1-Chloroethyl chloroformate

sc-251499

Material Safety Data Sheet

Hazard Alert Code Key: EXTREME HIGH MODERATE LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

1-Chloroethyl chloroformate

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA

SUPPLIER

Company: Santa Cruz Biotechnology, Inc.
2145 Delaware Ave
Santa Cruz, CA 95060
Telephone: 800.457.3801 or 831.457.3800
Emergency Tel: **CHEMWATCH: From within the US and Canada: 877-715-9305**
Emergency Tel: **From outside the US and Canada: +800 2436 2255 (1-800-CHEMCALL) or call +613 9573 3112**

PRODUCT USE

Reagent for the selective N-dealkylation of tertiary amines; preparation of alkyl iodides from alcohols via alkyl alpha-chloroethyl carbonates; useful in synthesis of drugs; reagent used in the synthesis of fluoroformates from alcohol.

SYNONYMS

C3-H4-Cl2-O2, ClCOOCH(Cl)CH3, "formic acid, chloro-, 1-chloroethyl ester", "chloroformic acid 1-chloroethyl ester", ACE-Cl

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability:	3		
Toxicity:	3		
Body Contact:	3		
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.
Toxic by inhalation.
Causes burns.
Risk of serious damage to eyes.
Harmful in contact with skin and if swallowed.
Flammable.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ 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.

■ The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.

■ Ingestion of acidic corrosives may produce burns around and in the mouth. the throat and esophagus. 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 esophageal 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 esophageal 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.

■ Ingestion of formic acid causes acute local tissue damage with other effects ranging from nausea and dizziness to unconsciousness. Intentional ingestion is reported to produce salivation, vomiting (which may be bloody), a burning sensation in the mouth and pharynx, diarrhoea and severe pain. Circulatory collapse may follow, causing death.

Formic acid might directly damage clotting factors leading to increases in haemorrhage and bleeding. It has an elimination half-life of 2.5 hours.

EYE

■ The material can produce 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.

■ Irritation of the eyes may produce a heavy secretion of tears (lachrymation).

■ 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.

■ Eye contact with formic acid liquid or high vapour concentrations will produce irritation and conjunctivitis and may cause corneal burns.

SKIN

■ Skin contact with the material may be harmful; systemic effects may resultfollowing absorption.

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

■ 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.

■ 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 formic acid may cause irritation and burns with possible chronic effects from repeated exposures. A worker receiving splashes of hot formic acid to the face developed marked dyspnea with difficulty in swallowing, inability to speak and died 6 hours later. The liquid causes burns with vesiculation, and keloid scars may often develop at the site. It is not clear whether irritancy is due to acid effects or whether it is due to the fact that formic acid may react as an aldehyde.

INHALED

■ If inhaled, this material can irritate the throat andlungs of some persons.

■ Inhalation of vapors or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce toxic effects.

■ Most exposures occur from breathing the gaseous hydrolysis products of chloroformate or by skin/ eye contact with the liquid. Exposure of small amounts usually causes eye, nose, and throat irritation. However the irritating effects can be so mild at first that the person does not leave the area. Extended exposure can cause severe breathing difficulties which can lead to chemical pneumonia and death. Severe breathing problems may not develop for as long as 24 hours after exposure.

A single small exposure from which the individual recovers quickly is not likely to cause delayed or long-term effects. Serious exposures may create permanent difficulty; individuals tend to develop lung infections easily.

■ 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.

Inhalation of HCl may cause choking, coughing, burning sensation and may cause ulceration of the nose, throat and larynx. Fluid on the lungs followed by generalised lung damage may follow.

Breathing of HCl vapour may aggravate asthma and inflammatory or fibrotic pulmonary disease.

High concentrations cause necrosis of the tracheal and bronchial epithelium, pulmonary oedema, atelectasis and emphysema and damage to the pulmonary blood vessels and liver.
■ 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.
■ Excessive inhalation of formic acid vapours can produce coughing, difficulty in breathing , possible bronchitis, headache, and body weakness. However, the warning properties of formic acid minimize the chances of systemic effects occurring as a result of inhalation. Workers exposed to 15 ppm of a mixture of formic and acetic acid complained of nausea.

CHRONIC HEALTH EFFECTS

■ 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.
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.
Chronic occupational exposures to formic acid may produce nausea and albumin or blood in the urine.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
1-chloroethyl chloroformate	50893-53-3	>98
decomposes in water/moist air to give		
hydrogen chloride	7647-01-0	
formic acid	64-18-6	

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.
- 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 Center 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 Center.
- 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 vapors or aerosols (mists, fumes) may cause lung edema. Corrosive substances may cause lung damage (e.g. lung edema, 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 authorized by him/her. (ICSC13719).

