Tetraethylenepentamine

sc-237036

Material Safety Data Sheet

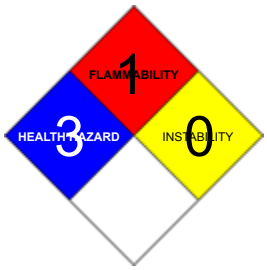
Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
Tetraethylenepentamine

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

NFPA



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

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

SYNONYMS
C8-H23-N5, NH2(CH2-CH2-NH)3-CH2-CH2-NH2, H2-N-CH2-(CH2-NH-CH2)3-CH2-NH2, H2-N-(C2-H4-NH)4-H, "tetraethylene pentamine", "N-(2-aminoethyl)-N-(2-((2-aminoethyl)amino)ethyl)-1, 2-ethanediamine", "1, 2-ethanediamine, N-(2-amino((2-aminoethyl)amino)ethyl)-", "1, 4, 7, 10, 13-pentaazatridecane", "1, 11-diamino-3, 6, 9-, triazaundecane", TEPA, "D.E.H. 26", ethyleneamine, "polyethylene-1, 2-ethanediamine"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability	1		
Toxicity	2		
Body Contact	3		
Reactivity	2		

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

Chronic 3

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

Causes burns.
Risk of serious damage to eyes.
May cause SENSITISATION by skin contact.
May cause harm to the unborn child.
Harmful in contact with skin and if swallowed.
Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.
■ The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.
■ Ingestion of amine epoxy-curing agents (hardeners) may cause severe abdominal pain, nausea, vomiting or diarrhea.
The vomitus may contain blood and mucous.

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.
■ Vapors of volatile amines irritate the eyes, causing excessive secretion of tears, inflammation of the conjunctiva and slight swelling of the cornea, resulting in "halos" around lights.
This effect is temporary, lasting only for a few hours.

SKIN

■ Skin contact with the material may be harmful; systemic effects may resultfollowing absorption.
■ The material can produce chemical burns following direct contactwith the skin.
■ Amine epoxy-curing agents (hardeners) may produce primary skin irritation and sensitization dermatitis in predisposed individuals.
Cutaneous reactions include erythema, intolerable itching and severe facial swelling.
■ 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.
■ Inhalation of aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual.
■ Inhalation of epoxy resin amine hardeners (including polyamines and amine adducts) and may produce bronchospasm and coughing episodes lasting several days after cessation of the exposure.
Even faint traces of these vapors may trigger an intense reaction in individuals showing "amine asthma".
■ Inhalation of amine vapors may cause irritation of the mucous membrane of the nose and throat, and lung irritation with respiratory distress and cough.
Swelling and inflammation of the respiratory tract is seen in serious cases; with headache, nausea, faintness and anxiety There may also be wheezing.
■ 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.

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.

Skin contact with the material is more likely to cause a sensitization reaction in some persons compared to the general population.

Ample evidence exists, from results in experimentation, that developmental disorders are directly caused by human exposure to the material.

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.

There is some evidence that inhaling this product is more likely to cause a sensitization reaction in some persons compared to the general population.

Secondary amines may react with nitrites to form potentially carcinogenicN-nitrosamines.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
commercial material typically		
tetraethylenepentamine	112-57-2	90 appr.
triethylenetetramine	112-24-3	9 appr.
pentaethylenehexamine	4067-16-7	1 appr.

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.

EYE

If this product comes in contact with the eyes

- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.

SKIN

If skin or hair contact occurs

- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.

Remove and destroy contaminated leather articles of clothing.

INHALED

- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.

Inhalation of vapors or aerosols (mists, fumes) may cause lung edema. Corrosive substances may cause lung damage (e.g.

NOTES TO PHYSICIAN

■ For acute or short-term repeated exposures to highly alkaline materials

- Respiratory stress is uncommon but present occasionally because of soft tissue edema.
- Unless endotracheal intubation can be accomplished under direct vision, cricothyroidotomy or tracheotomy may be necessary.

