Tri-tert-butylphosphine

sc-251289

Material Safety Data Sheet

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

Tri-tert-butylphosphine

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA

SUPPLIER

Santa Cruz Biotechnology, Inc.
2145 Delaware Avenue
Santa Cruz, California 95060
800.457.3801 or 831.457.3800
EMERGENCY:
ChemWatch
Within the US & Canada: 877-715-9305
Outside the US & Canada: +800 2436 2255
(1-800-CHEMCALL) or call +613 9573 3112

PRODUCT USE

- Intermediate.

SYNONYMS

C12-H27-P, [CH3(CH2)3]3P, "phosphine, tri-tert-butyl-", "tributyl phosphine"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

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

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

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

Spontaneously flammable in air.
Causes burns.
Risk of serious damage to eyes.
Highly flammable.
May cause fire.
May cause long-term adverse effects in the aquatic environment.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

- The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.
- The material has NOT been classified as "harmful by ingestion". This is because of the lack of corroborating animal or human evidence. The material may still be damaging to the health of the individual, following ingestion, especially where pre-existing organ (e.g. liver, kidney) damage is evident. Present definitions of harmful or toxic substances are generally based on doses producing mortality (death) rather than those producing morbidity (disease, ill-health). Gastrointestinal tract discomfort may produce nausea and vomiting. In an occupational setting however, unintentional ingestion is not thought to be cause for concern.
- Symptoms of exposure may be delayed.
- Not normally a hazard due to physical form of product.
- Considered an unlikely route of entry in commercial/industrial environments.

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).

SKIN

- The material can produce chemical burns following direct contactwith the skin.
- Skin contact with the material may damage the health of the individual; systemic effects may result following absorption.
- Reactions may not occur on exposure but response may be delayed with symptoms only appearing many hours later.
- Open cuts, abraded or irritated skin should not be exposed to this material.
- Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED

- If inhaled, this material can irritate the throat andlungs of some persons.
- The material is not thought to produce adverse health effects following inhalation (as classified using animal models). Nevertheless, adverse effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting.
- Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by narcosis, reduced alertness, loss of reflexes, lack of coordination and vertigo.
- 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.
- The only signs during exposure to phosphine may be mild respiratory irritation although some victims report dyspnea, weakness, tremor and convulsions.

Phosphine is a very toxic gas. It appears to cause, chiefly, a depression of the central nervous system (CNS) and irritation of the lungs. Inhalation of phosphine causes restlessness, followed by tremors, fatigue, slight drowsiness, nausea, vomiting, cyanosis, pulmonary oedema, rapid pulse (tachycardia) low blood pressure (hypotension) and frequently, severe gastric pain and diarrhoea. There is often headache, thirst, dizziness, oppression in the chest and burning substernal pain; later the patient may become dyspneic and develop cough and sputum. Coma or convulsions may precede death.

Overexposure may cause tightness of chest and cough, headache, dizziness, nausea, vomiting, tremor, loss of coordination, diarrhoea. More severe poisoning may result in pulmonary oedema, cardiovascular collapse, cardiac dysrhythmias, myocardial injury, disordered liver function. Mortality from severe poisoning is high. Death has resulted from exposure to 8 ppm phosphine for 1-2 hours per day over several days. Asthma and inflammatory or fibrotic pulmonary disease will be aggravated.

Phosphine which is not eventually expired through the lungs may be metabolised to phosphate, hyposphosphite and phosphite and excreted in urine. Oxyhaemoglobin in mammals is converted by phosphine into a verdichromogen-like material through Fe^{3+}-containg compounds. Birds exposed to phosphine exibited tonic-clonic convulsions; their organs were congested with oxygenated blood on exzmination. Similar effects were seen in cats, rabbits, rats and guinea pigs and death was attributed to respiratory paralysis followed by cardiac arrest.

CHRONIC HEALTH EFFECTS

- Repeated or prolonged exposure to corrosives may result in the erosion of teeth, inflammatory and ulcerative changes in the mouth and necrosis (rarely) of the jaw. Bronchial irritation, with cough, and frequent attacks of bronchial pneumonia may ensue. Gastrointestinal disturbances may also occur. Chronic exposures may result in dermatitis and/or conjunctivitis.

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

Chronic phosphine poisoning is said to resemble chronic phosphorus poisonings which produces stomach pains, vomiting and diarrhoea.