NOTES TO PHYSICIAN

■ For chloroformates:

- Patients exposed only to chloroformates gas do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with liquid or solvents containing chloroformates can secondarily contaminate rescue and medical personnel by direct contact or through off-gassing chloroformates.
- Chloroformates irritate lungs severely. Because of its slow hydrolysis in the alveoli, serious lung effects and, therefore, symptoms of toxicity may be delayed up to 24 hours. Signs of accumulation of fluid in the lungs (shortness of breath, cyanosis, expectoration, cough) do not usually appear for hours after even severely toxic exposures.
- There is no antidote to be administered to counteract the effects of chloroformates. Treatment consists of supportive measures.

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
- Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
- Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the dessicating action of the acid on proteins in specific tissues.

INGESTION:

- Immediate dilution (milk or water) within 30 minutes post ingestion is recommended.
- DO NOT attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
- Be careful to avoid further vomit since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
- Charcoal has no place in acid management.
- Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:

- Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
- Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

- Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjuctival cul-de-sacs. Irrigation should last at least 20-30 minutes. DO NOT use neutralizing agents or any other additives. Several liters of saline are required.
- Cycloplegic drops, (1% cyclopentolate for short-term use or 5% homatropine for longer term use) antibiotic drops, vasoconstrictive agents or artificial tears may be indicated dependent on the severity of the injury.
- Steroid eye drops should only be administered with the approval of a consulting ophthalmologist).

[Ellenhorn and Barceloux: Medical Toxicology].

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. Rest and medical observation is therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her should be considered. (ICSC24419/24421.

Section 5 - FIRE FIGHTING MEASURES

Vapor Pressure (mmHg):	168.014 (20 C)
Upper Explosive Limit (%):	Not available
Specific Gravity (water=1):	1.325
Lower Explosive Limit (%):	Not available

EXTINGUISHING MEDIA

■ Small Fire

- CO2, dry chemical, dry sand, alcohol-resistant foam (AFFF).
- NOTE: Most foams will react with the material and release corrosive/toxic gases

Large Fire

- Water spray, fog or alcohol-resistant foam.
- Move containers from fire area if you can do it without risk.
- Use water spray or fog; do not use straight streams.

Fire involving Tanks or Car/Trailer Loads

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Do not get water inside containers.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.

FIRE FIGHTING

■

- Alert Emergency Responders and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves for fire only.
- 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.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

■

- Liquid and vapor are flammable.
- Moderate fire hazard when exposed to heat or flame.
- Vapor forms an explosive mixture with air.
- Moderate explosion hazard when exposed to heat or flame.
- Vapor may travel a considerable distance to source of ignition.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).

Combustion products include: carbon dioxide (CO2), carbon monoxide (CO), hydrogen chloride, phosgene, other pyrolysis products typical of burning organic material.

May emit poisonous fumes.

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 ABE-P Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

■

- Cover spill with DRY earth, DRY sand or other non-combustible material followed with plastic sheet to minimise spreading or contact with rain.
- Use clean non-sparking tools to collect material and place it into loosely covered plastic containers for later disposal.
- 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

■

- All equipment used when handling the product must be grounded.
- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
- A vapour suppressing foam may be used to reduce vapors.
- DO NOT GET WATER on spilled substance or inside containers.
- Avoid allowing water runoff to contact spilled material.
- Prevent entry into sewers, basements or confined areas.

Chemical Class:acidic compounds, organic

For release onto land: recommended sorbents listed in order of priority.

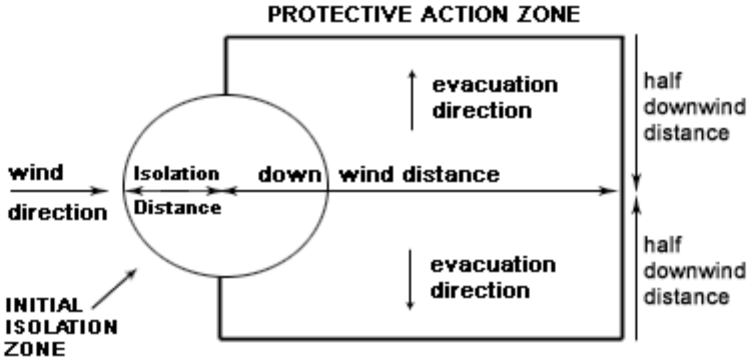
SORBENT TYPE	RANK	APPLICATION	COLLECTION	LIMITATIONS
LAND SPILL - SMALL				
wood fiber - pillow	1	throw	pitchfork	R, P, DGC, RT
cross-linked polymer - particulate	1	shovel	shovel	R,W,SS
cross-linked polymer - pillow	1	throw	pitchfork	R, DGC, RT
sorbent clay - particulate	2	shovel	shovel	R, I, P
foamed glass - pillow	2	throw	pitchfork	R, P, DGC, RT
wood fiber - particulate	3	shovel	shovel	R, W, P, DGC
LAND SPILL - MEDIUM				
cross-linked polymer -particulate	1	blower	skiploader	R, W, SS
polypropylene - particulate	2	blower	skiploader	W, SS, DGC
sorbent clay - particulate	2	blower	skiploader	R, I, P
cross-linked polymer - pillow	3	throw	skiploader	R, DGC, RT
polypropylene - mat	3	throw	skiploader	W, SS, DGC
expanded mineral - particulate	3	blower	skiploader	R, I, W, P, DGC

Legend
DGC: Not effective where ground cover is dense
R; Not reusable
I: Not incinerable
P: Effectiveness reduced when rainy

RT:Not effective where terrain is rugged
SS: Not for use within environmentally sensitive sites
W: Effectiveness reduced when windy
Reference: Sorbents for Liquid Hazardous Substance Cleanup and Control;
R.W Melvold et al: Pollution Technology Review No. 150: Noyes Data Corporation 1988.

