitis
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	2,8		
US OSHA Permissible Exposure Levels (PELs) - Table Z1	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3		
US - Minnesota Permissible Exposure Limits (PELs)	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3		
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)	(C)1	(C)3						
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3		
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3		
US - California Permissible Exposure Limits for Chemical	boron trifluoride-tetrahydrofuran complex (Boron	1	3			C			

Contaminants	trifluoride)							
US - Idaho - Limits for Air Contaminants	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3	
US - Hawaii Air Contaminant Limits	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3	
US - Alaska Limits for Air Contaminants	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3	
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1		
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)	1	3	-	-			
US - Washington Permissible exposure limits of air contaminants	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1		
US - Michigan Exposure Limits for Air Contaminants	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3	
Canada - Prince Edward Island Occupational Exposure Limits	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1		TLV® Basis LRT irr; pneumonitis
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3	
Canada - Nova Scotia Occupational Exposure Limits	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1		TLV Basis lower respiratory tract irritation; pneumonitis
US - Oregon Permissible Exposure Limits (Z-1)	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	3	
Canada - Northwest Territories Occupational Exposure Limits (English)	boron trifluoride-tetrahydrofuran complex (Boron trifluoride)					1	2.8	

Canada - British Columbia Occupational Exposure Limits	boron trifluoride-tetrahydrofuran complex (Fluorides (as F))		2.5				
US - Oregon Permissible Exposure Limits (Z-2)	boron trifluoride-tetrahydrofuran complex (Fluoride as dust (Z37.28-1969))		2.5				
US - Wyoming Toxic and Hazardous Substances Table Z-2 Acceptable ceiling concentration, Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift	boron trifluoride-tetrahydrofuran complex (Fluoride as dust (Z37.28-1969))		2.5				
US OSHA Permissible Exposure Levels (PELs) - Table Z2	boron trifluoride-tetrahydrofuran complex (Fluoride as dust (Z37.28–1969))		2.5				
Canada - Alberta Occupational Exposure Limits	tetrahydrofuran (Tetrahydrofuran)	50	147	100	295		
Canada - British Columbia Occupational Exposure Limits	tetrahydrofuran (Tetrahydrofuran Revised 2005)	50		100			Skin
US NIOSH Recommended Exposure Limits (RELs)	tetrahydrofuran ()	200	590	250	735		
US OSHA Permissible Exposure Levels (PELs) - Table Z1	tetrahydrofuran (Tetrahydrofuran)	200	590				
US ACGIH Threshold Limit Values (TLV)	tetrahydrofuran (Tetrahydrofuran)	50		100			TLV® Basis URT irr; CNS impair; kidney dam
US - Minnesota Permissible Exposure Limits (PELs)	tetrahydrofuran (Tetrahydrofuran)	200	590	250	735		
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	tetrahydrofuran (Tetrahydrofuran)	200	590				
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	tetrahydrofuran (Tetrahydrofuran)	200	590	250	735		

US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	tetrahydrofuran (Tetrahydrofuran)	200	590	250	735		
US - California Permissible Exposure Limits for Chemical Contaminants	tetrahydrofuran (Tetrahydrofuran)	200	590	250	735		
US - Idaho - Limits for Air Contaminants	tetrahydrofuran (Tetrahydrofuran)	200	590				
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	tetrahydrofuran (Tetrahydrofuran)	100	300				
US - Hawaii Air Contaminant Limits	tetrahydrofuran (Tetrahydrofuran)	200	590	250	735		
US - Alaska Limits for Air Contaminants	tetrahydrofuran (Tetrahydrofuran)	200	590	250	735		
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	tetrahydrofuran (Tetrahydrofuran)	50		100			Skin
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	tetrahydrofuran (Tetrahydrofuran)	200	590	250	700		
US - Washington Permissible exposure limits of air contaminants	tetrahydrofuran (Tetrahydrofuran)	200		250			
US - Michigan Exposure Limits for Air Contaminants	tetrahydrofuran (Tetrahydrofuran)	200	590	250	735		
Canada - Prince Edward Island Occupational Exposure Limits	tetrahydrofuran (Tetrahydrofuran)	50		100			TLV® Basis URT irr; CNS impair; kidney dam
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	tetrahydrofuran (Tetrahydrofuran)	200	590				
Canada - Nova Scotia Occupational Exposure Limits	tetrahydrofuran (Tetrahydrofuran)	50		100			TLV Basis upper respiratory tract irritation; central nervous system impairment; kidney damage