Chronic poisoning, characterised by anemia, bronchitis, gastrointestinal disturbances and visual, speech and motor disturbances may result from continued exposure to low concentrations.
Chronic exposure may produce systemic poisoning characterised by cachexia (general ill-health and malnutrition), anaemia, bronchitis, and necrosis of the mandible, the so-called "phossy" or Lucifer's" jaw. Other bones may also be involved as demonstrated by chronic systemic administration to animals which produces dense growth lines in all extremities proximal to the epiphyses (phosphoschicht).

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
tri-tert-butylphosphine	13716-12-6	>98
NOTE: Reacts with water or moisture to give		
phosphine	7803-51-2	

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. For THERMAL burns: · Do NOT remove contact lens · Lay victim down, on stretcher if available and pad BOTH eyes, make sure dressing does not press on the injured eye by placing thick pads under dressing, above and below the eye. · Seek urgent medical assistance, or transport to hospital.

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. In case of burns: · Immediately apply cold water to burn either by immersion or wrapping with saturated clean cloth. · DO NOT remove or cut away clothing over burnt areas. DO NOT pull away clothing which has adhered to the skin as this can cause further injury. · DO NOT break blister or remove solidified material. · Quickly cover wound with dressing or clean cloth to help prevent infection and to ease pain. · For large burns, sheets, towels or pillow slips are ideal; leave holes for eyes, nose and mouth. · DO NOT apply ointments, oils, butter, etc. to a burn under any circumstances. · Water may be given in small quantities if the person is conscious. · Alcohol is not to be given under any circumstances. · Reassure. · Treat for shock by keeping the person warm and in a lying position. · Seek medical aid and advise medical personnel in advance of the cause and extent of the injury and the estimated time of arrival of the patient.

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. 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 severe acute or short term repeated exposures to phosphine:
· There is no antidote. Clinical manifestations include headache, fatigue, nausea, vomiting, cough, dyspnea, parethesias, jaundice, ataxia, intention tremor, weakness and diplopia.
· i Care is supportive and all obviously symptomatic patients should be monitored in an intensive care setting. Watch for dysrhythmias. ii Replace fluids/electrolytes. iii Follow blood chemistries (calcium, phosphorus, glucose, prothrombin time, CBC) at least daily. iv Follow renal and hepatic function at least daily. Avoid any alcohol intake.
· The risk of pulmonary edema after severe exposure requires observation for 24-48 hours but can appear several days later. Initial X-ray may be useful in assessing development of edema. If edema develops, nurse with trunk upright and administer oxygen at atmospheric pressure. Diuretics, morphine, theophylline derivatives are of little benefit since edema is exudate rather than transudate. Bronchodilators by nebulizer or metered aerosol may reduce bronchospasm and dyspnea. Where immediate respiratory symptoms suggest lower airway exposure, steroids may be beneficial, with intravenous injection of methylprednisolone up to 30 mg/kg body weight initially with subsequent smaller doses. Prophylactic antibiotics are indicated in all but mild cases. Intermittent positive pressure ventilation with bronchial toilet and suction may be important elements of treatment. [I.L.O. Health and Safety Guide No. 28].
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

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

EXTINGUISHING MEDIA

■ For SMALL FIRES:
· Dry chemical, CO2, water spray or foam.
For LARGE FIRES:
· Foam, fog or water spray
· DO NOT use water jets.

FIRE FIGHTING

· 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.
· Fight fire from a safe distance, with adequate cover.
· If safe, switch off electrical equipment until vapor fire hazard removed.
· Use water delivered as a fine spray to control the fire and cool adjacent area.
· Avoid spraying water onto liquid pools.
· 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.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

· May ignite on contact with air leading to spontaneous combustion and burning rapidly.
· May decompose explosively when heated or involved in fire.
· May REIGNITE after fire is extinguished.
· Gases generated in fire may be poisonous, corrosive or irritating.
· Containers may explode on heating.
· Runoff may create multiple fire or explosion hazard.
Combustion products include: carbon dioxide (CO2), nitrogen oxides (NOx), phosphorus oxides (POx), other pyrolysis products typical of burning organic material.

