Chloroacetyl chloride

sc-239516

Material Safety Data Sheet

Hazard Alert Code Key: EXTREME | HIGH | MODERATE | LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

Chloroacetyl chloride

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA

SUPPLIER

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

PRODUCT USE

Preparation of chloroacetophenone; intermediate; tear gas.

SYNONYMS

C2-H2-Cl2-O, ClCH2COCl, "acetyl chloride, chloro-", "chloroacetic acid chloride", "chloroacetic chloride", "monochloroacetyl chloride"

Section 2 - HAZARDS IDENTIFICATION

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

Reacts violently with water.
Causes severe burns.
Risk of serious damage to eyes.
Toxic: danger of serious damage to health by prolonged exposure through inhalation.
Toxic by inhalation, in contact with skin and if swallowed.

Very toxic to aquatic organisms.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

- The material can produce severe chemical burns within the oral cavity and gastrointestinal tract following ingestion.
- Toxic effects may result from the accidental ingestion of the material; animal experiments indicate that ingestion of less than 40 gram may be fatal or may produce serious damage to the health of the individual.
- Ingestion of acidic corrosives may produce burns around and in the mouth. the throat and 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.
- Monochloroacetic acids are highly poisonous and irritate the skin and eyes. Symptoms include jerks and convulsions, absence of urine movements, and depression of breathing.
- Ingestion of low-molecular organic acid solutions may produce spontaneous hemorrhaging, production of blood clots, gastrointestinal damage and narrowing of the esophagus and stomach entry.

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. 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.
- Irritation of the eyes may produce a heavy secretion of tears (lachrymation).
- Solutions of low-molecular weight organic acids cause pain and injuryto the eyes.

SKIN

- The material can produce severe chemical burns following direct contactwith the skin.
- Skin contact with the material may produce toxic effects; systemic effectsmay result following absorption.
- Skin contact with acidic corrosives may result in pain and burns; these may be deep with distinct edges and may heal slowly with the formation of scar tissue.
- 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.
- Human fatalities have occurred when chloroacetic acid covered 10% of skin area. Clinical symptoms involving a whole body drench included first degree burns to the skin and spitting up of blood, convulsions, loss of consciousness and death within 4 hours. Autopsy first-degree burns on the body, haemorrhage of the lungs, pleura membranes, liver, damage, and mucous membranes of the bronchia; point shaped bleedings of the epicardium, pleura and brain; spotted bleeding between the soft membranes of the brain; and the right heart cavities were dilated and filled with blood. In animal tests lethal results have followed from 3% skin area cover.

INHALED

- 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. 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.
- 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.

- Mice, rats and guinea pigs, exposed for 1.5 and 60 minutes to air saturated with chloroacetic acid survived with only mild eye and nasal irritation. Mild hyperaemia of the lungs was observed at autopsy.
- Inhalation of aerosols (mists, fumes), generated by the material during the course of normal handling, may produce toxic effects; these may be fatal.
- High concentrations cause inflamed airways and watery swellingof the lungs with edema.

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. Chronic exposure may inflame the skin or conjunctiva.

Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.

There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment.

Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.

In general, alpha-halocarboxylic acids and their esters are good alkylating agents and should be handled with care.

Alkylating agents may damage the stem cell which acts as the precursor to components of the blood. Loss of the stem cell may result in pancytopenia (a reduction in the number of red and white blood cells and platelets) with a latency period corresponding to the lifetime of the individual blood cells. Granulocytopenia (a reduction in granular leukocytes) develops within days and thrombocytopenia (a disorder involving platelets), within 1-2 weeks, whilst loss of erythrocytes (red blood cells) needs months to become clinically manifest. Aplastic anaemia

develops due to complete destruction of the stem cells.
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.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

HAZARD RATINGS

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

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

NAME	CAS RN	%
chloroacetyl chloride	79-04-9	>98
decomposes in water/moist air to produce		
hydrogen chloride	7647-01-0	
chloroacetic acid	79-11-8	

Section 4 - FIRST AID MEASURES

SWALLOWED

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- 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

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- 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 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].