US - Oregon Permissible Exposure Limits (Z-1)	tetrahydrofuran (Tetrahydrofuran)	200	590				
Canada - Northwest Territories Occupational Exposure Limits (English)	tetrahydrofuran (Tetrahydrofuran)	200	590	250	735		
Canada - British Columbia Occupational Exposure Limits	sulfur dioxide (Sulfur dioxide)	2		5			
Canada - Ontario Occupational Exposure Limits	sulfur dioxide (Sulfur dioxide / Soufre, dioxyde de)	2	5.2	5	10.4		
US - Minnesota Permissible Exposure Limits (PELs)	sulfur dioxide (Sulfur dioxide)	2	5	5	13		
US ACGIH Threshold Limit Values (TLV)	sulfur dioxide (Sulfur dioxide)			0.25			TLV® Basis Pulm func; LRT irr
US NIOSH Recommended Exposure Limits (RELs)	sulfur dioxide ()	2	5	5	13		
Canada - Alberta Occupational Exposure Limits	sulfur dioxide (Sulphur dioxide)	2	5.2	5	13		
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)	sulfur dioxide (SULFUR DIOXIDE)	0.01					
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	sulfur dioxide (Sulfur dioxide)	2	5	5	10		
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	sulfur dioxide (Sulfur dioxide)	5	13				
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	sulfur dioxide (Sulfur dioxide)	2	5	5	10		
US - California Permissible Exposure Limits for Chemical Contaminants	sulfur dioxide (Sulfur dioxide)	2	5	5	10		
US - Idaho - Limits for Air Contaminants	sulfur dioxide (Sulfur dioxide)	5	13				
US OSHA Permissible Exposure Levels (PELs) - Table Z1	sulfur dioxide (Sulfur dioxide)	5	13				

Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	sulfur dioxide (Sulphur dioxide)	2		5		
US - Hawaii Air Contaminant Limits	sulfur dioxide (Sulfur dioxide)	2	5	5	10	
US - Alaska Limits for Air Contaminants	sulfur dioxide (Sulfur dioxide)	2	5	5	10	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	sulfur dioxide (Sulphur dioxide)	5	13	5	13	
Canada - Yukon Carcinogens with a Permitted Exposure	sulfur dioxide (Arsenic trioxide production - (SO)2)	C5				
US - Washington Permissible exposure limits of air contaminants	sulfur dioxide (Sulfur dioxide)	2		5		
US - Michigan Exposure Limits for Air Contaminants	sulfur dioxide (Sulfur dioxide)	2	5	5	10	
Canada - Prince Edward Island Occupational Exposure Limits	sulfur dioxide (Sulfur dioxide)			0.25		TLV® Basis Pulm func; LRT irr
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	sulfur dioxide (Sulfur dioxide)	5	13			
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	sulfur dioxide (Sulfur dioxide)	2	5.2	5	13	
US - Oregon Permissible Exposure Limits (Z-1)	sulfur dioxide (Sulfur dioxide)	5	13			
Canada - Northwest Territories Occupational Exposure Limits (English)	sulfur dioxide (Sulphur dioxide)	2	5	5	13	
Canada - Nova Scotia Occupational Exposure Limits	sulfur dioxide (Sulfur dioxide)			0.25		TLV Basis pulmonary function; lower respiratory tract irritation

PERSONAL PROTECTION




RESPIRATOR

- Type ABE-P Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 1432000 & 1492001, ANSI Z88 or national equivalent)

EYE

- Safety glasses with unperforated side shields may be used where continuous eye protection is desirable, as in laboratories; spectacles are not sufficient where complete eye protection is needed such as when handling bulk-quantities, where there is a danger of splashing, or if the material may be under pressure
- Chemical goggles.whenever there is a danger of the material coming in contact with the eyes; goggles must be properly fitted
- Full face shield (20 cm, 8 in minimum) may be required for supplementary but never for primary protection of eyes; these afford face protection.
- Alternatively a gas mask may replace splash goggles and face shields.
- Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59], [AS/NZS 1336 or national equivalent]

HANDS/FEET

- Elbow length PVC gloves
- When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.