If lavage is performed, suggest endotracheal and/or oesophascopic control.

If burn is present, treat as a thermal burn, after decontamination. [Dow]

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG)	< 0.001 @ 20 C
Upper Explosive Limit (%)	4.6 estimation
Specific Gravity (water=1)	0.998 @ 20 C
Lower Explosive Limit (%)	0.8 estimation

EXTINGUISHING MEDIA

- Water spray or fog.
- Foam.

* Water may be ineffective on a fire.

FIRE FIGHTING

- Alert Emergency Responders and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.

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

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

- Combustible.
- Slight fire hazard when exposed to heat or flame.

Combustion products include carbon dioxide (CO_2), nitrogen oxides (NOx), other pyrolysis products typical of burning organic material.
May emit corrosive fumes.

FIRE INCOMPATIBILITY

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

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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.

Small spills should be covered with inorganic absorbents and disposed of properly. Organic absorbents have been known to ignite when contaminated with amines in closed containers. Certain cellulosic materials used for spill cleanup such as wood chips or sawdust have shown reactivity with ethyleneamines and should be avoided. Ethyleneamine leaks will frequently be identified by the odor (ammoniacal) or by the formation of a white, solid, waxy substance (amine carbamates). Inorganic absorbents or water may be used to clean up the amine waste.

- Clean up all spills immediately.
- Avoid breathing vapors and contact with skin and eyes.

MAJOR SPILLS

- DO NOT touch the spill material
- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- DO NOT USE brass or copper containers / stirrers
- DO NOT allow clothing wet with material to stay in contact with skin
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.

RECOMMENDED STORAGE METHODS

- Lined metal can, Lined metal pail/drum
- Plastic pail

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.

STORAGE REQUIREMENTS

for bulk storages

- If slight coloration of the ethyleneamine is acceptable, storage tanks may be made of carbon steel or black iron, provided they are free of rust and mill scale. However, if the amine is stored in such tanks, color may develop due to iron contamination. If iron contamination cannot be tolerated, tanks constructed of types 304 or 316 stainless steel should be used. (Note Because they are quickly corroded by amines, do not use copper, copper alloys, brass, or bronze in tanks or lines.)
- This product should be stored under a dry inert gas blanket, such as nitrogen, to minimize contamination resulting from contact with air and water
- Store in original containers.
- Keep containers securely sealed.

DO NOT store near acids, or oxidizing agents.

- No smoking, naked lights, heat or ignition sources.

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³	Peak ppm	Peak mg/m³	TWA F/CC	Notes
US AIHA Workplace Environmental Exposure Levels (WEELs)	tetraethylenepentamine (Tetraethylene Pentamine)		5						skin; DSEN
Canada - Ontario Occupational Exposure Limits	triethylenetetramine (Triethylenetetramine / Triéthylènetétramine)	0.5	3						Skin / Peau
US AIHA Workplace Environmental Exposure Levels (WEELs)	triethylenetetramine (Triethylenetetramine)	1							skin

The following materials had no OELs on our records

• pentaethylenehexamine CAS4067-16-7

PERSONAL PROTECTION

RESPIRATOR

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

EYE

- Chemical goggles.
- Full face shield.

HANDS/FEET

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

NOTE The material may produce skin sensitization in predisposed individuals. Care must be taken, when removing gloves and other protective equipment, to avoid all possible skin contact.

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

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739, AS/NZS 2161.1 or national equivalent).

- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.
- Contaminated gloves should be replaced.

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

Leather wear not recommended Contaminated leather footwear, watch bands, should be destroyed, i.e. burnt, as it cannot be adequately decontaminated.

- When handling liquid-grade epoxy resins wear chemically protective gloves (e.g nitrile or nitrile-butatoluene rubber), boots and aprons.
- DO NOT use cotton or leather (which absorb and concentrate the resin), polyvinyl chloride, rubber or polyethylene gloves (which absorb the resin).
- DO NOT use barrier creams containing emulsified fats and oils as these may absorb the resin; silicone-based barrier creams should be reviewed prior to use.