- DO NOT touch the spill material
- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- No smoking, naked lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse vapor.
- Contain or absorb spill with sand, earth or vermiculite.
- Use only spark-free shovels and explosion proof equipment.
- Collect recoverable product into labeled containers for recycling.
- Collect solid residues and seal in labeled 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.

PROTECTIVE ACTIONS FOR SPILL



From IERG (Canada/Australia)	
Isolation Distance	25 meters
Downwind Protection Distance	250 meters

From US Emergency Response Guide 2000 Guide 155

SMALL SPILLS			
Name	Isolation Distance	Downwind Day	Protection Night
Iso-butyl chloroformate	100 ft (30 m)	0.1 mile (0.2 km)	0.1 mile (0.2 km)
sec-Butyl chloroformate	100 ft (30 m)	0.1 mile (0.2 km)	0.1 mile (0.2 km)

LARGE SPILLS			
Name	Isolation Distance	Downwind Day	Protection Night
Iso-butyl chloroformate	200 ft (60 m)	0.2 mile (0.3 km)	0.5 mile (0.8 km)
sec-Butyl chloroformate	100 ft (30 m)	0.2 mile (0.3 km)	0.4 mile (0.6 km)

FOOTNOTES

1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.
2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.
3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.
4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.
5 Guide 155 is taken from the US DOT emergency response guide book.
6 IERG information is derived from CANUTEC - Transport Canada.

ACUTE EXPOSURE GUIDELINE LEVELS (AEGL) (in ppm)

1-					
chloroet					
hyl					
chloroform					
ate					
AEGL Type	10 min	30 min	60 min	4 hr	8 hr
1	1.8	1.8	1.8	1.8	GALSYN~
2	100	43	22	11	GALSYN~
3	620	210	100	26	GALSYN~
hydrogen					
chloride					
AEGL Type	10 min	30 min	60 min	4 hr	8 hr
1	1.8	1.8	1.8	1.8	GALSYN~
2	100	43	22	11	GALSYN~
3	620	210	100	26	GALSYN~

AEGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
AEGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
AEGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

EMERGENCY RESPONSE PLANNING GUIDELINES (ERPG)

The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour WITHOUT experiencing or developing

life-threatening health effects is:

1-chloroethyl chloroformate	150ppm

irreversible or other serious effects or symptoms which could impair an individual's ability to take protective action is:

1-chloroethyl chloroformate	20ppm

other than mild, transient adverse effects without perceiving a clearly defined odour is:

1-chloroethyl chloroformate	3ppm

American Industrial Hygiene Association (AIHA)

Ingredients considered according exceed the following cutoffs

Very Toxic (T+)	>= 0.1%	Toxic (T)	>= 3.0%
R50	>= 0.25%	Corrosive (C)	>= 5.0%
R51	>= 2.5%		
else	>= 10%		

where percentage is percentage of ingredient found in the mixture

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

■

- 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.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- DO NOT enter confined spaces until atmosphere has been checked.
- DO NOT allow material to contact humans, exposed food or food utensils.

- 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.
- Containers, even those that have been emptied, may contain explosive vapors.
- Do NOT cut, drill, grind, weld or perform similar operations on or near containers.

RECOMMENDED STORAGE METHODS

■ Glass container.

- Lined metal can, Lined metal pail/drum
- Plastic pail
- Polyliner drum
- Packing as recommended by manufacturer.
- Check all containers are clearly labeled 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, there must be sufficient inert cushioning material in contact with inner and outer packages * . - In addition, where inner packagings are glass and contain liquids of packing group I and II there must be sufficient inert absorbent to absorb any spillage *. - * unless the outer packaging is a close fitting molded plastic box and the substances are not incompatible with the plastic. All inner and sole packagings for substances that have been assigned to Packaging Groups I or II on the basis of inhalation toxicity criteria, must be hermetically sealed.