Experimental antidotes effective against fluoroacetates are said to be effective against chloroacetates. For poisonings involving fluoroacetate the following regime is advised:

- Induce vomiting immediately if possible.
- Gastric lavage with tap water unless convulsions/imminent convulsions make this impracticable.
- Instill into the stomach sodium or magnesium sulfate in water (15-30 gm).
- Although the clinical efficacy of monoacetin (glycerol monoacetate) is not established, it should probably be administered if available. The recommended dose is 0.5 ml/kg of undiluted fluid intramuscularly every half-hour for several hours and then at a reduced level for at least 12 hours. In the same dose monoacetin may also be given intravenously after dilution with 5 parts of sterile isotonic saline. No preparation of monoacetin is known to be available on the market. Usual commercial fluid contains free glycerin and assays at 70% at best. even the use of nonsterile preparations must be considered. Injection may be expected to produce some sedation and vasodilation. Intramuscular injection sites must be varied because of local pain and edema. Should parenteral administration be not feasible, the patient may drink a mixture of 100 ml of monoacetin in 500 ml water. Repeat every hour.
- If monoacetin is not available, acetamide or ethanol may be given in the same doses.
- A short-acting barbiturate drug or diazepam may be tried to control convulsions.
- Oxygen therapy and artificial ventilation as required.
- It is doubtful that digitalis is ever warranted. Parenteral procainamide or quinidine may be given a therapeutic trial but in experimental poisonings these drugs have proved less successful than monoacetin in controlling cardiac arrhythmias.
- If possible, monitor the electrocardiogram continuously and secure chest electrodes for external defibrillation if it becomes necessary.

[GOSSELIN, SMITH HODGE: Clinical Toxicology of Commercial Products 5th Ed].

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):	60.005 @ 41.5 C
Upper Explosive Limit (%):	Not available
Specific Gravity (water=1):	1.418
Lower Explosive Limit (%):	Not available

EXTINGUISHING MEDIA

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- DO NOT use water.

FIRE FIGHTING

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- Alert Emergency Responders and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear breathing apparatus plus protective gloves.
- 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

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

Combustion products include: carbon monoxide (CO), carbon dioxide (CO2), 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 AB-P Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

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- Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
- Check regularly for spills and leaks.
- Clean up waste regularly and abnormal spills immediately.
- Avoid breathing dust and contact with skin and eyes.
- Wear protective clothing, gloves, safety glasses and dust respirator.
- Use dry clean up procedures and avoid generating dust.
- Vacuum up or sweep up. NOTE: Vacuum cleaner must be fitted with an exhaust micro filter (HEPA type) (consider explosion-proof machines designed to be grounded during storage and use).
- Dampen with water to prevent dusting before sweeping.
- Place in suitable containers for disposal.

MAJOR SPILLS

• Chemical Class:acidic compounds, organic

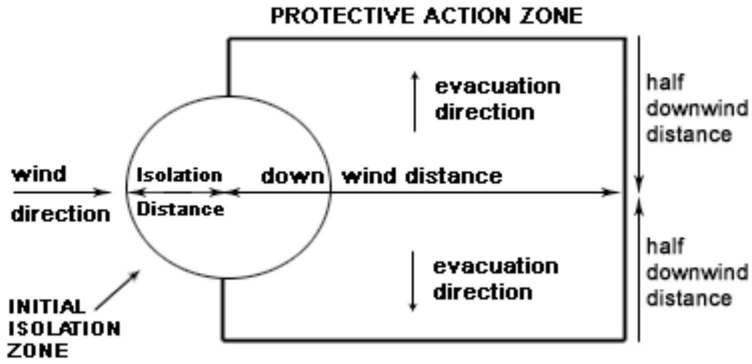
For release onto land: recommended sorbents listed in order of priority.

