Isobutyryl chloride

sc-252917

Material Safety Data Sheet

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
Isobutyryl chloride

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
C4-H7-Cl-O, (CH3)2CHCOCl, "isobutyryl chloride"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

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

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

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

Reacts violently with water.
Harmful if swallowed.
Very toxic by inhalation.
Causes severe burns.
Risk of serious damage to eyes.
HARMFUL - May cause lung damage if swallowed.
Highly flammable.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ The material can produce severe chemical burns within the oral cavity and gastrointestinal tract following ingestion.
■ Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 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 esophagus.
■ Swallowing of the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis; serious consequences may result. (ICSC13733).

EYE

■ The material can produce severe chemical burns to the eye following direct contact. Vapors 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.
■ Irritation of the eyes may produce a heavy secretion of tears (lachrymation).

SKIN

■ The material can produce severe chemical burns following direct contactwith the skin.
■ 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.
■ 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

■ Inhalation of vapors or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce severely toxic effects; these may be fatal.
■ The material can cause respiratory irritation in some persons.
The body's response to such irritation can cause further lung damage.
■ Corrosive acids can cause irritation of the respiratory tract, with coughing, choking and mucous membrane damage.
There may be dizziness, headache, nausea and weakness.
■ Effects of phosgene exposure may be delayed.
Rapid olfactory fatigue occurs.
■ Inhalation of quantities of liquid mist may be extremely hazardous, even lethal due to spasm, extreme irritation of larynx and bronchi, chemical pneumonitis and pulmonary edema.
■ Hydrogen chloride (HCl) vapour or fumes present a hazard from a single acute exposure.
Exposures of 1300 to 2000 ppm have been lethal to humans in a few minutes.

CHRONIC HEALTH EFFECTS

■ 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.
Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.
Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.
Chronic minor exposure to hydrogen chloride (HCl) vapour or fume may cause discolouration or erosion of the teeth, bleeding of the nose and gums; and ulceration of the nasal mucous membranes.
Repeated exposures of animals to concentrations of about 34 ppm HCl produced no immediate toxic effects.
Workers exposed to hydrochloric acid suffered from gastritis and a number of cases of chronic bronchitis have also been reported.
Repeated or prolonged exposure to dilute solutions of HCl may cause dermatitis.
The extremely short half life in aqueous solution (0.026 secs), with rapid release of hydrochloric acid means no significant retention of

phosgene in the body is possible.
Odour fatigue and phosgene tolerance may develop following continuous and repeated use. The development of tolerance is believed to the triggering mechanism of chronic, irreversible pulmonary changes of emphysema and fibrosis from prolonged daily exposure that produce no ostensible acute response.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
iso-butyryl chloride	79-30-1	>98
decomposes slowly in water to give		
hydrogen chloride	7647-01-0	
contaminant as		
phosgene	75-44-5	

Section 4 - FIRST AID MEASURES

SWALLOWED

· For advice, contact a Poisons Information Center or a doctor at once. · Urgent hospital treatment is likely to be needed. · Avoid giving milk or oils. · Avoid giving alcohol. · If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus.

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.

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.

INHALED

· If fumes or combustion products are inhaled remove from contaminated area. · Lay patient down. Keep warm and rested. Inhalation of vapors or aerosols (mists, fumes) may cause lung edema. Corrosive substances may cause lung damage (e.g.