STORAGE REQUIREMENTS

■

- 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.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

X X + X X +

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

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m^3	STEL ppm	STEL mg/m^3	Peak ppm	Peak mg/m^3	TWA F/CC	Notes
Canada - Alberta Occupational Exposure Limits	1-chloroethyl chloroformate (Formic acid)	5	9.4	10	19				
Canada - British Columbia Occupational Exposure Limits	1-chloroethyl chloroformate (Formic acid)	5		10					

Canada - Ontario Occupational Exposure Limits	1-chloroethyl chloroformate (Formic acid)	5		10				
US OSHA Permissible Exposure Levels (PELs) - Table Z1	1-chloroethyl chloroformate (Formic acid)	5	9					
US ACGIH Threshold Limit Values (TLV)	1-chloroethyl chloroformate (Formic acid)	5		10				TLV Basis: upper respiratory tract, eye & skin irritation
US NIOSH Recommended Exposure Limits (RELs)	1-chloroethyl chloroformate (Formic acid)	5	9					
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	1-chloroethyl chloroformate (Formic acid)	5	9					
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	1-chloroethyl chloroformate (Formic acid)	5	9					
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	1-chloroethyl chloroformate (Formic acid)	5	9					
US - Minnesota Permissible Exposure Limits (PELs)	1-chloroethyl chloroformate (Formic acid)	5	9					
US - California Permissible Exposure Limits for Chemical Contaminants	1-chloroethyl chloroformate (Formic acid)	5	9	10	19			
US - Idaho - Limits for Air Contaminants	1-chloroethyl chloroformate (Formic acid)	5	9					
US - Hawaii Air Contaminant Limits	1-chloroethyl chloroformate (Formic acid)	5	9	10	18			
US - Alaska Limits for Air Contaminants	1-chloroethyl chloroformate (Formic acid)	5	9					
US - Michigan Exposure Limits for Air Contaminants	1-chloroethyl chloroformate (Formic acid)	5	9					
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	1-chloroethyl chloroformate (Formic acid)	5	9	5	9			
US - Washington Permissible exposure limits of air contaminants	1-chloroethyl chloroformate (Formic acid)	5		10				
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	1-chloroethyl chloroformate (Formic acid)	5		10				
Canada - Prince Edward Island Occupational Exposure Limits	1-chloroethyl chloroformate (Formic acid)	5		10				TLV Basis: upper respiratory tract, eye & skin irritation
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	1-chloroethyl chloroformate (Formic acid)	5	9					
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	1-chloroethyl chloroformate (Formic acid)	5	9.4	10	19			
US - Oregon Permissible Exposure Limits (Z-1)	1-chloroethyl chloroformate (Formic acid)	5	9					

Canada - Northwest Territories Occupational Exposure Limits (English)	1-chloroethyl chloroformate (Formic acid)	5	9	10	18			
Canada - Nova Scotia Occupational Exposure Limits	1-chloroethyl chloroformate (Formic acid)	5		10				TLV Basis: upper respiratory tract, eye & skin irritation
Canada - British Columbia Occupational Exposure Limits	1-chloroethyl chloroformate (Hydrogen chloride Revised 2003)					2		
Canada - Ontario Occupational Exposure Limits	1-chloroethyl chloroformate (Hydrogen chloride)					2		
US - Minnesota Permissible Exposure Limits (PELs)	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
US ACGIH Threshold Limit Values (TLV)	1-chloroethyl chloroformate (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
US NIOSH Recommended Exposure Limits (RELs)	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
Canada - Alberta Occupational Exposure Limits	1-chloroethyl chloroformate (Hydrogen chloride)					2	3	
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	1-chloroethyl chloroformate (Hydrogen chloride)	(C)5	(C)7					
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
US - California Permissible Exposure Limits for Chemical Contaminants	1-chloroethyl chloroformate (Hydrogen chloride; muriatic acid)					5	7	
US - Idaho - Limits for Air Contaminants	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
US - Hawaii Air Contaminant Limits	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
US - Alaska Limits for Air Contaminants	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
US - Michigan Exposure Limits for Air Contaminants	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	1-chloroethyl chloroformate (Hydrogen chloride)	5	7	-	-			
US - Washington Permissible exposure limits of air contaminants	1-chloroethyl chloroformate (Hydrogen chloride)					5.0		
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	1-chloroethyl chloroformate (Hydrogen chloride)					2		
US - Oregon Permissible Exposure Limits (Z-1)	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	