FIRE INCOMPATIBILITY

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

PERSONAL PROTECTION

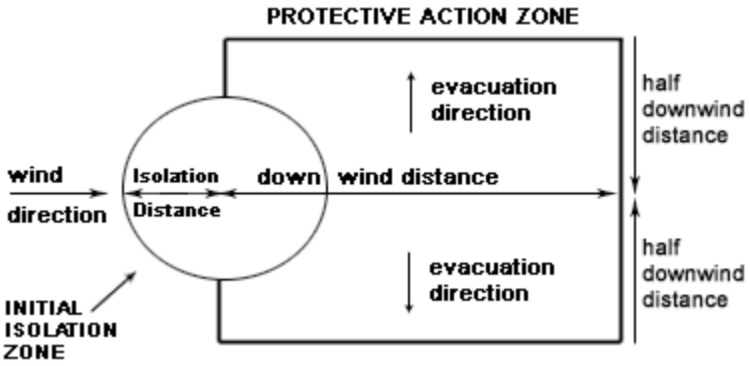
Glasses:
Full face- shield.
Gloves:
Respirator:
Type AB Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS
· Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
· Check regularly for spills and leaks.
· Eliminate all ignition sources.
· Cover with WET earth, sand or other non-combustible material.
· Use clean, non-sparking tools to collect absorbed material
· Wear gloves and safety glasses as appropriate.
MAJOR SPILLS
· Clear area of personnel and move upwind.
· Alert Emergency Responders and tell them location and nature of hazard.
· Eliminate all ignition sources (no smoking, flares, sparks or flames)
· Stop leak if safe to do so; prevent entry into waterways, drains or confined spaces.
· May be violently or explosively reactive.
· DO NOT walk through spilled material.
· Wear full protective clothing plus breathing apparatus.
· DO NOT touch damaged containers or spilled material unless wearing appropriate protective clothing.
· Cover with WET earth, sand or other non-combustible material.
· Water spray may be used to knock down vapors or divert vapor clouds.
· Use clean, non-sparking tools to collect absorbed material and place into loosely-covered metal or plastic containers ready for disposal.
· Alternately, the spill may be contained using WET earth, sand, or other non-combustible material.
· Recover the liquid using non-sparking appliances and place in labeled, sealable container.
· Wash area with water and dike for later disposal;
· 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	50 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 136 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)

phosphine
AEGL Type 10 min 30 min 60 min 4 hr 8 hr
1 NR NR NR NR GALSYN~
3 7.2 7.2 3.6 0.9 GALSYN~
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.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

· DO NOT allow clothing wet with material to stay in contact with skin.
· For large scale or continuous use, spark-free, earthed ventilation system venting directly to the outside and separate from usual ventilation systems
· Provide dust collectors with explosion vents.
· Avoid all personal contact, including inhalation.
· Wear protective clothing when risk of overexposure occurs.
· Use in a well-ventilated area.
· Avoid smoking, naked lights or ignition sources.
· Avoid contact with incompatible materials.
· When handling, DO NOT eat, drink or smoke.
· Keep containers securely sealed when not in use.
· Avoid physical damage to containers.
· Always wash hands with soap and water after handling.
· Work clothes should be laundered separately and before re-use

· Use good occupational work practice.
· Observe manufacturer's storing/handling recommendations.
· Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

NOTE: The material may remove oxygen from the air thus producing a severe hazard to workers inside enclosed or confined spaces where the material might accumulate. Before entry to such areas, sampling and test procedures for low oxygen levels should be undertaken; control conditions should be established to ensure the availability of adequate oxygen supply.

RECOMMENDED STORAGE METHODS

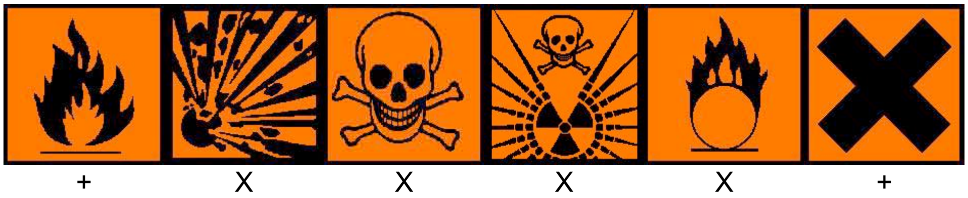
■ Storage containers must be hermetically sealed under an inert atmosphere.