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.
- Consider evacuation (or protect in place).
- Stop leak if safe to do so.
- Contain spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Neutralize/decontaminate residue.
- 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 US Emergency Response Guide 2000 Guide 156

SMALL SPILLS

Name	Isolation Distance	Downwind Day	Protection Night
Chloroacetyl chloride (when spilled in water)	100 ft (30 m)	0.1 mile (0.2 km)	0.1 mile (0.2 km)
Chloroacetyl chloride (when spilled on land)	100 ft (30 m)	0.1 mile (0.2 km)	0.3 mile (0.5 km)

LARGE SPILLS

Name	Isolation Distance	Downwind Day	Protection Night
Chloroacetyl chloride (when spilled in water)	200 ft (60 m)	0.2 mile (0.3 km)	0.8 mile (1.3 km)
Chloroacetyl chloride (when spilled on land)	300 ft (95 m)	0.5 mile (0.8 km)	1 mile (1.6 km)

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

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 156 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)

chloroacet					
yl					
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~
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~
chloroacet					
ic acid					
AEGL Type	10 min	30 min	60 min	4 hr	8 hr
1	NR	NR	NR	NR	GALSYN~
3	NR	NR	NR	NR	

NOTES
NR = Not recommended due to insufficient data
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:

chloroacetyl chloride	10ppm

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

chloroacetyl chloride	0.5ppm

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

chloroacetyl chloride	0.05ppm

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

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- 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.

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

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- 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/m³	STEL ppm	STEL mg/m³	Peak ppm	Peak mg/m³	TWA F/CC	Notes
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	chloroacetyl chloride (Hydrogen chloride)					5	7,5		
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	chloroacetyl chloride (Hydrogen chloride)					5	7		

US OSHA Permissible Exposure Levels (PELs) - Table Z1	chloroacetyl chloride (Hydrogen chloride)					5	7	
US ACGIH Threshold Limit Values (TLV)	chloroacetyl chloride (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
Canada - Prince Edward Island Occupational Exposure Limits	chloroacetyl chloride (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
US - Michigan Exposure Limits for Air Contaminants	chloroacetyl chloride (Hydrogen chloride)					5	7	
US - Alaska Limits for Air Contaminants	chloroacetyl chloride (Hydrogen chloride)					5	7	
US - Oregon Permissible Exposure Limits (Z-1)	chloroacetyl chloride (Hydrogen chloride)					5	7	
Canada - Nova Scotia Occupational Exposure Limits	chloroacetyl chloride (Hydrogen chloride)					2		TLV Basis: upper respiratory tract irritation
Canada - Northwest Territories Occupational Exposure Limits (English)	chloroacetyl chloride (Hydrogen chloride)					5	7.5	
US NIOSH Recommended Exposure Limits (RELs)	chloroacetyl chloride (Hydrogen chloride)					5	7	
US - Idaho - Limits for Air Contaminants	chloroacetyl chloride (Hydrogen chloride)					5	7	
US - California Permissible Exposure Limits for Chemical Contaminants	chloroacetyl chloride (Hydrogen chloride; muriatic acid)					5	7	
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	chloroacetyl chloride (Hydrogen chloride)					5	7	
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	chloroacetyl chloride (Hydrogen chloride)					5	7	
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	chloroacetyl chloride (Hydrogen chloride)	(C)5	(C)7					
Canada - British Columbia Occupational Exposure Limits	chloroacetyl chloride (Hydrogen chloride Revised 2003)					2		
Canada - Alberta Occupational Exposure Limits	chloroacetyl chloride (Hydrogen chloride)					2	3	
Canada - Ontario Occupational Exposure Limits	chloroacetyl chloride (Hydrogen chloride)					2		
US - Minnesota Permissible Exposure Limits (PELs)	chloroacetyl chloride (Hydrogen chloride)					5	7	
US - Washington Permissible exposure limits of air contaminants	chloroacetyl chloride (Hydrogen chloride)					5.0		
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	chloroacetyl chloride (Hydrogen chloride)	5	7	-	-			
US - Hawaii Air Contaminant Limits	chloroacetyl chloride (Hydrogen chloride)					5	7	
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	chloroacetyl chloride (Hydrogen chloride)					2		
Canada - Nova Scotia Occupational Exposure Limits	chloroacetyl chloride (Chloroacetyl chloride)	0.05		0.15				TLV Basis: upper respiratory tract irritation