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

- 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, AS/NZS 2161.1 or national equivalent).

- 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, AS/NZS 2161.10.1 or national equivalent) 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, AS/NZS 2161.10.1 or national equivalent) 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.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

ENGINEERING CONTROLS

■ Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.

The basic types of engineering controls are

Process controls which involve changing the way a job activity or process is done to reduce the risk.

Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use.

Employers may need to use multiple types of controls to prevent employee overexposure.

Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Correct fit is essential to obtain adequate protection. Supplied-air type respirator may be required in special circumstances. Correct fit is essential to ensure 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, vapours, 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 favourable 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

Corrosive.
Acid.
Toxic or noxious vapours/gas.

State	LIQUID	Molecular Weight	139.91
Melting Range (°F)	52- 55	Viscosity	Not Available
Boiling Range (°F)	356	Solubility in water (g/L)	Reacts
Flash Point (°F)	198	pH (1% solution)	Not Available
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not Applicable
Autoignition Temp (°F)	Not Available	Vapour Pressure (mmHG)	Not Applicable
Upper Explosive Limit (%)	Not Available	Specific Gravity (water=1)	1.268
Lower Explosive Limit (%)	Not Available	Relative Vapour Density (air=1)	Not Available
Volatile Component (%vol)	Not Available	Evaporation Rate	Not Available

Material	Value
TETRAHYDROFURAN	
log Kow (Prager 1995)	0.46
log Kow (Sangster 1997)	0.46
log Kow	0.32-0.46

APPEARANCE

Liquid; reacts with water.

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

¦ Presence of a stabilising inhibitor prevents/retards peroxide formation.

- Presence of elevated temperatures.
- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.

STORAGE INCOMPATIBILITY

■ Boron trifluoride

- reacts with moist air, water, steam, producing hydrogen fluoride, boric acid and fluoboric acid
- reacts violently with allyl chloride, alkyl nitrate, benzyl nitrate, calcium oxide, ethyl ether, iodine, magnesium tetrahydroaluminate, active metals (except magnesium)
- may explode on contact with monomers
- corrodes most metals in the presence of moisture
- In presence of moisture, the material is corrosive to aluminium, zinc and tin producing highly flammable hydrogen gas.
- Reacts vigorously with alkali metals
- Reacts with mild steel, galvanised steel / zinc producing hydrogen gas which may form an explosive mixture with air.

Salts of inorganic fluoride

- react with water forming acidic solutions.
- are violent reactive with boron, bromine pentafluoride,bromine trifluoride, calcium disilicide, calcium hydride, oxygen difluoride, platinum, potassium.
- in aqueous solutions are incompatible with sulfuric acid, alkalis, ammonia, aliphatic amines, alkanolamines, alkylene oxides, amides, epichlorohydrin, isocyanates, nitromethane, organic anhydrides, vinyl acetate.
- corrode metals in presence of moisture
- may be incompatible with glass and porcelain

For tetrahydrofuran (THF)