US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	1-chloroethyl chloroformate (Hydrogen chloride)					5	7,5	
US OSHA Permissible Exposure Levels (PELs) - Table Z1	1-chloroethyl chloroformate (Hydrogen chloride)					5	7	
Canada - Northwest Territories Occupational Exposure Limits (English)	1-chloroethyl chloroformate (Hydrogen chloride)					5	7.5	
Canada - Nova Scotia Occupational Exposure Limits	1-chloroethyl chloroformate (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
Canada - Prince Edward Island Occupational Exposure Limits	1-chloroethyl chloroformate (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
Canada - British Columbia Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride Revised 2003)					2		
Canada - Ontario Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride)					2		
US - Minnesota Permissible Exposure Limits (PELs)	hydrogen chloride (Hydrogen chloride)					5	7	
US ACGIH Threshold Limit Values (TLV)	hydrogen chloride (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
US NIOSH Recommended Exposure Limits (RELs)	hydrogen chloride (Hydrogen chloride)					5	7	
Canada - Alberta Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride)					2	3	
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	hydrogen chloride (Hydrogen chloride)					5	7	
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)	(C)5	(C)7					
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)					5	7	
US - California Permissible Exposure Limits for Chemical Contaminants	hydrogen chloride (Hydrogen chloride; muriatic acid)					5	7	
US - Idaho - Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)					5	7	
US - Hawaii Air Contaminant Limits	hydrogen chloride (Hydrogen chloride)					5	7	
US - Alaska Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)					5	7	
US - Michigan Exposure Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)					5	7	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	hydrogen chloride (Hydrogen chloride)	5	7	-	-			
US - Washington Permissible exposure limits of air contaminants	hydrogen chloride (Hydrogen chloride)					5.0		

Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	hydrogen chloride (Hydrogen chloride)					2		
US - Oregon Permissible Exposure Limits (Z-1)	hydrogen chloride (Hydrogen chloride)					5	7	
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)					5	7	
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	hydrogen chloride (Hydrogen chloride)					5	7,5	
US OSHA Permissible Exposure Levels (PELs) - Table Z1	hydrogen chloride (Hydrogen chloride)					5	7	
Canada - Northwest Territories Occupational Exposure Limits (English)	hydrogen chloride (Hydrogen chloride)					5	7.5	
Canada - Nova Scotia Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
Canada - Prince Edward Island Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
Canada - Alberta Occupational Exposure Limits	formic acid (Formic acid)	5	9.4	10	19			
Canada - British Columbia Occupational Exposure Limits	formic acid (Formic acid)	5		10				
Canada - Ontario Occupational Exposure Limits	formic acid (Formic acid)	5		10				
US OSHA Permissible Exposure Levels (PELs) - Table Z1	formic acid (Formic acid)	5	9					
US ACGIH Threshold Limit Values (TLV)	formic acid (Formic acid)	5		10				TLV Basis: upper respiratory tract, eye & skin irritation
US NIOSH Recommended Exposure Limits (RELs)	formic acid (Formic acid)	5	9					
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	formic acid (Formic acid)	5	9					
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	formic acid (Formic acid)	5	9					
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	formic acid (Formic acid)	5	9					
US - Minnesota Permissible Exposure Limits (PELs)	formic acid (Formic acid)	5	9					
US - California Permissible Exposure Limits for Chemical Contaminants	formic acid (Formic acid)	5	9	10	19			
US - Idaho - Limits for Air Contaminants	formic acid (Formic acid)	5	9					
US - Hawaii Air Contaminant Limits	formic acid (Formic acid)	5	9	10	18			
US - Alaska Limits for Air Contaminants	formic acid (Formic acid)	5	9					
US - Michigan Exposure Limits for Air Contaminants	formic acid (Formic acid)	5	9					
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	formic acid (Formic acid)	5	9	5	9			

US - Washington Permissible exposure limits of air contaminants	formic acid (Formic acid)	5		10					
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	formic acid (Formic acid)	5		10					
Canada - Prince Edward Island Occupational Exposure Limits	formic acid (Formic acid)	5		10					TLV Basis: upper respiratory tract, eye & skin irritation
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	formic acid (Formic acid)	5	9						
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	formic acid (Formic acid)	5	9.4	10	19				
US - Oregon Permissible Exposure Limits (Z-1)	formic acid (Formic acid)	5	9						
Canada - Northwest Territories Occupational Exposure Limits (English)	formic acid (Formic acid)	5	9	10	18				
Canada - Nova Scotia Occupational Exposure Limits	formic acid (Formic acid)	5		10					TLV Basis: upper respiratory tract, eye & skin irritation

EMERGENCY EXPOSURE LIMITS

Material	Revised IDLH Value (mg/m3)	Revised IDLH Value (ppm)
1-chloroethyl chloroformate		30 [Unch]
hydrogen chloride		50
formic acid		30 [Unch]

MATERIAL DATA

1-CHLOROETHYL CHLOROFORMATE:
HYDROGEN CHLORIDE:
■ for hydrogen chloride:
Odour Threshold Value: 0.262 ppm (detection), 10.06 ppm (recognition)
NOTE: Detector tubes for hydrochloric acid, measuring in excess of 1 ppm, are available commercially.
Hydrogen chloride is a strong irritant to the eyes, mucous membranes and skin. Chronic exposure produces a corrosive action on the teeth. Reports of respiratory irritation following short-term exposure at 5 ppm have lead to the recommended TLV-C. There is no indication that skin contact with hydrogen chloride elicits systemic poisoning and a skin designation has not been applied.
Exposure of humans to hydrogen chloride at 50 to 100 ppm for 1 hour is reported to be barely tolerable; 35 ppm caused irritation of the throat on short exposure and 10 ppm was the maximal concentration for prolonged exposure. It has been stated that hydrogen chloride at concentrations of 5 ppm is immediately irritating.
Odour Safety Factor(OSF)
OSF=1.3 (HYDROGEN CHLORIDE).
1-CHLOROETHYL CHLOROFORMATE:
FORMIC ACID:
■ for formic acid:
Odour Threshold Value: 20-40 mg/m3 (detection)
NOTE: Detector tubes for formic acid, measuring in excess of 1 ppm, are available commercially.
The TLV-TWA is thought to be protective against the risk of respiratory and eye irritation and possible skin irritation.
1-CHLOROETHYL CHLOROFORMATE:
■ No exposure limits set by NOHSC or ACGIH.