Canada - Northwest Territories Occupational Exposure Limits (English)	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.23	0.15	0.69				
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.23	0.15	0.69				
Canada - Prince Edward Island Occupational Exposure Limits	chloroacetyl chloride (Chloroacetyl chloride)	0.05		0.15					TLV Basis: upper respiratory tract irritation
US - Michigan Exposure Limits for Air Contaminants	chloroacetyl chloride (Chloroacetyl chloride)	0.5	0.2						
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	chloroacetyl chloride (Chloroacetyl chloride)	0.05		0.15					Skin
US - Washington Permissible exposure limits of air contaminants	chloroacetyl chloride (Chloroacetyl chloride)	0.05		0.15					
US - Alaska Limits for Air Contaminants	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.2						
US - Hawaii Air Contaminant Limits	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.2						
US ACGIH Threshold Limit Values (TLV)	chloroacetyl chloride (Chloroacetyl chloride)	0.05		0.15					TLV Basis: upper respiratory tract irritation
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.2						
US - California Permissible Exposure Limits for Chemical Contaminants	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.2	0.15	0.69				
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.2						
US - Minnesota Permissible Exposure Limits (PELs)	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.2						
Canada - Alberta Occupational Exposure Limits	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.2	0.15	0.7				
US NIOSH Recommended Exposure Limits (RELs)	chloroacetyl chloride (Chloroacetyl chloride)	0.05	0.2						
Canada - Ontario Occupational Exposure Limits	chloroacetyl chloride (Chloroacetyl chloride)	0.05		0.15					
Canada - British Columbia Occupational Exposure Limits	chloroacetyl chloride (Chloroacetyl chloride)	0.05		0.15					Skin
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	chloroacetic acid (Monochloroacetic acid)	0.5	1.9					
Canada - British Columbia Occupational Exposure Limits	chloroacetic acid (Chloroacetic acid)	0.3						
Canada - Ontario Occupational Exposure Limits	chloroacetic acid (Monochloroacetic acid, inhalable, vapour and aerosol)	0.5						Skin
US AIHA Workplace Environmental Exposure Levels (WEELs)	chloroacetic acid (Monochloroacetic Acid)	0.5						skin
Canada - Nova Scotia Occupational Exposure Limits	chloroacetic acid (Monochloroacetic acid)	0.5						TLV Basis: upper respiratory tract irritation

Canada - Prince Edward Island Occupational Exposure Limits	chloroacetic acid (Monochloroacetic acid)	0.5	TLV Basis: upper respiratory tract irritation
US ACGIH Threshold Limit Values (TLV)	chloroacetic acid (Monochloroacetic acid)	0.5	TLV Basis: upper respiratory tract irritation

EMERGENCY EXPOSURE LIMITS

Material	Revised IDLH Value (mg/m3)	Revised IDLH Value (ppm)
chloroacetyl chloride		50
hydrogen chloride		50

MATERIAL DATA

CHLOROACETYL CHLORIDE:
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).
CHLOROACETIC ACID:
CHLOROACETYL CHLORIDE:
• For chloroacetic acid;
OES TWA: 0.3 ppm, 1.2 mg/m3 (skin) *
Odour Threshold Value: < 5 ppm
Monochloroacetic acid (MCA) is a strong acids which causes severe burns to the skin, eyes and respiratory tract. Skin exposure to molten MCA may be lethal. the perception of mucous membrane irritation in humans is reportedly 1.5 ppm (5.7 mg/m3). A workplace environmental exposure limit (WEEL) has been proposed by the AIHA * and is thought to be low enough to prevent irritation whilst protecting against systemic toxicity.
CHLOROACETIC ACID:
CHLOROACETYL CHLORIDE:
• Exposure limits with "skin" notation indicate that vapor and liquid may be absorbed through intact skin. Absorption by skin may readily exceed vapor inhalation exposure. Symptoms for skin absorption are the same as for inhalation. Contact with eyes and mucous membranes may also contribute to overall exposure and may also invalidate the exposure standard.
CHLOROACETYL CHLORIDE:
• For chloroacetyl chloride:
The TLV-TWA is thought to be protective against eye, skin and respiratory system irritation, against gastrointestinal effects and severe systemic effects including life-threatening coma, cardiac arrest and pulmonary oedema.
Odour Safety Factor(OSF)
OSF=1.3 (chloroacetyl chloride).