- Avoid contact with oxygen, air, light and heat
- Contact with lithium aluminium hydride or with sodium or potassium hydroxide can be hazardous when peroxides are present. THF may polymerise in the presence of cationic initiators such as Lewis acids or strong proton acids.
- Segregate from lithium aluminium hydride, sodium or potassium hydroxide, cationic initiators such as Lewis acids or strong proton acids.
- In the absence of inhibitors tetrahydrofuran is subject to auto-oxidation with the formation of 2-tetrahydrofuryl hydroperoxide . When heated this tends to decompose smoothly but if allowed to accumulate over a considerable period it transforms to other peroxidic species, such as unstable and explosive polyalkylidene peroxide, which violently decompose.
- Copper(I) chloride has been recommended to remove trace amounts of peroxide. An attempt to remove peroxides by shaking with solid ferrous sulfate, prior to distillation, did not prevent explosion of the distillation residue. Alkali treatment does not appear to be safe.
- Peroxides may be destroyed by passage through activated carbon at 20-66 C with contact time in excess of 2 min.
- is incompatible with borane, calcium hydride, lithium tetrahydroaluminate, sodium aluminium tetrahydride
- reacts violently with strong oxidisers, bromine, oxygen, magnesium tetrahydroaluminate, metal halides, peroxyacetic acid, potassium hydride
- attacks some plastics and coatings
- may accumulate static charges that can result in ignition of its vapours

Storage tanks and other equipment should be absolutely dry and free from air, ammonia, acetylene, hydrogen sulfide, rust and other contaminants.

- Avoid strong acids, bases.
- The unhindered oxygen atom found on cyclic ethers such as the epoxides, oxetanes, furans, dioxanes and pyrans, carries two unshared pairs of electrons - a structure which favors the formation of coordination complexes and the solvation of cations.
- Cyclic ethers are used as important solvents, as chemical intermediate and as monomers for ring-opening polymerization.
- They are unstable at room temperature due to possibility of peroxide formation; stabiliser is sometimes needed for storage and transportation.

NOTE Ethers lacking non-methyl hydrogen atoms adjacent to the ether link are thought to be relatively safe.

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

Section 11 - TOXICOLOGICAL INFORMATION

boron trifluoride-tetrahydrofuran complex

TOXICITY AND IRRITATION

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

■ Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of

highly irritating compound. Key criteria for the diagnosis of RADS include the absence of preceding respiratory disease, in a non-atopic individual, with abrupt onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. A reversible airflow pattern, on spirometry, with the presence of moderate to severe bronchial hyperreactivity on methacholine challenge testing and the lack of minimal lymphocytic inflammation, without eosinophilia, have also been included in the criteria for diagnosis of RADS. RADS (or asthma) following an irritating inhalation is an infrequent disorder with rates related to the concentration of and duration of exposure to the irritating substance. Industrial bronchitis, on the other hand, is a disorder that occurs as result of exposure due to high concentrations of irritating substance (often particulate in nature) and is completely reversible after exposure ceases. The disorder is characterised by dyspnea, cough and mucus production.
TETRAHYDROFURAN
BORON TRIFLUORIDE-TETRAHYDROFURAN COMPLEX
■ The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin. Repeated exposures may produce severe ulceration.
■ The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
BORON TRIFLUORIDE-TETRAHYDROFURAN COMPLEX

BORON TRIFLUORIDE

TOXICITY	IRRITATION
Inhalation (rat) LC50 1180 mg/m³/4h	Nil Reported
Inhalation (rat) LCLo 750 ppm/5.5 h	

TOXICITY	IRRITATION
TETRAHYDROFURAN	
Oral (rat) LD50 2816 mg/kg	
Inhalation (human) TCLo 25000 ppm	
Inhalation (rat) LC50 2100 ppm/3h	
Oral (human) LDLo 50 mg/kg* [CCINFO]*	Nil reported
SULFUR DIOXIDE	
Inhalation (rat) LC50 2520 ppm/1h	Nil Reported
Inhalation (human) LCLo 1000 ppm/10m	
Inhalation (human) TCLo 3 ppm/5d	

■ The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

400-500 ppm - immediately dangerous to life.

NOTE Aggravates chronic pulmonary disease and increases the risk of acute

and chronic respiratory disease - condition aggravated by smoking.