For low viscosity materials and solids: Drums and jerricans must be of the non-removable head type. Where a can is to be used as an inner package, the can must have a screwed enclosure. For materials with a viscosity of at least 2680 cSt. (23 deg. C):
· Removable head packaging and
· cans with friction closures may be used.Where combination packages are used, there must be sufficient inert absorbent material to absorb completely any leakage that may occur, unless the outer packaging is a close fitting molded plastic box and the substances are not incompatible with the plastic. All combination packages for Packing group I and II must contain cushioning material.

STORAGE REQUIREMENTS

■ Store under an inert gas, e.g. argon or nitrogen.
· Store below 38 deg. C.
FOR MINOR QUANTITIES:
· Store in an indoor fireproof cabinet or in a room of noncombustible construction
· Provide adequate portable fire-extinguishers in or near the storage area.
FOR PACKAGE STORAGE:
· Store in original containers in approved flame-proof area.
· No smoking, naked lights, heat or ignition sources.
· DO NOT store in pits, depressions, basements or areas where vapors may be trapped.
· Keep containers securely sealed.
· Store away from incompatible materials in a cool, dry well ventilated area.
· Protect containers against physical damage and check regularly for leaks.
· Protect containers from exposure to weather and from direct sunlight unless: (a) the packages are of metal or plastic construction; (b) the packages are securely closed are not opened for any purpose while in the area where they are stored and (c) adequate precautions are taken to ensure that rain water, which might become contaminated by the dangerous goods, is collected and disposed of safely.
· Ensure proper stock-control measures are maintained to prevent prolonged storage of dangerous goods.
· Observe manufacturer's storing and handling recommendations.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS



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

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³	Notes
Canada - Alberta Occupational Exposure Limits	phosphine (Phosphine)	0.3	0.4	1	1.4	
Canada - British Columbia Occupational Exposure Limits	phosphine (Phosphine)	0.3		1		
Canada - Ontario Occupational Exposure Limits	phosphine (Phosphine)	0.3	0.4	1	1.4	
US OSHA Permissible Exposure Levels (PELs) - Table Z1	phosphine (Phosphine)	0.3	0.4			

US ACGIH Threshold Limit Values (TLV)	phosphine (Phosphine)	0.3		1		TLV Basis: upper respiratory tract irritation; headache; gastrointestinal irritation; central nervous system impairment
US NIOSH Recommended Exposure Limits (RELs)	phosphine (Phosphine)	0.3	0.4	1	1	
US - Minnesota Permissible Exposure Limits (PELs)	phosphine (Phosphine)	0.3	0.4	1	1	
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	phosphine (Phosphine)	0.3	0.4	1	1	
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	phosphine (Phosphine)	0.3	0.4			
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	phosphine (Phosphine)	0.3	0.4	1	1	
US - California Permissible Exposure Limits for Chemical Contaminants	phosphine (Phosphine; PH3)	0.3	0.4	1	1	
US - Idaho - Limits for Air Contaminants	phosphine (Phosphine)	0.3	0.4			
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	phosphine (Phosphine)	0.3		1		
US - Hawaii Air Contaminant Limits	phosphine (Phosphine)	0.3	0.4	1	1.4	
US - Alaska Limits for Air Contaminants	phosphine (Phosphine)	0.3	0.4	1	1	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	phosphine (Phosphine)	0.3	0.4	1	1	
US - Washington Permissible exposure limits of air contaminants	phosphine (Carbonyl chloride-(Phosgene))	0.1		0.3		
US - Washington Permissible exposure limits of air contaminants	phosphine (Phosphine)	0.3		1		
US - Michigan Exposure Limits for Air Contaminants	phosphine (Phosphine)	0.3	0.4	1	1	
Canada - Prince Edward Island Occupational Exposure Limits	phosphine (Phosphine)	0.3		1		TLV Basis: upper respiratory tract irritation; headache; gastrointestinal irritation; central

						nervous system impairment
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	phosphine (Phosphine)	0.3	0.4			
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	phosphine (Phosphine)	0.3	0.42	1	1.4	
US - Oregon Permissible Exposure Limits (Z-1)	phosphine (Phosphine)	0.3	0.4			
Canada - Northwest Territories Occupational Exposure Limits (English)	phosphine (Phosphine)	0.3	0.42	1	1.3	
Canada - Nova Scotia Occupational Exposure Limits	phosphine (Phosphine)	0.3		1		TLV Basis: upper respiratory tract irritation; headache; gastrointestinal irritation; central nervous system impairment