PERSONAL PROTECTION

Consult your EHS staff for recommendations

EYE

•

- Chemical goggles.
- Full face shield.
- Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

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).

- 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.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

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	AB-1 P	-
1000	50	-	AB-1 P
5000	50	Airline*	-
5000	100	-	AB-2 P
10000	100	-	AB-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	112.94
Melting Range (°F)	-7.6	Viscosity	Not Available
Boiling Range (°F)	221- 222.8	Solubility in water (g/L)	Reacts violently
Flash Point (°F)	Not Available	pH (1% solution)	Not available
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapor Pressure (mmHg)	60.005 @ 41.5 C
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	1.418
Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	>1
Volatile Component (%vol)	100	Evaporation Rate	Not available

APPEARANCE

Colourless to light yellow liquid with pungent odour of hydrochloric acid which serves as a reasonably reliable warning of its presence.; decomposes in water

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

•

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

STORAGE INCOMPATIBILITY

• Chloroacetyl chloride:

- forms corrosive vapours in air
- decomposes violently in water producing chloroacetic acid and hydrogen chloride gas
- reacts violently with combustibles, alcohols, metal powders, sodium amide, and many organic materials and compounds, producing toxic fumes and the danger of fire and explosion
- aqueous solutions are incompatible with caustics, alkalis, alcohols, aliphatic amines, alkanolamines, ammonia, epichlorohydrin, isocyanates, alkylene oxides, sulfuric acid

Chloroacetyl chloride is one compound in the series of chlorinated acetyl chlorides. These are acetyl chloride, chloroacetyl chloride, dichloroacetyl chloride, and trichloroacetyl chloride. Chloroacetyl chloride displays reactivity with water that is intermediate between acetyl chloride and dichloroacetyl chloride. Acid chlorides react with water to produce the corresponding carboxylic acid, hydrogen ion, and chloride. The generic reaction of acid chlorides and nucleophiles such as water, alcohols, and amines, is used for the laboratory scale preparation of the corresponding acids, esters, and amides and is referred to as an acylation reaction. These reactions proceed exothermically and generally occur rapidly at room temperature.

Chloroacetyl chloride decomposes rapidly and exothermically upon addition to water. An ampoule containing 3 g of the material reacted completely in 750 mL of water in two hours, which corresponds to a t1/2 < 30 minutes. The authors note that the rate of reaction was limited by the rate at which the material went into solution. When chloroacetyl chloride is added in a co-solvent (in 150 mL of acetone) to 600 mL of water the reactions proceeded even more rapidly. In the gas phase, hydrolysis of chloroacetyl chloride and water vapor is slow.

Chloroacetic acid:

- is a strong acid in aqueous solution; reacts violently with strong bases
- is in compatible with sulfuric acid, ammonia, alcohols, amines, alkanolamines, alkylene oxides, cyanides, epichlorohydrin, isocyanates, strong oxidisers, sulfides
- attacks some plastics, rubbers and coatings, including nitrile rubber, PVC and polyvinyl alcohol (PVA)
- attacks most metals in the presence of moisture

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

Reacts with mild steel, galvanized steel / zinc producing hydrogen gas which may form an explosive mixture with air.
Avoid storage with reducing agents.
Segregate from alcohol, water.

- Avoid strong bases.
- NOTE: May develop pressure in containers; open carefully. Vent periodically.

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

Section 11 - TOXICOLOGICAL INFORMATION

chloroacetyl chloride

TOXICITY AND IRRITATION

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

TOXICITY	IRRITATION
Oral (rat) LD50: 280 mg/kg	Nil Reported
Inhalation (rat) LC50: 1000 ppm/4h	
Dermal (rat) LD50: 662 mg/kg	
Oral (mouse) LD50: 220 mg/kg	
Inhalation (mouse) LC50: 1300 ppm/2h	
Intravenous (mouse) LD50: 32 mg/kg	

- 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.

for monochloroacetic acid (MCA) and sodium monochloroacetate (SMCA)

The anticipated acute and chronic human health hazards posed by MCA/SMCA are effects on the cardiac system, the central nervous system, and kidneys. Chronic exposure may also result in hepatoxicity and teratogenic effects (SMCA tested only). In addition, MCA is highly corrosive and irritating to the eyes, skin and respiratory tract.