NOTES TO PHYSICIAN

■ Any material aspirated during vomiting may produce lung injury. Therefore emesis should not be induced mechanically or pharmacologically.
For acute or short term repeated exposures to strong acids:
· Airway problems may arise from laryngeal edema and inhalation exposure. Treat with 100% oxygen initially.
· Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.
Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung edema often do not manifest until a few hours have passed and they are aggravated by physical effort.
For phosgene:
· Toxic effects of phosgene may be delayed and any person exposed to phosgene should be medically observed for onset of symptoms for at least 24 hours.
· In the absence of special detector badges worn by workers, there is no way of knowing the extent of phosgene exposure. But if one waits for the appearance of symptoms, pulmonary oedema may be lethal. Consequently, any exposed person must be treated as if the exposure is life threatening. The person should be kept at rest and given a glucocorticoid anti-inflammatory medication, and should be given oxygen-enriched air.
[Patty's]
Phosgene is an extremely strong respiratory tract irritant. Alveolar toxic oedema may become evident 1 to 24 h after exposure depending upon the level and duration of exposure. Signs and symptoms of this type of pulmonary oedema are rapid shallow breathing, shortness of breath, cough with production of frothy fluid, pulmonary shadows on the X-ray, and reduction in vital capacity and respiratory volume.
· Immediate termination of exposure is essential and the patient should be removed to fresh air.
· After exposure to liquid phosgene, contaminated clothing should be removed and disposed of.
· Exposed skin should be washed with large amounts of soap and water. If there was eye contact, the eyes should be flushed with copious amounts of water for at least 15 min.
· After exposure by inhalation, physical exertion should be avoided and strict bed rest enforced for between 24 and 72 h, particularly if the exposure dose was unknown or above 100 mg/m3-min (25 ppm-min). Chest radiographs, arterial blood gases and other diagnostic procedures are indicated to evaluate the presence of pulmonary oedema, the primary danger after inhalation exposure to phosgene. When pulmonary oedema is present the patient should be managed as though respiratory failure was impending. Deep breathing is recommended to remove additional phosgene from the lung.
· No specific antidote is known. Hexamethylenetetramine is effective only if administered prior to phosgene inhalation.
· Pulmonary oedema should be managed with positive pressure oxygen ventilation and the early intravenous administration of steroids (e.g., 1 g of methyl-prednisolone) may be beneficial. Additionally, the administration of such adrenergic agonists as terbutaline, albuteral, isoetharine and metaproterenol (as aerosols or nebulizers) seems to be effective to correct bronchospasms. In severe cases

aminophylline should be considered to control bronchoconstriction and relieve vasoconstriction. Most other drugs are ineffective and may even be harmful, e.g., atropine, epinephrine, cardiac glycosides, sedatives and expectorants.
· Antibiotic treatment might become necessary if secondary infectious pneumonitis occurs.
· Symptomatic therapy may become necessary, and patients should be followed and surveyed until pulmonary function has normalized and the patient fully recovered.
· Depending upon the exposure concentration and time, full recovery can take several months.
IPCS Health and Safety Guide No. 106.

Section 5 - FIRE FIGHTING MEASURES

Vapor Pressure (mmHg):	45.004
Upper Explosive Limit (%):	8.2 (v)
Specific Gravity (water=1):	1.017
Lower Explosive Limit (%):	2.1 (v)

EXTINGUISHING MEDIA
· DO NOT use water.

FIRE FIGHTING
· Alert Emergency Responders and tell them location and nature of hazard.
· May be violently or explosively reactive.
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
■ Combustion products include: carbon dioxide (CO2), hydrogen chloride, phosgene, other pyrolysis products typical of burning organic material.
· Highly flammable.
· Severe hazard when exposed to heat, flame or oxidizers.

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

PERSONAL PROTECTION
Glasses:
Full face- shield.
Gloves:
Respirator:
Type AB-P Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS
· Remove all ignition sources.
· Clean up all spills immediately.
· 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.
MAJOR SPILLS
· DO NOT touch the spill material.
· Clear area of personnel and move upwind.
· Alert Emergency Responders and tell them location and nature of hazard.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING
· Containers, even those that have been emptied, may contain explosive vapours.
· Do NOT cut, drill, grind, weld or perform similar operations on or near containers.
· DO NOT allow clothing wet with material to stay in contact with skin.
· Avoid all personal contact, including inhalation.
· Wear protective clothing when risk of exposure occurs.

RECOMMENDED STORAGE METHODS
· Lined metal can. Lined metal drum. Lined metal safety cans.
· Packing as supplied and/or recommended by manufacturer.
· Plastic lining or containers may only be used if approved for flammable liquid
(non-polar type).