ENDOELTABLE
The following materials had no OELs on our records

- tri-tert-butylphosphine: CAS:13716-12-6

EMERGENCY EXPOSURE LIMITS
Material Revised IDLH Value (mg/m3) Revised IDLH Value (ppm)
phosphine 50

MATERIAL DATA

PHOSPHINE:
TRI-TERT-BUTYLPHOSPHINE:
■ Odour Threshold Value: 0.010-0.014 ppm (recognition)
NOTE: Detector tubes for phosphine, measuring in excess of 0.1 ppm, are commercially available.
The TLV-TWA is protective against respiratory irritation, lung injury and gastrointestinal symptoms (nausea, vomiting) and central nervous system symptoms noted in workers exposed at mean concentrations below 10 ppm.
This limit does not take into account possible chronic phosphorus poisoning said to result from prolonged exposure to phosphine.
Odour Safety Factor(OSF)
OSF=0.1 (PHOSPHINE).

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

- 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.
· Fire resistant/ heat resistant gloves where practical, otherwise
· Heavy-duty chemically resistant gloves capable of providing short-term protection against spontaneous ignition.

OTHER

· Protective overalls, closely fitted at neck and wrist.
· Eye-wash unit.
IN CONFINED SPACES:
· Non-sparking protective boots
· Static-free clothing.
· Ensure availability of lifeline.
Staff should be trained in all aspects of rescue work.
Rescue gear: Two sets of SCUBA breathing apparatus Rescue Harness, lines etc.

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	-
1000	50	-	AB-1
5000	50	Airline*	-
5000	100	-	AB-2
10000	100	-	AB-3
	100+		Airline* *

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

ENGINEERING CONTROLS

■ General exhaust is adequate under normal operating conditions. If risk of overexposure exists, wear an approved respirator. Correct fit is essential to obtain adequate protection. Provide adequate ventilation in warehouse or closed storage areas. 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

Corrosive.

State	LIQUID	Molecular Weight	202.32
Melting Range (°F)	Not available	Viscosity	Not Available
Boiling Range (°F)	215.6- 217.4 (13 mm)	Solubility in water (g/L)	Reacts
Flash Point (°F)	1.004	pH (1% solution)	Not applicable
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapour Pressure (mmHG)	Not available
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	Not available
Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	>1
Volatile Component (%vol)	Not available	Evaporation Rate	Not available

APPEARANCE

Cloudy, colourless liquid with unpleasant garlic-like odour; decomposes in water. Miscible with ether, methanol, ethanol and benzene.

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

· Presence of incompatible materials.
· May heat spontaneously
· Identify and remove sources of ignition and heating.
· Incompatible material, especially oxidizers, and/or other sources of oxygen may produce unstable product(s).
· Hazardous polymerization will not occur.

STORAGE INCOMPATIBILITY

■ Segregate from alcohol, water.
· Explosion hazard may follow contact with incompatible materials.
· Phosphine gas may react with certain metals and cause corrosion, especially at elevated temperatures and humidities.
· Metals such as copper, brass, and other copper alloys, aluminium and precious metals such as gold and silver are susceptible to corrosion by phosphine. Small electric motors smoke detectors, brass sprinkler heads, batteries and battery chargers, fork lifts, temperature monitoring systems, switching gears, communication devices, computers, calculators and other electrical equipment may be damaged by this gas.
· Phosphine will also react with certain metallic salts and therefore sensitive items such as photographic film, some inorganic pigments, etc., should not be exposed to the gas.
· Other incompatible materials include natural rubber, neoprene, polyethylene, PVC.
· Even small amounts of oxygen in phosphine give an explosive mixture in which autoignition occurs at low pressures.
· Pure phosphine does not spontaneously ignite in air below 150 deg. C. unless it is thoroughly dried, when it ignites in cold air. The presence of diphosphanes in phosphine as normally prepared causes it to ignite spontaneously in air, even below -15 deg. C. Traces of oxidants promote pyrophoricity (e.g dinitrogen trioxide, nitrous acid or similar oxidants).
· Lower flammability limit of pure phosphine in moist air (0.39 vol% water vapour) at 1037 mbar is 2.1% at 10 deg. C and 1.8% at 50 deg. C.
· Ignition occurs on contact of phosphine with chlorine or bromine or their aqueous solutions (hypochlorous or hypobromous acids).
· Passage of phosphine into silver nitrate solution causes ignition or explosion depending on gas rate.
· Interaction of phosphine with boron trichloride is energetic.
· Mercury(II) nitrate solution gives a complex phosphide, explosive when dry.
· In contact with chlorine, phosphine ignites at ambient temperatures.
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

TRI-TERT-BUTYLPHOSPHINE

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

ORGANOPHOSPHATE PESTICIDES	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	P65-MC

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:

PHOSPHINE:

TRI-TERT-BUTYLPHOSPHINE:

■ DO NOT discharge into sewer or waterways.