PERSONAL PROTECTION




Consult your EHS staff for recommendations

EYE

■
- Chemical goggles.
- Full face shield.

- Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

HANDS/FEET

■ Wear chemical protective gloves, eg. PVC.

Wear safety footwear or safety gumboots, eg. Rubber.

- 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).

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

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

OTHER

■

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

RESPIRATOR

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

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

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

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

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

ENGINEERING CONTROLS

■ Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator. Correct fit is essential to obtain adequate protection an approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

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

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favorable to capture	1: Disturbing room air currents

2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

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

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

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

State	Liquid	Molecular Weight	142.97
Melting Range (°F)	Not available	Viscosity	Not Available
Boiling Range (°F)	244.4- 246.2	Solubility in water (g/L)	Reacts
Flash Point (°F)	104.9	pH (1% solution)	Not available
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapor Pressure (mmHg)	168.014 (20 C)
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	1.325
Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	>1
Volatile Component (%vol)	Not available	Evaporation Rate	Not available

APPEARANCE

Colourless liquid; decomposes in water and alkalies. Soluble in most organic solvents. Some sources record flash point as 40 deg C. Consider storage as flammable goods.

log Kow -1.55- -0.22

Material	Value

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

■

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerization will not occur.

STORAGE INCOMPATIBILITY

■ Chloroformates:

- reaction with sulfoxides may be violent or explosive in the absence of diluent or other effective control of reaction rate; violent reactions may be explained in terms of exothermic polymerisation of formaldehyde which is formed under a variety of conditions by interaction of the sulfoxide with reactive halides.
- may react with rust on corroded materials
- avoid contact with metallic compounds which may act as decomposition catalysts

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 aliphatic amines, alkanolamines, alkylene oxides, aluminium, aluminium-titanium alloys, aromatic amines, amides, 2-aminoethanol, ammonia, ammonium hydroxide, calcium phosphide, chlorosulfonic acid, ethylenediamine, ethyleneimine, epichlorohydrin, isocyanates, metal acetylides, metal carbides, oleum, organic anhydrides, perchloric acid, 3-propiolactone, sulfuric acid, uranium phosphide, vinyl acetate, vinylidene fluoride
- attacks most metals forming flammable hydrogen gas, and some plastics, rubbers and coatings
- Contact with moisture or water may generate heat

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. In the absence of diluent or other effective control of reaction rate, sulfoxides may react violently or explosively with certain acyl halides. These violent reactions may be explained in terms of exothermic polymerization of formaldehyde which is formed under a variety of conditions by interaction of the sulfoxide with reactive halides.BRETHERICK L.: Handbook of Reactive Chemical Hazards.

Reacts with mild steel, galvanized steel / zinc producing hydrogen gas which may form an explosive mixture with air.
Formic acid:

- reacts explosively or violently strong oxidisers, with hydrogen peroxide, furfuryl alcohol, hypochlorites, isocyanides, nitromethane, chromic acid, nitric acid, phosphorus pentaoxide, strong bases thallium nitrate, nitromethane.
- reacts with concentrated sulfuric acid to produce carbon dioxide
- is incompatible with alkalis, ammonia, aliphatic amines, alkanolamines, furfuryl alcohol, isocyanates, alkylene oxides, epichlorohydrin, palladium
- is a strong reducing agent
- attacks aluminium, cast iron and steel, some plastics, rubber and coatings
- slowly decomposes in storage forming carbon dioxide gas

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

1-chloroethyl chloroformate

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.
No significant acute toxicological data identified in literature search.