· Check that containers are clearly labelled and free from leaks.
· For low viscosity materials (i): Drums and jerricans must be of the non-removable head type. (ii): 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).
Glass container.

STORAGE REQUIREMENTS

· Store in original containers in approved flame-proof area.
· No smoking, naked lights, heat or ignition sources.

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
Canada - Alberta Occupational Exposure Limits	iso-butyryl chloride (Hydrogen chloride)					2	3		
Canada - British Columbia Occupational Exposure Limits	iso-butyryl chloride (Hydrogen chloride Revised 2003)					2			
US - Minnesota Permissible Exposure Limits (PELs)	iso-butyryl chloride (Hydrogen chloride)					5	7		
US ACGIH Threshold Limit Values (TLV)	iso-butyryl chloride (Hydrogen chloride)					2			TLV Basis: upper respiratory tract irritation
US NIOSH Recommended Exposure Limits (RELs)	iso-butyryl chloride (Hydrogen chloride)					5	7		
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	iso-butyryl chloride (Hydrogen chloride)					5	7		
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	iso-butyryl chloride (Hydrogen chloride)	(C)5	(C)7						
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	iso-butyryl chloride (Hydrogen chloride)					5	7		
US - California Permissible Exposure Limits for Chemical Contaminants	iso-butyryl chloride (Hydrogen chloride; muriatic acid)	5	7			C			

US - Idaho - Limits for Air Contaminants	iso-butyryl chloride (Hydrogen chloride)					5	7	
US - Hawaii Air Contaminant Limits	iso-butyryl chloride (Hydrogen chloride)					5	7	
US - Alaska Limits for Air Contaminants	iso-butyryl chloride (Hydrogen chloride)					5	7	
US - Michigan Exposure Limits for Air Contaminants	iso-butyryl chloride (Hydrogen chloride)					5	7	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	iso-butyryl chloride (Hydrogen chloride)	5	7	-	-			
US - Washington Permissible exposure limits of air contaminants	iso-butyryl chloride (Hydrogen chloride)					5.0		
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	iso-butyryl chloride (Hydrogen chloride)					2		
US - Oregon Permissible Exposure Limits (Z-1)	iso-butyryl chloride (Hydrogen chloride)					5	7	
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	iso-butyryl chloride (Hydrogen chloride)					5	7	
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	iso-butyryl chloride (Hydrogen chloride)					5	7,5	
US OSHA Permissible Exposure Levels (PELs) - Table Z1	iso-butyryl chloride (Hydrogen chloride)					5	7	
Canada - Northwest Territories Occupational Exposure Limits (English)	iso-butyryl chloride (Hydrogen chloride)					5	7.5	
Canada - Nova Scotia Occupational Exposure Limits	iso-butyryl chloride (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation

Canada - Prince Edward Island Occupational Exposure Limits	iso-butyryl chloride (Hydrogen chloride)				2			TLV Basis: upper respiratory tract irritation
US NIOSH Recommended Exposure Limits (RELs)	phosgene (Phosgene)	0.1	0.4		0.2	0.8		(Ceiling ([15-minute]))
Canada - Alberta Occupational Exposure Limits	phosgene (Carbonyl chloride (Phosgene))	0.1	0.4					
Canada - British Columbia Occupational Exposure Limits	phosgene (Phosgene)	0.1						
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	phosgene (Phosgene)	0.1	0.4					
US OSHA Permissible Exposure Levels (PELs) - Table Z1	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4					
US ACGIH Threshold Limit Values (TLV)	phosgene (Phosgene)	0.1						TLV Basis: upper respiratory tract irritation; pulmonary edema & emphysema
US - Minnesota Permissible Exposure Limits (PELs)	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4					
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4					
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4					
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4					
US - California Permissible Exposure Limits for Chemical Contaminants	phosgene (Phosgene; carbonyl chloride; COCl2)	0.1	0.4					
US - Idaho - Limits for Air Contaminants	phosgene (Phosgene (carbonyl chloride))	0.1	0.4					

Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	phosgene (Phosgene (Carbonyl chloride))	0.1		0.3		
US - Hawaii Air Contaminant Limits	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4			
US - Alaska Limits for Air Contaminants	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4			
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	phosgene (Carbonyl chloride (phosgene))	0.05	0.2	-	-	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	phosgene (Phosgene (carbonyl chloride))	0.1	0.4	0.3	1.2	
US - Washington Permissible exposure limits of air contaminants	phosgene (Phosgene (carbonyl chloride))	0.1		0.3		
US - Michigan Exposure Limits for Air Contaminants	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4			
Canada - Nova Scotia Occupational Exposure Limits	phosgene (Phosgene)	0.1				TLV Basis: upper respiratory tract irritation; pulmonary edema & emphysema
Canada - Prince Edward Island Occupational Exposure Limits	phosgene (Phosgene)	0.1				TLV Basis: upper respiratory tract irritation; pulmonary edema & emphysema
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4			
US - Oregon Permissible Exposure Limits (Z-1)	phosgene (Phosgene (carbonyl chloride))	0.1	0.4			
Canada - Northwest Territories Occupational Exposure Limits	phosgene (Phosgene (Carbonyl chloride))	0.1	0.4	0.3	1.2	

(English)

ENDOELTABLE

PERSONAL PROTECTION

RESPIRATOR

• type ab-p filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

EYE

· Chemical goggles.
· Full face shield.

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: 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, 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.
· 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.

ENGINEERING CONTROLS

■ For flammable liquids and flammable gases, local exhaust ventilation or a process enclosure ventilation system may be required. Ventilation equipment should be explosion-resistant.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Liquid.
Corrosive.
Acid.
Toxic or noxious vapours/gas.
Reacts violently with water.

State	Liquid	Molecular Weight	106.55
Melting Range (°F)	-130	Viscosity	0.55 cSt@40°C
Boiling Range (°F)	196- 199	Solubility in water (g/L)	Reacts
Flash Point (°F)	47(DIN 51755)	pH (1% solution)	Not applicable
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	617 (DIN 51794)	Vapor Pressure (mmHg)	45.004
Upper Explosive Limit (%)	8.2 (v)	Specific Gravity (water=1)	1.017
Lower Explosive Limit (%)	2.1 (v)	Relative Vapor Density (air=1)	>1
Volatile Component (%vol)	Not available	Evaporation Rate	Not available

APPEARANCE
Colourless liquid with unpleasant odour; decomposes in water and alcohols. Soluble in ether.

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY
· Presence of incompatible materials.
· Product is considered stable.

STORAGE INCOMPATIBILITY
■ Acyl halides tend to react violently with protic organic solvents, water, and the aprotic solvents, dimethylformamide and dimethyl sulfoxide. Their facile reaction with ethers is also potentially dangerous.<\div>.
Hydrogen chloride:
· reacts strongly with strong oxidisers (releasing chlorine gas), acetic anhydride, caesium cyanotridecahydrodecaborate(2-), ethylidene difluoride, hexalithium disilicide, metal acetylide, sodium, silicon dioxide, tetraselenium tetranitride, and many organic materials
· is incompatible with alkaline materials, acetic anhydride, acetylides, aliphatic amines, alkanolamines, alkylene oxides, aluminium, aluminium-titanium alloys, aromatic amines, amines, amides, 2-aminoethanol, ammonia, ammonium hydroxide, borides, calcium phosphide, carbides, carbonates, cyanides, chlorosulfonic acid, ethylenediamine, ethyleneimine, epichlorohydrin, formaldehyde, isocyanates, metals, metal oxides, metal hydroxides, metal acetylides, metal carbides, oleum, organic anhydrides, potassium permanganate, perchloric acid, phosphides, 3-propiolactone, silicides, sulfides, sulfites, sulfuric acid, uranium phosphide, vinyl acetate, vinylidene fluoride
· attacks most metals forming flammable hydrogen gas, and some plastics, rubbers and coatings
· reacts with zinc, brass, galvanised iron, aluminium, copper and copper alloys.
Reacts with mild steel, galvanized steel / zinc producing hydrogen gas which may form an explosive mixture with air.
Segregate from alcohol, water.
· Avoid strong bases.
Avoid reaction with oxidizing agents.
· NOTE: May develop pressure in containers; open carefully. Vent periodically.