CARCINOGEN

Boron and Compounds (Oral Route)*	US EPA Carcinogens Listing	Carcinogenicity
Boron and Compounds (Oral Route)*	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category
boron trifluoride-tetrahydrofuran complex	US - Maine Chemicals of High Concern List	Carcinogen
boron trifluoride-tetrahydrofuran complex	US - Maine Chemicals of High Concern List	Carcinogen

boron trifluoride-tetrahydrofuran complex	Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens	Notes	Data are inadequate for an assessment of human carcinogenic potential
Fluorides (inorganic, used in drinking-water)	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3
Fluorides, as F	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	A4
boron trifluoride	US - Rhode Island Hazardous Substance List	IARC	
boron trifluoride	US - Maine Chemicals of High Concern List	Carcinogen	A4
boron trifluoride	Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens	Notes	TLV® Basis Bone dam; fluorosis ; BEI
boron trifluoride	Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens	Notes	TLV Basis bone damage; fluorosis. BEI
Tetrahydrofuran	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	A3
tetrahydrofuran	US - Rhode Island Hazardous Substance List	IARC	
tetrahydrofuran	US - Maine Chemicals of High Concern List	Carcinogen	A3
tetrahydrofuran	US - Maine Chemicals of High Concern List	Carcinogen	
tetrahydrofuran	Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens	Notes	TLV® Basis URT irr; CNS impair; kidney dam
tetrahydrofuran	Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens	Notes	TLV Basis upper respiratory tract irritation; central nervous system impairment; kidney damage
Sulfur dioxide	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3
Sulfur dioxide	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	A4
sulfur dioxide	US - Rhode Island Hazardous Substance List	IARC	
sulfur dioxide	US - Maine Chemicals of High Concern List	Carcinogen	A4
sulfur dioxide	Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens	Notes	TLV® Basis Pulm func; LRT irr
sulfur dioxide	Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens	Notes	TLV Basis pulmonary function; lower respiratory tract irritation

SKIN

tetrahydrofuran	US ACGIH Threshold Limit Values (TLV) - Skin	Skin Designation	Yes
tetrahydrofuran	US AIHA Workplace Environmental Exposure Levels (WEELs) - Skin	Notes	TLV® Basis URT irr; CNS impair; kidney dam
tetrahydrofuran	US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants - Skin	Skin Designation	Yes
tetrahydrofuran	Canada - British Columbia Occupational Exposure Limits - Skin	Notation	Skin
tetrahydrofuran	US - Minnesota Permissible Exposure Limits (PELs) - Skin	Skin Designation	Yes
tetrahydrofuran	US OSHA Permissible Exposure Levels (PELs) - Skin	Skin Designation	Yes
tetrahydrofuran	Canada - Alberta Occupational Exposure Limits - Skin	Substance Interaction	1

Section 12 - ECOLOGICAL INFORMATION

This material and its container must be disposed of as hazardous waste.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
boron trifluoride	No Data Available	No Data Available		
tetrahydrofuran	LOW	No Data Available	LOW	HIGH
sulfur dioxide	LOW	No Data Available	LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information
Corrosivity characteristic: use EPA hazardous waste number D002 (waste code C)
B. Component Waste Numbers
When tetrahydrofuran is present as a solid waste as a discarded commercial chemical product, off-specification species, as a container residue, or a spill residue, use EPA waste number U213 (waste code I).

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.

- Containers may still present a chemical hazard/ danger when empty.
- Return to supplier for reuse/ recycling if possible.

Otherwise:

- If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill.
- Where possible retain label warnings and MSDS and observe all notices pertaining to the product.

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 or process equipment to enter drains.
- It may be necessary to collect all wash water for treatment before disposal.
- In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.
- Where in doubt contact the responsible authority.
- Recycle wherever possible.
- Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable

treatment or disposal facility can be identified.