The toxicity profile of MCA and SMCA are similar for the oral route of exposure. However, SMCA is much less toxic than MCA by the dermal route in acute studies indicating that dermal absorption of MCA is greater than for SMCA. Toxicity associated with inhalation exposure is difficult to determine for MCA because of poor study design and/or inadequate reporting of available studies: studies for SMCA are not available. However, due to the corrosive property of MCA and toxicity profile of MCA/SMCA it is prudent to recommend that exposure by the inhalation to MCA and SMCA should be avoided.

Acute dermal exposure of workers to MCA may result in death even after rapid and extensive washing of the skin area. The effects may be delayed. However, under "normal" exposure conditions with strict use of recommended protective measures it is envisaged that exposure and subsequent effects will be low. It has been suggested that oral and inhalation absorption may be limited because of the irritating effects of MCA and that the low odour threshold for MCA (0.01 ppm, 0.042 mg/m3) indicates good alert properties of the compound. In contrast, SMCA is less irritating and therefore oral, inhalation dermal exposure may occur unobserved. Because SMCA forms dusts, inhalation and dermal exposure may represent important routes of exposure.

The biochemical mechanism of action resulting in death is not understood. Contributing factors apparently believed to be involved are: (i) the inhibition of the tricarboxylic acid cycle decreasing cellular energy supply and increasing acidosis with glycolic acid and oxalate production, and; (ii) effects on cellular components where sulfhydryl groups are critical for normal biological activity. Both of these effects may contribute to CNS, cardiovascular, renal and hepato effects. In addition, the metabolites glycolic acid and oxalates may contribute to CNS and renal toxicity.

Monofluoroacetic acid (MFA; CAS No. 144-49-0), monoidoacetic acid (MIA: CAS No. 64-69-7), monobromoactic acid (MBA; CAS No. 79-08-3) and the sodium salts of MFA and MIA (CAS No. 62-74-8 and 305-53-3) are close structural analogues of MCA and SMCA. MFA is more toxic than MCA but it is also corrosive and may cause effects on the cardiac system, the central nervous system and kidneys which may result in death. However, MCA apparently has a different mechanism of action than its structural halo analogues. For example, both MCA and MFA inhibit aconitase required for acetate metabolism in the tricarboxylic acid cycle but their inhibition kinetics are different. In addition, MCA like MIA but unlike MFA depletes organ thiols. Hence, comparison of MCA or SMCA with its structural halo analogues for risk assessment or identifying antidotes should only be done with prudence.

CARCINOGEN

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

SKIN

chloroacetyl chloride	ND	Skin Designation	Yes
chloroacetyl chloride	ND	Notation	Skin
chloroacetyl chloride	US - California Permissible Exposure Limits for Chemical Contaminants - Skin	Skin	S
chloroacetyl chloride	Canada - Alberta Occupational Exposure Limits - Skin	Substance Interaction	1,3
chloroacetic acid	ND	Notes	Skin

chloroacetic acid	ND	Notes	skin
chloroacetic acid	ND	Skin Designation	Yes
chloroacetic acid	Canada - Alberta Occupational Exposure Limits - Skin	Substance Interaction	1,3