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

Section 11 - TOXICOLOGICAL INFORMATION

iso-butyryl chloride

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.
ISO-BUTYRYL CHLORIDE:

TOXICITY	IRRITATION
Oral (Rat) LD50: 1000 mg/kg *	Eye (rabbit): Corrosive *Inhalation (R
Dermal (Rabbit) LD50: >2000 mg/kg *	

0.47-<1.95 mg/l/4h *Skin (rabbit): Corrosive *
Inhalation-risk test (IRT): Mortality within 10 minutes as shown in rat studies. The inhalation of a highly saturated vapor-air mixture represents a severe hazard.
* BASF MSDS

TOXICITY	IRRITATION
HYDROGEN CHLORIDE:	
Inhalation (human) LCLo: 1300 ppm/30m	Eye (rabbit): 5 mg/30s - Mild

Inhalation (human) LCLo: 3000 ppm/5m

Inhalation (rat) LC50: 3124 ppm/60m

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

4701 ppm/30m

PHOSGENE:

Inhalation (human) LC50: 3300 mg/m³

Inhalation (human) LCLo: 50 ppm/5m

Inhalation (man) LCLo: 360 mg/m³/30m

Inhalation (human) TCLo: 25 ppm/30m

Inhalation (rat) LC50: 1400 mg/m³/30m

Nil Reported

■ For phosgene:

In view of the extremely short half-life (0.026 seconds) in aqueous solutions, and the penetration into the tissues of the respiratory tract by phosgene gas, only minimal amounts of phosgene are distributed in the body and no significant retention of phosgene in the body is possible. The hydrolytic products of phosgene, hydrochloric acid and carbon dioxide, are disposed by the body through normal physiological processes. Phosgene exerts its toxicity through the acylation of proteins as well as through the release of hydrochloric acid. The amino, hydroxyl and sulfhydryl groups in proteins appear to be the target for acylation, leading to marked inhibition of several enzymes related to energy metabolism and a breakdown of the blood:air barrier.

The cascade of events after acute inhalation exposure in humans is similar to that in experimental animals. Their occurrence is dose-related and results in pulmonary oedema and death in humans at levels exceeding 120 mg/m3-min. Three distinct clinico-pathological phases can be recognised, namely: pain in the eyes and throat and tightness of the chest, often with shortness of breath, wheezing and coughing; a latent phase which is often asymptomatic and lasts normally up to 24 h depending upon the concentration and duration of exposure; and the final phase of pulmonary oedema. In one study pulmonary oedema occurred after a latent phase of 48 h.

Populations exposed to phosgene after industrial accidents have reported a wide variety of symptoms, including headache, nausea, cough, dyspnoea, fatigue, pharyngeal pain, chest tightness and pain, intense pain in the eye, and severe lacrimation. After short-term exposures throat irritation occurs at levels of 12 mg/m3 and eye irritation is noted at 16 mg/m3. It has been calculated that doses below 100 mg/m3 will result in no permanent adverse effects, whereas pulmonary oedema results from doses above 600 mg/m3-min. Death has been recorded at doses above 400 mg/m3-min, and exposure for several hours at concentrations at or below the odour threshold of 6 mg/m3 may result in severe tissue damage and death. Thus, the odour threshold for phosgene is an unacceptable parameter for early warning