- Treat and neutralise at an approved treatment plant. Treatment should involve: Neutralisation with soda-ash or soda-lime followed by: burial in a land-fill specifically licenced to accept chemical and / or pharmaceutical wastes or Incineration in a licenced apparatus
- Decontaminate empty containers with 5% aqueous sodium hydroxide or soda ash, followed by water. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols:	None	Hazard class or Division:	8
Identification Numbers:	UN3265	PG:	II
Label Codes:	8	Special provisions:	B2, IB2, T11, TP2, TP27
Packaging: Exceptions:	154	Packaging: Non-bulk:	202
Packaging: Exceptions:	154	Quantity limitations: Passenger aircraft/rail:	1 L
Quantity Limitations: Cargo aircraft only:	30 L	Vessel stowage: Location:	B
Vessel stowage: Other:	40		

Hazardous materials descriptions and proper shipping names:
Corrosive liquid, acidic, organic, n.o.s.

Air Transport IATA:

ICAO/IATA Class:	8	ICAO/IATA Subrisk:	None
UN/ID Number:	3265	Packing Group:	II
Special provisions:	A3		
Cargo Only			
Packing Instructions:	855	Maximum Qty/Pack:	30 L
Passenger and Cargo		Passenger and Cargo	
Packing Instructions:	851	Maximum Qty/Pack:	1 L
Passenger and Cargo Limited Quantity		Passenger and Cargo Limited Quantity	
Packing Instructions:	Y840	Maximum Qty/Pack:	0.5 L

Shipping name:CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.(contains boron trifluoride-tetrahydrofuran complex)

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	None
UN Number:	3265	Packing Group:	II
EMS Number:	F-A,S-B	Special provisions:	274
Limited Quantities:	1 L		

Shipping name:CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.(contains boron trifluoride-tetrahydrofuran complex)

Section 15 - REGULATORY INFORMATION

boron trifluoride-tetrahydrofuran complex (CAS: 462-34-0) is found on the following regulatory lists;
"Canada Non-Domestic Substances List (NDSL)","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory"

Regulations for ingredients

boron trifluoride (CAS: 7637-07-2,13319-75-0) is found on the following regulatory lists;
"Canada - Alberta Occupational Exposure Limits","Canada - Northwest Territories Occupational Exposure Limits (English)","Canada - Nova Scotia Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits","Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)","Canada - Saskatchewan Industrial Hazardous Substances","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada Ingredient Disclosure List (SOR/88-64)","Canada National Pollutant Release Inventory (NPRI)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System -

WHMIS (English)","OECD List of High Production Volume (HPV) Chemicals","US - Alaska Limits for Air Contaminants","US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List","US - California Permissible Exposure Limits for Chemical Contaminants","US - Connecticut Hazardous Air Pollutants","US - Delaware Pollutant Discharge Requirements - Reportable Quantities","US - Hawaii Air Contaminant Limits","US - Idaho - Limits for Air Contaminants","US - Massachusetts Oil & Hazardous Material List","US - Michigan Exposure Limits for Air Contaminants","US - Minnesota Hazardous Substance List","US - Minnesota Permissible Exposure Limits (PELs)","US - New Jersey Right to Know Hazardous Substances (English)","US - North Dakota Air Pollutants - Guideline Concentrations","US - Oregon Hazardous Materials","US - Oregon Permissible Exposure Limits (Z-1)","US - Pennsylvania - Hazardous Substance List","US - Rhode Island Hazardous Substance List","US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Permissible exposure limits of air contaminants","US - Wisconsin Control of Hazardous Pollutants - Emission Thresholds, Standards and Control Requirements (Hazardous Air Contaminants)","US - Wyoming List of Highly Hazardous Chemicals, Toxics and Reactives","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US Department of Homeland Security Chemical Facility Anti-Terrorism Standards - Chemicals of Interest","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA Acute Exposure Guideline Levels (AEGLs) - Interim","US EPCRA Section 313 Chemical List","US List of Lists - Consolidated List of Chemicals Subject to EPCRA, CERCLA and Section 112(r) of the Clean Air Act","US NFPA 45 Fire Protection for Laboratories Using Chemicals - Flammability Characteristics of Common Compressed and Liquefied Gases","US NIOSH Recommended Exposure Limits (RELs)","US OSHA List of Highly Hazardous Chemicals, Toxics and Reactives","US OSHA Permissible Exposure Levels (PELs) - Table Z1","US SARA Section 302 Extremely Hazardous Substances","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory","USA: Chemical Facility Anti-Terrorism Standards - List Appendix A - 6CFR 27"

tetrahydrofuran (CAS: 109-99-9) is found on the following regulatory lists;