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:
CHLOROACETIC ACID:
CHLOROACETYL CHLORIDE:
• For chloroacetic acid and sodium monochloroacetate (MCA and SMCA):
Environmental fate:
Chloroacetic acid does not appreciably absorb UV radiation above 290 nm and is therefore not expected to be directly photolysed. It photodechlorinates very slowly in air-saturated solutions with only <0.4 % being converted to free chloride when irradiated for 11 hours in a laboratory photoreactor (the rate significantly decreases after a few hours). Photodechlorination is much lower in the absence of oxygen. The presence of radiosensitisers such as p-cresol and tryptophan which generate superoxide anion radicals (O2.-) increase the rate of photodechlorination by up to 16-fold. Hydrolysis did not contribute to the degradation in these experiments.
Volatilisation from water/soil: Chloroacetic acid has a pKa of 2.86 and will be completely ionized at environmental pHs. Evaporation from water will therefore not be a significant loss process.
Atmospheric fate: MCA/SMCA released to the atmosphere, i.e. during production or pesticide spraying, is dissolved in water as an aerosol. The aerosol will be subject to gravitational settling and undergo slow photodechlorination. Degradation in the atmosphere is therefore expected to be low.
Biodegradation: Chloroacetic acid is degraded by greater than 70-90% within 5-10 days in laboratory biodegradation tests using sewage or acclimated sludge inocula. The degradation rate is increased by acclimation and involves dechlorination. In river water, 73% MCA/SMCA is mineralized to carbon dioxide in 8-10 days at 29 C. Even under anaerobic conditions the compound seems to be readily degraded to methane, CO2 and chloride ions (86-90% reduction within 2 days at 34 C). Degradation occurs in soil, however, under acidic conditions and/or a low temperature MCA/SMCA is comparatively persistent.
Aquatic fate: MCA is mineralised in water (73% in 8-10 days), and is not appreciably adsorbed to sediment.
Chloroacetic acid has a very low log octanol/water partition coefficient, 0.22, and therefore is not expected to bioconcentrate in fish.
Terrestrial fate: When MCA/SMCA is released onto the soil surface, it will leach into the ground. Degradation occurs in the soil, however, under acidic conditions and/or at low temperature, MCA/SMCA is only slowly degraded. Chloroacetic acid has a very low log octanol/water partition coefficient, 0.22, and therefore is not expected to be appreciably adsorbed to soil particles.
Ecotoxicity:
MCA/SMCA are very highly toxic to aquatic and terrestrial plants and highly acute toxic to birds.
MCA/SMCA are low/moderate acute and chronic toxic to aquatic animals.
The anticipated ecotoxicological hazards posed by MCA/SMCA are low/moderate acute and chronic toxicity to aquatic animals. In acute studies with fish the acid form was more toxic than the salt form. This difference is probably a pH dependent effect. Acute toxicity data are available for three trophic levels. .
• Ecotoxicity:
The tolerance of water organisms towards pH margin and variation is diverse. Recommended pH values for test species listed in OECD guidelines are between 6.0 and almost 9. Acute testing with fish showed 96h-LC50 at about pH 3.5.
• Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash-waters.
Wastes resulting from use of the product must be disposed of on site or at approved waste sites.
• Very toxic to aquatic organisms.
HYDROGEN CHLORIDE:
CHLOROACETIC ACID:
CHLOROACETYL CHLORIDE:
• DO NOT discharge into sewer or waterways.
CHLOROACETYL CHLORIDE:
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.
CHLOROACETIC ACID:

• Fish LC50 (96hr.) (mg/l):	150

• log Kow (Prager 1995):	0.22
• Hazardous Air Pollutant:	Yes
• Half- life Soil - High (hours):	168
• Half- life Soil - Low (hours):	24
• Half- life Air - High (hours):	2050
• Half- life Air - Low (hours):	205
• Half- life Surface water - High (hours):	168
• Half- life Surface water - Low (hours):	24
• Half- life Ground water - High (hours):	336
• Half- life Ground water - Low (hours):	48
• Aqueous biodegradation - Aerobic - High (hours):	168
• Aqueous biodegradation - Aerobic - Low (hours):	24
• Aqueous biodegradation - Anaerobic - High (hours):	672
• Aqueous biodegradation - Anaerobic - Low (hours):	96
• Aqueous biodegradation - Removal secondary treatment - High (hours):	19000
• Aqueous biodegradation - Removal secondary treatment - Low (hours):	1900
• Photolysis maximum light absorption - High (nano- m):	360
• Aqueous photolysis half- life - High (hours):	19000
• Aqueous photolysis half- life - Low (hours):	1900
• Photooxidation half- life air - High (hours):	2300
• Photooxidation half- life air - Low (hours):	230
• First order hydrolysis half- life (hours):	23000
• Fish LC50 (96hr.) (mg/l):	14- 20
• Daphnia magna EC50 (48hr.) (mg/l):	30

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
chloroacetyl chloride	HIGH		LOW	HIGH
hydrogen chloride	LOW		LOW	HIGH
chloroacetic acid	LOW	HIGH	LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information

Corrosivity characteristic: use EPA hazardous waste number D002 (waste code C)