■ The principal problems of phosphate contamination of the environment relates to eutrophication processes in lakes and ponds. Phosphorus is an essential plant nutrient and is usually the limiting nutrient for blue-green algae. A lake undergoing eutrophication shows a rapid growth of algae in surface waters. Planktonic algae cause turbidity and flotation films. Shore algae cause ugly muddying, films and damage to reeds. Decay of these algae causes oxygen depletion in the deep water and shallow water near the shore. The process is self-perpetuating because anoxic conditions at the sediment/ water interface causes the release of more adsorbed phosphates from the sediment. The growth of algae produces undesirable effects on the treatment of water for drinking purposes, on fisheries, and on the use of lakes for recreational purposes.

■ Phosphine will oxidise rapidly under influence of radiation and UV light. Phosphine is highly toxic to aquatic life.

Phosphine is a gas with a low water solubility; it either oxidises or volatises rapidly from water. Because of its lower water solubility, physical state (gas), and slow reactivity, phosphine persists in the atmosphere for relatively long times. In most natural water, phosphine is very unstable and oxidises even under anoxic conditions. Depending upon the redox potential of water, the oxidation products are diphosphine (P_2H_4), phosphorus, hypophosphorus acid, phosphorus acid, and phosphoric acid. Diphosphane is a potential alkylating agent, which finally forms H_2PO_4 (phosphoric acid), salts, and water. In the presence of oxygen, these breakdown products are formed rapidly from phosphine . Only a small fraction of phosphine undergoes oxidation with the formation of phosphates. Based on soil studies, small amounts of phosphine may also be adsorbed (reversible sorption) or chemisorbed (irreversible sorption) to suspended solid and sediments in water. However, based on the estimated Henry's law constant (H) of 0.09 atm·m^3/mol and the expected volatility associated with various ranges of H, volatilisation is expected to be the most important loss process for phosphine in water.

In sealed tubes, phosphine completely disappeared in less than 40 days from three different types of soil with varying amounts of moisture. The disappearance was attributed to initial sorption, and the subsequent biotic and abiotic oxidation of part of the sorbed compound. The rate of adsorption increased with decreasing moisture content and increasing organic soil content . The study showed that phosphine sorption in soil can occur by both physical and chemical sorption processes, and that the chemisorption process is higher in soils with a low organic matter and high mineral content Chemisorption irreversibly binds phosphine in soil so that it is not available for volatilisation. However, since phosphine is gaseous and is only slightly soluble in water, volatilisation from soil may be the most important process by which phosphine is lost from soil when chemisorption is not occurring.

The important process for the loss of phosphine in the atmosphere is most likely its reaction with hydroxyl radicals. Based on measured rates under simulated conditions, the estimated lifetime of phosphine in the troposphere due to reaction with hydroxyl radicals is <1 day. The hydrogen abstraction reaction may produce the free radical [PH_2], which may react with ozone to produce H_2PO. [PH_2] another free radical, which is highly reactive, with or without ozone. Ultraviolet (U]V) light can also induce phosphine to form [PH_2]. H_2PO may produce hypophosphorus acid (H_2PO_2) as a result of a reaction with nitrogen dioxide in air and subsequent hydrolysis. The hypophosphorus acid is ultimately oxidized to phosphorus and phosphoric acid.

Oxidation to phosphate is likely in biological systems with no suggestion of bioaccumulation or biomagnification.

Toxicity of phosphine to one or two day old pupae of Triboleum castaneum was increased by atmospheric CO_2 concentration up to 40% in air. A maximum pupal mortality of 11% was observed for CO_2 levels at 10-70% for 24 hours.

Frog LC50 (30 min) : 0.56 mg/l

Bacterial EC50: Baccillus subtilis 2.7 mg/l (growth inhibition).

■ 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.

TRI-TERT-BUTYLPHOSPHINE:

■ May cause long-term adverse effects in the aquatic environment.