"Canada - Alberta Occupational Exposure Limits","Canada - British Columbia Occupational Exposure Limits","Canada - Northwest Territories Occupational Exposure Limits (English)","Canada - Nova Scotia Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens","Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)","Canada - Saskatchewan Industrial Hazardous Substances","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada CEPA Environmental Registry Substance Lists - List of substances on the DSL that meet the human health criteria for categorization (English)","Canada Ingredient Disclosure List (SOR/88-64)","Canada National Pollutant Release Inventory (NPRI)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","GESAMP/EHS Composite List - GESAMP Hazard Profiles","IMO IBC Code Chapter 17: Summary of minimum requirements","IMO MARPOL 73/78 (Annex II) - List of Noxious Liquid Substances Carried in Bulk","OECD List of High Production Volume (HPV) Chemicals","US - Alaska Limits for Air Contaminants","US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List","US - California Permissible Exposure Limits for Chemical Contaminants","US - Connecticut Hazardous Air Pollutants","US - Delaware Pollutant Discharge Requirements - Reportable Quantities","US - Hawaii Air Contaminant Limits","US - Idaho - Limits for Air Contaminants","US - Massachusetts Oil & Hazardous Material List","US - Michigan Exposure Limits for Air Contaminants","US - Minnesota Hazardous Substance List","US - Minnesota Permissible Exposure Limits (PELs)","US - New Jersey Right to Know Hazardous Substances (English)","US - North Dakota Air Pollutants - Guideline Concentrations","US - Oregon Permissible Exposure Limits (Z-1)","US - Pennsylvania - Hazardous Substance List","US - Rhode Island Hazardous Substance List","US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants","US - Vermont Hazardous wastes which are Discarded Commercial Chemical Products or Off-Specification Batches of Commercial Chemical Products or Spill Residues of Either","US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Discarded Chemical Products List - ""U"" Chemical Products","US - Washington Permissible exposure limits of air contaminants","US - Wisconsin Control of Hazardous Pollutants - Emission Thresholds, Standards and Control Requirements (Hazardous Air Contaminants)","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US ACGIH Threshold Limit Values (TLV) - Carcinogens","US CAA (Clean Air Act) - HON Rule - Organic HAPs (Hazardous Air Pollutants)","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA High Production Volume Program Chemical List","US EPA Master Testing List - Index I Chemicals Listed","US FDA Indirect Food Additives: Adhesives and Components of Coatings - Substances for Use Only as Components of Adhesives - Adhesives","US FDA List of ""Indirect"" Additives Used in Food Contact Substances","US List of Lists - Consolidated List of Chemicals Subject to EPCRA, CERCLA and Section 112(r) of the Clean Air Act","US NIOSH Recommended Exposure Limits (RELs)","US OSHA Permissible Exposure Levels (PELs) - Table Z1","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory","US TSCA Section 12(b) - List of Chemical Substances Subject to Export Notification Requirements","US TSCA Section 4 - Chemicals Subject to Testing Consent Orders","US TSCA Section 4/12 (b) - Sunset Date/Status","US TSCA Section 8 (a) - Preliminary Assessment Information Rules (PAIR) - Reporting List","US TSCA Section 8 (d) - Health and Safety Data Reporting"

sulfur dioxide (CAS: 7446-09-5) is found on the following regulatory lists;