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:	None	Hazard class or Division:	6.1
Identification Numbers:	UN1752	PG:	I
Label Codes:	6.1, 8	Special provisions:	2, B3, B8, B9, B14, B32, B77, N34, N43, T20, TP2, TP13, TP38, TP45
Packaging: Exceptions:	None	Packaging: Non-bulk:	227
Packaging: Exceptions:	None	Quantity limitations: Passenger aircraft/rail:	Forbidden
Quantity Limitations: Cargo aircraft only:	Forbidden	Vessel stowage: Location:	D
Vessel stowage: Other:	40		

Hazardous materials descriptions and proper shipping names:
Chloroacetyl chloride

Air Transport IATA:

ICAO/IATA Class:	6.1	ICAO/IATA Subrisk:	8
UN/ID Number:	1752	Packing Group:	-
Special provisions:	A2		
Cargo Only			
Packing Instructions:	Forbidden	Maximum Qty/Pack:	Forbidden
Passenger and Cargo		Passenger and Cargo	
Packing Instructions:	Forbidden	Maximum Qty/Pack:	Forbidden
Passenger and Cargo Limited Quantity		Passenger and Cargo Limited Quantity	
Packing Instructions:	-	Maximum Qty/Pack:	-

Shipping Name: CHLOROACETYL CHLORIDE

Maritime Transport IMDG:

IMDG Class:	6.1	IMDG Subrisk:	8
UN Number:	1752	Packing Group:	I
EMS Number:	F-A , S-B	Special provisions:	None
Limited Quantities:	0		

Shipping Name: CHLOROACETYL CHLORIDE

Section 15 - REGULATORY INFORMATION

chloroacetyl chloride (CAS: 79-04-9) is found on the following regulatory lists;

"Canada - Alberta Occupational Exposure Limits","Canada - British Columbia Occupational Exposure Limits","Canada - Northwest Territories Occupational Exposure Limits (English)","Canada - Nova Scotia Occupational Exposure Limits","Canada - Ontario 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 Ingredient Disclosure List (SOR/88-64)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","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 - Hawaii Air Contaminant Limits","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 - 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 ACGIH Threshold Limit Values (TLV)","US Department of Homeland Security Chemical Facility Anti-Terrorism Standards - Chemicals of Interest","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA Acute Exposure Guideline Levels (AEGLs) - Interim","US EPA High Production Volume Program Chemical List","US NIOSH

Recommended Exposure Limits (RELs)","US Toxic Substances Control Act (TSCA) - Inventory","USA: Chemical Facility Anti-Terrorism Standards - List Appendix A - 6CFR 27"

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"

chloroacetic acid (CAS: 79-11-8) is found on the following regulatory lists;

"Canada - Alberta Occupational Exposure Limits","Canada - British Columbia Occupational Exposure Limits","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 Ingredient Disclosure List (SOR/88-64)","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","OECD Representative List of High Production Volume (HPV) Chemicals","US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified","US - California Toxic Air Contaminant List Category IV","US - Massachusetts Oil & Hazardous Material List","US - Minnesota Hazardous Substance List","US - New Jersey Right to Know Hazardous Substances","US - Pennsylvania - Hazardous Substance List","US ACGIH Threshold Limit Values (TLV)","US ACGIH Threshold Limit Values (TLV) - Carcinogens","US AIHA Workplace Environmental Exposure Levels (WEELs)","US CAA (Clean Air Act) - HON Rule - Organic HAPs (Hazardous Air Pollutants)","US Clean Air Act - Hazardous Air Pollutants","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA Acute Exposure Guideline Levels (AEGLs) - Final","US EPA High Production Volume Program Chemical List","US EPA Master Testing List - Index I Chemicals Listed","US EPCRA Section 313 Chemical List","US FDA Indirect Food Additives: Adhesives and Components of Coatings - Substances for Use Only as Components of Adhesives - Adhesives","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 SARA Section 302 Extremely Hazardous Substances","US Toxic Substances Control Act (TSCA) - Inventory"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

- Cumulative effects may result following exposure*.
- Limited evidence of a carcinogenic effect*.

* (limited evidence).

- 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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