In all species that have been studied, the lung is the major target organ. After acute exposures of between 4 and 800 mg/m3 (1-200 ppm) the toxicological effect is due to the exposure (C) x time (T) (Habers Law), based on studies of lung disease and death. This relationship does not hold for chronic exposures. The L(CT)50 for single exposure was reported to vary widely among animal species, ranging from 900 mg/m3-min (225 ppm-min) in the mouse to 1920 mg/m3-min (250 ppm-min) in the monkey. In all species the characteristic pathological feature was the dose-dependent clinical manifestation of pulmonary oedema. The extent of the long-term chronic effects of acute exposure appears to depend on the severity of the initial pathology. At low concentrations, pathological changes in the terminal bronchioles and alveoli were reported to be typical of a pulmonary irritant, whereas at higher levels pulmonary oedema occurred, leading to interference with gas exchange and death. Preliminary data from single 4-h exposures to 2 or 4 mg/m3 in rats and mice (480 mg/m3-min or 960 mg/m3-min) indicated a decrease in pulmonary immuno-competence. No effects were seen at 0.4 mg/m3 (96 mg/m3-min). Although limited, other data confirmed these findings. In rats exposed to 4 mg/m3 for 4 h (960 mg/m3-min), a 10-fold increase in influenza virus titre was noted per day post-infection. Pulmonary bacterial clearance was reduced in rats exposed for 6 h to 0.4 mg phosgene/m3 (144 mg/m3-min) or to 0.4 mg/m3 for 6 h/day, 5 days/week for 4 to 12 weeks. This effect was reversible following termination of exposure. In a host resistance assay in mice, exposure to

concentrations of phosgene of 0.1 mg/m3 or more for 4 h (>24 mg/m3-min) led to an increase in mortality from Streptococcus zooepidemicus infection.

CARCINOGEN

Hydrochloric acid	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3
Acid mists, strong inorganic	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	1
Zinc and Compounds	US EPA Carcinogens Listing	Carcinogenicity	D
Zinc and Compounds	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	D
Hydrogen chloride	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	A4
hydrogen chloride	US - Rhode Island Hazardous Substance List	IARC	
ORGANIC BROMINE COMPOUNDS	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	P65-MC
hydrogen chloride	US - Maine Chemicals of High Concern List	Carcinogen	D
TWAPPM~	US - Maine Chemicals of High Concern List	Carcinogen	A4
PBIT_(PERS~	US - Maine Chemicals of High Concern List	Carcinogen	
phosgene	US - Rhode Island Hazardous Substance List	IARC	

SKIN

phosgene	Canada - British Columbia Occupational Exposure Limits - Skin	Notation	Skin
phosgene	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
iso-butyryl chloride	HIGH	No Data Available	LOW	HIGH
hydrogen chloride	LOW	No Data Available	LOW	HIGH
phosgene	LOW	LOW	LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information
Ignitability characteristic: use EPA hazardous waste number D001 (waste code I)
Corrosivity characteristic: use EPA hazardous waste number D002 (waste code C)
B. Component Waste Numbers
When phosgene 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 P095 (waste code T).

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.
¦ Puncture containers to prevent re-use and bury at an authorized landfill.
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.
· 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.

Section 14 - TRANSPORTATION INFORMATION

DOT:
Symbols: None Hazard class or Division: 3
Identification Numbers: UN2395 PG: II
Label Codes: 3, 8 Special provisions: IB1, T7,
TP2
Packaging: Exceptions: 150 Packaging: Non- bulk: 202
Packaging: Exceptions: 150 Quantity limitations: 1 L
Passenger aircraft/rail:
Quantity Limitations: Cargo 5 L Vessel stowage: Location: C
aircraft only:
Vessel stowage: Other: 40
Hazardous materials descriptions and proper shipping names:
Isobutyryl chloride

Air Transport IATA:

UN/ID Number: 2395 Packing Group: II
Special provisions: None
Cargo Only
Packing Instructions: 363 Maximum Qty/Pack: 5 L
Passenger and Cargo Passenger and Cargo
Packing Instructions: Y340 Maximum Qty/Pack: 1 L
Passenger and Cargo Limited Quantity Passenger and Cargo Limited Quantity
Packing Instructions: 352 Maximum Qty/Pack: 0.5 L
Shipping Name: ISOBUTYRYL CHLORIDE