"Canada - Alberta Ambient Air Quality Objectives","Canada - Alberta Occupational Exposure Limits","Canada - British Columbia Occupational Exposure Limits","Canada - Northwest Territories Occupational Exposure Limits (English)","Canada - Nova Scotia Occupational Exposure Limits","Canada - Ontario Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens","Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Carcinogens with a Permitted Exposure","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada Domestic Substances List (DSL)","Canada Environmental Protection Act (CEPA) 1999 - Schedule 1 Toxic Substances List","Canada Environmental Quality Guidelines (EQGs) Air","Canada Ingredient Disclosure List (SOR/88-64)","Canada National Pollutant Release Inventory (NPRI)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs","International Council of Chemical Associations (ICCA) - High Production Volume List","International Fragrance Association (IFRA) Survey: Transparency List","OECD List of High Production Volume (HPV) Chemicals","US - Alaska Limits for Air

Contaminants","US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List","US - California OEHHA/ARB - Acute Reference Exposure Levels and Target Organs (RELs)","US - California Permissible Exposure Limits for Chemical Contaminants","US - Delaware Pollutant Discharge Requirements - Reportable Quantities","US - Hawaii Air Contaminant Limits","US - Idaho - Limits for Air Contaminants","US - Massachusetts Oil & Hazardous Material List","US - Michigan Exposure Limits for Air Contaminants","US - Minnesota Hazardous Substance List","US - Minnesota Permissible Exposure Limits (PELs)","US - New Jersey Right to Know Hazardous Substances (English)","US - Oregon Hazardous Materials","US - Oregon Permissible Exposure Limits (Z-1)","US - Pennsylvania - Hazardous Substance List","US - Rhode Island Hazardous Substance List","US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Permissible exposure limits of air contaminants","US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values","US - Wyoming List of Highly Hazardous Chemicals, Toxics and Reactives","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US ACGIH Threshold Limit Values (TLV) - Carcinogens","US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)","US Clean Air Act (CAA) National Ambient Air Quality Standards (NAAQS)","US Department of Homeland Security Chemical Facility Anti-Terrorism Standards - Chemicals of Interest","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA Acute Exposure Guideline Levels (AEGLs) - Final","US EPA High Production Volume Chemicals Additional List","US FDA CFSAN GRAS Substances evaluated by the Select Committee on GRAS Substances (SCOGS)","US FDA Direct Food Substances Generally Recognized as Safe","US FDA Everything Added to Food in the United States (EAFUS)","US List of Lists - Consolidated List of Chemicals Subject to EPCRA, CERCLA and Section 112(r) of the Clean Air Act","US NFPA 45 Fire Protection for Laboratories Using Chemicals - Flammability Characteristics of Common Compressed and Liquefied Gases","US NIOSH Recommended Exposure Limits (RELs)","US OSHA List of Highly Hazardous Chemicals, Toxics and Reactives","US OSHA Permissible Exposure Levels (PELs) - Table Z1","US SARA Section 302 Extremely Hazardous Substances","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory","US USDA National Organic Program - Nonagricultural (nonorganic) substances allowed as ingredients in or on processed products labeled as “organic” or “made with organic (specified ingredients or food group(s))”","US USDA National Organic Program - Synthetic substances allowed for use in organic crop production","USA: Chemical Facility Anti-Terrorism Standards - List Appendix A - 6CFR 27"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Skin contact may produce health damage*.
■ Cumulative effects may result following exposure*.
■ Limited evidence of a carcinogenic effect*.
■ May be harmful to the foetus/embryo*.
* (limited evidence).

Denmark Advisory list for selfclassification of dangerous substances

Substance	CAS	Suggested codes
boron trifluoride- tetrahydrofuran complex	462- 34- 0	Xi; R38

Ingredients with multiple CAS Nos

Ingredient Name	CAS
boron trifluoride	7637-07-2, 13319-75-0

■ Classification of the preparation 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.

■ For detailed advice on Personal Protective Equipment, refer to the following U.S. Regulations and Standards:
OSHA Standards - 29 CFR:
1910.132 - Personal Protective Equipment - General requirements
1910.133 - Eye and face protection
1910.134 - Respiratory Protection
1910.136 - Occupational foot protection
1910.138 - Hand Protection
Eye and face protection - ANSI Z87.1
Foot protection - ANSI Z41
Respirators must be NIOSH approved.