CARCINOGEN

Hydrochloric acid	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3
Hydrogen chloride	ND	Carcinogen Category	A4

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:
FORMIC ACID:
1-CHLOROETHYL CHLOROFORMATE:
■ for formic acid (and formates)

- In the atmosphere, formic acid reacts with photochemically produced hydroxyl radicals (half-life 34 days).
- Formic acid is highly soluble in water, it is non-persistent (half-life 2-20 days).
- Leaches into some soils where it is expected to be biodegradable.
- Does not concentrate in food chain

HYDROGEN CHLORIDE:
FORMIC ACID:
1-CHLOROETHYL CHLOROFORMATE:
■ DO NOT discharge into sewer or waterways.
1-CHLOROETHYL CHLOROFORMATE:
■ For chloroformates:
Environmental fate:
If released to the atmosphere, chloroformates will degrade in the vapor phase by reaction with photochemically produced hydroxyl radicals . Since chloroformates hydrolyse readily in water, atmospheric degradation may occur through dissolution into clouds or through contact with rain or other atmospheric water. If released to water or moist soil, hydrolysis will be the dominate degradation process. If released to dry surfaces, chloroformates will evaporate into the atmosphere.
Aqueous hydrolysis will be the dominant fate process in moist soils. The low-boiling chloroformic esters, such as chloroethyl chloroformate, are highly volatile; therefore, evaporation from dry surfaces to the atmosphere will occur. Results of a single biodegradation study (using the Japanese MITI protocol) have classified ethyl chloroformate as biodegradable but ethyl chloroformate hydrolyses so fast the biodegradation rates are probably for the hydrolysis products.
Readily hydrolysis means that bioconcentration in aquatic organisms will not be an important process
However after hydrolysis of the ester the non-chlorofomate portion of the molecule must also be considered in terms of environmental fate and ecotoxicity.
HYDROGEN CHLORIDE:

■ Although inorganic chloride ions are not normally considered toxic they can exist in effluents at acutely toxic levels (chloride >3000 mg/l). the resulting salinity can exceed the tolerances of most freshwater organisms.

Inorganic chlorine eventually finds its way into the aqueous compartment and as such is bioavailable. Incidental exposure to inorganic chloride may occur in occupational settings where chemicals management policies are improperly applied. The toxicity of chloride salts depends on the counter-ion (cation) present; that of chloride itself is unknown. Chloride toxicity has not been observed in humans except in the special case of impaired sodium chloride metabolism, e.g. in congestive heart failure . Healthy individuals can tolerate the intake of large quantities of chloride provided that there is a concomitant intake of fresh water.

Although excessive intake of drinking-water containing sodium chloride at concentrations
above 2.5 g/litre has been reported to produce hypertension, this effect is believed to be related to the sodium ion concentration.

Chloride concentrations in excess of about 250 mg/litre can give rise to detectable taste in water, but the threshold depends upon the associated cations. Consumers can, however, become accustomed to concentrations in excess of 250 mg/litre. No health-based guideline value is proposed for chloride in drinking-water.

In humans, 88% of chloride is extracellular and contributes to the osmotic activity of body fluids. The electrolyte balance in the body is maintained by adjusting total dietary intake and by excretion via the kidneys and gastrointestinal tract. Chloride is almost completely absorbed in normal individuals, mostly from the proximal half of the small intestine. Normal fluid loss amounts to about 1.5?2 liters/day, together with about 4 g of chloride per day. Most (90 - 95%) is excreted in the urine, with minor amounts in faeces (4- %) and sweat (2%)

Chloride increases the electrical conductivity of water and thus increases its corrosivity. In metal pipes, chloride reacts with metal ions to form soluble salts thus increasing levels of metals in drinking-water. In lead pipes, a protective oxide layer is built up, but chloride enhances galvanic corrosion. It can also increase the rate of pitting corrosion of metal pipes.

FORMIC ACID:

■ Prevent, by any means available, spillage from entering drains or watercourses.

log Kow: -1.55- -0.22
BOD 5 if unstated: 0.02-0.27
ThOD: 0.35
BCF: 0.22
Degradation Biological: sig
processes Abiotic: RxnOH*

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
1-chloroethyl chloroformate	HIGH		HIGH	HIGH
hydrogen chloride	LOW		LOW	HIGH
formic acid	HIGH		HIGH	HIGH

GESAMP/EHS COMPOSITE LIST - GESAMP Hazard Profiles

Name / Cas No / RTECS No	EHS	TRN	A1a	A1b	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3
E1:_INTER F~ / CAS:50893 - 53- 3 / LQ4900000		809		356	0	NI	0	R	2	NI	1	(1)	2	3C	3	D	3

Legend: EHS=EHS Number (EHS=GESAMP Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships) NRT=Net Register Tonnage, A1a=Bioaccumulation log Pow, A1b=Bioaccumulation BCF, A1=Bioaccumulation, A2=Biodegradation, B1=Acuteaquatic toxicity LC/ECIC50 (mg/l), B2=Chronic aquatic toxicity NOEC (mg/l), C1=Acute mammalian oral toxicity LD50 (mg/kg), C2=Acutemammalian dermal toxicity LD50 (mg/kg), C3=Acute mammalian inhalation toxicity LC50 (mg/kg), D1=Skin irritation & corrosion, D2=Eye irritation& corrosion, D3=Long-term health effects, E1=Tainting, E2=Physical effects on wildlife & benthic habitats, E3=Interference with coastal amenities, For column A2: R=Readily biodegradable, NR=Not readily biodegradable. For column D3: C=Carcinogen, M=Mutagenic, R=Reprotoxic, S=Sensitising, A=Aspiration hazard, T=Target organ systemic toxicity, L=Lunginjury, N=Neurotoxic, I=Immunotoxic. For column E1: NT=Not tainting (tested), T=Tainting test positive. For column E2: Fp=Persistent floater, F=Floater, S=Sinking substances. The numerical scales start from 0 (no hazard), while higher numbers reflect increasing hazard. (GESAMP/EHS Composite List of Hazard Profiles - Hazard evaluation of substances transported by ships)