Maritime Transport IMDG:

IMDG Class: 3 IMDG Subrisk: 8
UN Number: 2395 Packing Group: II
EMS Number: F-E,S-C Special provisions: None
Limited Quantities: 1 L
Shipping Name: ISOBUTYRYL CHLORIDE

Section 15 - REGULATORY INFORMATION

hydrogen chloride (CAS: 7647-01-0) 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 - 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 Industrial Hazardous Substances","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada Domestic Substances List (DSL)","Canada Ingredient Disclosure List (SOR/88-64)","Canada National Pollutant Release Inventory (NPRI)","Canada Prohibited Toxic Substances, Schedule 2, Concentration Limits (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","CODEX General Standard for Food Additives (GSFA) - Additives Permitted for Use in Food in General, Unless Otherwise Specified, in Accordance with GMP","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","International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs","International Council of Chemical Associations (ICCA) - High Production Volume List","International Maritime Dangerous Goods Requirements (IMDG Code) - Goods Forbidden for Transport","United Nations Convention Against Illicit Traffic in Narcotic Drugs and Psychotropic Substances - Table II","United Nations List of Precursors and Chemicals Frequently used in the Illicit Manufacture of Narcotic Drugs and Psychotropic Substances Under International Control (Red List) - Table II","US - Alaska Limits for Air Contaminants","US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified","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 OEHHA/ARB - Chronic Reference Exposure Levels and Target Organs (CRELs)","US - California Permissible Exposure Limits for Chemical Contaminants","US - California Toxic Air Contaminant List Category II","US - Connecticut Hazardous Air Pollutants","US - Florida Essential Chemicals","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","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 - 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 Clean Air Act - Hazardous Air Pollutants","US CWA (Clean Water Act) - List of Hazardous Substances","US CWA (Clean Water Act) - Reportable Quantities of Designated Hazardous Substances","US Department of Homeland Security Chemical Facility Anti-Terrorism Standards - Chemicals of Interest","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 Drug Enforcement Administration (DEA) List I and II Regulated Chemicals","US EPA Acute Exposure Guideline Levels (AEGLs) - Final","US EPA High Production Volume Chemicals Additional List","US EPA Master Testing List - Index I Chemicals Listed","US EPCRA Section 313 Chemical List","US Food Additive Database","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 Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide","US SARA Section 302 Extremely Hazardous Substances","US Spacecraft Maximum Allowable Concentrations (SMACs) for Airborne Contaminants","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory"

Regulations for ingredients

phosgene (CAS: 75-44-5) 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 - Prince Edward Island Occupational Exposure Limits","Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada Chemical Weapons Schedule 3 (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)","Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (English)","International Council of Chemical Associations (ICCA) - High Production Volume List","US - Alaska Limits for Air Contaminants","US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified","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 - California Toxic Air Contaminant List Category II","US - Connecticut Hazardous Air Pollutants","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","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 Hazardous Constituents","US - Vermont Hazardous Waste - Acutely Hazardous Wastes","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 Dangerous waste constituents list","US - Washington Discarded Chemical Products List - ""P"" Chemical Products","US - Washington Permissible exposure limits of 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 CAA (Clean Air Act) - HON Rule - Organic HAPs (Hazardous Air Pollutants)","US Clean Air Act - Hazardous Air Pollutants","US CWA (Clean Water Act) - List of Hazardous Substances","US CWA (Clean Water Act) - Reportable Quantities of Designated Hazardous Substances","US Department of Homeland Security Chemical Facility Anti-Terrorism Standards - Chemicals of Interest","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 Acute Exposure Guideline Levels (AEGLs) - Final","US EPA Acute Exposure Guideline Levels (AEGLs) - Interim","US EPA High Production Volume Program Chemical List","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 Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide","US RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes","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"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Skin contact may produce health damage*.
■ Cumulative effects may result following exposure*.
* (limited evidence).

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■ 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.

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