PHOSPHINE:

Marine Pollutant: Yes

■ Hazardous Air Pollutant: Yes

■ Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
tri-tert-butylphosphine	HIGH		LOW	MED
phosphine	LOW		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)

Reactivity characteristic: use EPA hazardous waste number D003 (waste code R).

B. Component Waste Numbers

When phosphine 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 P096 (waste code T).

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.
¦ Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.
A Hierarchy of Controls seems to be common - the user should investigate:
· Reduction
· Reuse
· Recycling
· Disposal (if all else fails)
This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.
DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.
· 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 followed by: Burial in a licensed land-fill or Incineration in a licensed apparatus
· Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION

DOT:
Symbols: G Hazard class or Division: 4.2
Identification Numbers: UN3185 PG: II
Label Codes: 4.2, 8 Special provisions: IB2
Packaging: Exceptions: None Packaging: Non- bulk: 202
Packaging: Exceptions: None Quantity limitations: 1 L
Passenger aircraft/rail:
Quantity Limitations: Cargo 5 L Vessel stowage: Location: C
aircraft only:
Vessel stowage: Other: None
Hazardous materials descriptions and proper shipping names:
Self-heating liquid, corrosive, organic, n.o.s.

Air Transport IATA:

ICAO/IATA Class: 4.2 ICAO/IATA Subrisk: 8
UN/ID Number: 3185 Packing Group: II
Special provisions: A3
Cargo Only
Packing Instructions: 414 Maximum Qty/Pack: 5 L
Passenger and Cargo Passenger and Cargo
Packing Instructions: 408 Maximum Qty/Pack: 1 L
Passenger and Cargo Limited Quantity Passenger and Cargo Limited Quantity
Packing Instructions: - Maximum Qty/Pack: -
Shipping Name: SELF-HEATING LIQUID, CORROSIVE, ORGANIC,
N.O.S. *(CONTAINS TRI-TERT-BUTYLPHOSPHINE)

Maritime Transport IMDG:

IMDG Class: 4.2 IMDG Subrisk: 8
UN Number: 3185 Packing Group: II
EMS Number: F-A , S-J Special provisions: 274
Limited Quantities: 0
Shipping Name: SELF-HEATING LIQUID, CORROSIVE, ORGANIC, N.O.S.(contains tri-tert-butylphosphine)

Section 15 - REGULATORY INFORMATION

REGULATIONS

ND

Ingredient CAS % de minimus concentration
phosphine 7803-51-2 1.0

ND

Ingredient	CAS	RQ
phosphine	7803-51-2	100 lb (45.4 kg)

tri-tert-butylphosphine (CAS: 13716-12-6) is found on the following regulatory lists;

"US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified"

Regulations for ingredients

phosphine (CAS: 7803-51-2) 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 - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada Ingredient Disclosure List (SOR/88-64)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","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 - 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 Hazardous Constituents","US - Vermont Hazardous Waste - Acutely Hazardous Wastes","US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Dangerous waste constituents list","US - Washington Discarded Chemical Products List - ""P"" Chemical Products","US - Washington Permissible exposure limits of air contaminants","US - Wyoming List of Highly Hazardous Chemicals, Toxics and Reactives","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US CERCLA Priority List of Hazardous Substances","US Clean Air Act - Hazardous Air Pollutants","US Department of Homeland Security Chemical Facility Anti-Terrorism Standards - Chemicals of Interest","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA Acute Exposure Guideline Levels (AEGLs) - Final","US EPA Carcinogens Listing","US EPCRA Section 313 Chemical List","US List of Lists - Consolidated List of Chemicals Subject to EPCRA, CERCLA and Section 112(r) of the Clean Air Act","US NFPA 45 Fire Protection for Laboratories Using Chemicals - Flammability Characteristics of Common Compressed and Liquefied Gases","US NIOSH Recommended Exposure Limits (RELs)","US OSHA List of Highly Hazardous Chemicals, Toxics and Reactives","US OSHA Permissible Exposure Levels (PELs) - Table Z1","US RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes","US SARA Section 302 Extremely Hazardous Substances","US Toxic Substances Control Act (TSCA) - Inventory","USA: Chemical Facility Anti-Terrorism Standards - List Appendix A - 6CFR 27"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

- Skin contact may produce health damage*.
- Cumulative effects may result following exposure*.
- Vapors potentially cause drowsiness and dizziness*.

* (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.

Issue Date: Mar-13-2010

Print Date:Oct-6-2010