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 formic acid 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 U123 (waste code C,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.
- Treat and neutralize at an approved treatment plant. Treatment should involve: Neutralization with soda-ash or soda-lime followed by: Burial in a licensed land-fill or Incineration in a licensed 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:	G	Hazard class or Division:	6.1
Identification Numbers:	UN2742	PG:	II
Label Codes:	6.1, 8, 3	Special provisions:	5, IB1, T7, TP2
Packaging: Exceptions:	153	Packaging: Non-bulk:	202
Packaging: Exceptions:	153	Quantity limitations: Passenger aircraft/rail:	1 L
Quantity Limitations: Cargo aircraft only:	30 L	Vessel stowage: Location:	A
Vessel stowage: Other:	12, 13, 21, 25, 40, 100		

Hazardous materials descriptions and proper shipping names:
Chloroformates, toxic, corrosive, flammable, n.o.s.

Air Transport IATA:

ICAO/IATA Class:	6.1	ICAO/IATA Subrisk:	3, 8
UN/ID Number:	2742	Packing Group:	II
Special provisions:	None		

Shipping Name: CHLOROFORMATES, TOXIC, CORROSIVE, FLAMMABLE, N.O.S.(CONTAINS 1-CHLOROETHYL CHLOROFORMATE)

Maritime Transport IMDG:

IMDG Class:	6.1	IMDG Subrisk:	3, 8
UN Number:	2742	Packing Group:	II
EMS Number:	F-E , S-C	Special provisions:	None
Limited Quantities:	100 ml		

Shipping Name: CHLOROFORMATES, TOXIC, CORROSIVE, FLAMMABLE, N.O.S.(contains 1-chloroethyl chloroformate)

Section 15 - REGULATORY INFORMATION

REGULATIONS

ND

Ingredient	CAS	% de minimus concentration
hydrogen chloride	7647-01-0	1.0

formic acid	64-18-6	1.0

ND

Ingredient	CAS	RQ
hydrogen chloride	7647-01-0	5000 lb (2270 kg)
formic acid	64-18-6	5000 lb (2270 kg)

1-chloroethyl chloroformate (CAS: 50893-53-3) 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 - Ontario 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 Domestic Substances List (DSL)","Canada Ingredient Disclosure List (SOR/88-64)","Canada National Pollutant Release Inventory (NPRI)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","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 Council of Chemical Associations (ICCA) - High Production Volume List","OECD Representative 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 - 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 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 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 Dangerous waste constituents list","US - Washington Discarded Chemical Products List - ""U"" Chemical Products","US - Washington Permissible exposure limits of air contaminants","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US Cosmetic Ingredient Review (CIR) Cosmetic ingredients found safe, with qualifications","US CWA (Clean Water Act) - List of Hazardous Substances","US CWA (Clean Water Act) - Reportable Quantities of Designated Hazardous Substances","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 EPCRA Section 313 Chemical List","US Food Additive Database","US List of Lists - Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) 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) - Hazardous Constituents - Appendix VIII to 40 CFR 261","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes","US Toxic Substances Control Act (TSCA) - Inventory"

Regulations for ingredients

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 - 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 Industrial Hazardous Substances","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada Controlled Drugs and Substances Act Schedule VI","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)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","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","OECD Representative List of High Production Volume (HPV) Chemicals","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 - 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 - 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 the Emergency Planning and Community Right-to-Know Act (EPCRA) 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) - Inventory"

formic acid (CAS: 64-18-6) 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 - Ontario 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 Domestic Substances List (DSL)","Canada Ingredient Disclosure List (SOR/88-64)","Canada National Pollutant Release Inventory (NPRI)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","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 Council of Chemical Associations (ICCA) - High Production Volume List","OECD Representative 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 - 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 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 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 Dangerous waste constituents list","US - Washington Discarded Chemical Products List - ""U"" Chemical Products","US - Washington Permissible exposure limits of air contaminants","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US Cosmetic Ingredient Review (CIR) Cosmetic ingredients found safe, with qualifications","US CWA (Clean Water Act) - List of Hazardous Substances","US CWA (Clean Water Act) - Reportable Quantities of Designated Hazardous Substances","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 EPCRA Section 313 Chemical List","US Food Additive Database","US List of Lists - Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) 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) - Hazardous Constituents - Appendix VIII to 40 CFR 261","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes","US Toxic Substances Control Act (TSCA) - Inventory"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Cumulative effects may result following exposure*.
* (limited evidence).

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

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

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

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