OTHER

- Overalls.
- PVC Apron.

ENGINEERING CONTROLS

Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Liquid.
Mixes with water.
Corrosive.
Alkaline.

State	Liquid	Molecular Weight	189.30
Melting Range (°F)	-22	Viscosity	Not Available
Boiling Range (°F)	645	Solubility in water (g/L)	Miscible
Flash Point (°F)	>280	pH (1% solution)	>7
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not Available
Autoignition Temp (°F)	572	Vapour Pressure (mmHG)	< 0.001 @ 20 C
Upper Explosive Limit (%)	4.6 estimation	Specific Gravity (water=1)	0.998 @ 20 C
Lower Explosive Limit (%)	0.8 estimation	Relative Vapor Density (air=1)	6.53
Volatile Component (%vol)	Not available.	Evaporation Rate	Not Available

tetraethylenepentamine	
log Kow (Prager 1995)	-1.503

APPEARANCE

Colored, viscous hygroscopic liquid with a disagreeable, penetrating ammoniacal odour. Mixes with water and most organic solvents. Corrosive to the skin.

All members of this cluster are miscible or soluble in water. The estimated value of log Kows-range from 3.67 to 1.8 is consistent with the available experimental water solubilities. Vapour pressures range from 1.1x 10-6 hPa to 0.31 hPa. Estimated and experimental pKbs are in a relatively narrow range of 9.68 to 10.7. log Kow -1.503 TEPA is not biodegradable (<10% after 28 days) and it should be noted that complexes of TEPA are expected to biodegrade even slower. However, TEPA is not expected to bioconcentrate due to its estimated low log Kow of -3.16 and high water solubility. It should be noted that TEPA is protonated at environmental pH and the log Kow is not a good indicator of the chemical's sorption behavior.

Material	Value

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

- Presence of incompatible materials.
- Product is considered stable.

STORAGE INCOMPATIBILITY

- Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous

Avoid strong acids.

- Avoid contact with copper, aluminium and their alloys.

Avoid reaction with oxidizing agents.
Segregate from aldehydes, ketones, organic halides, especially ethylene dichloride, hydrogen peroxide.

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

Section 11 - TOXICOLOGICAL INFORMATION

tetraethylenepentamine

TOXICITY AND IRRITATION

unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.
For alkyl polyamines
The alkyl polyamines cluster consists of organic compounds containing two terminal primary amine groups and at least one secondary amine group.Typically these substances are derivatives of ethylenediamine, propylenediamine or hexanediamine. The molecular weight range for the entire cluster is relatively narrow, ranging from 103 to 232
Acute toxicity of the alkyl polyamines cluster is low to moderate via oral exposure and a moderate to high via dermal exposure. Cluster members have been shown to be eye irritants, skin irritants, and skin sensitisers in experimental animals. Repeated exposure in rats via the oral route indicates a range of toxicity from low to high

hazard. Most cluster members gave positive results in tests for potential genotoxicity.
Limited carcinogenicity studies on several members of the cluster showed no evidence of carcinogenicity. Unlike aromatic amines, aliphatic amines are not expected to be potential carcinogens because they are not expected to undergo metabolic activation, nor would activated intermediates be stable enough to reach target macromolecules.
Polyamines potentiate NMDA induced whole-cell currents in cultured striatal neurons.
Handling ethyleneamine products is complicated by their tendency to react with other chemicals, such as carbon dioxide in the air, which results in the formation of solid carbamates. Because of their ability to produce chemical burns, skin rashes, and asthma-like symptoms, ethyleneamines also require substantial care in handling. Higher molecular weight ethyleneamines are often handled at elevated temperatures further increasing the possibility of vapor exposure to these compounds.
Because of the fragility of eye tissue, almost any eye contact with any ethyleneamine may cause irreparable damage, even blindness. A single, short exposure to ethyleneamines, may cause severe skin burns, while a single, prolonged exposure may result in the material being absorbed through the skin in harmful amounts. Exposures have caused allergic skin reactions in some individuals. Single dose oral toxicity of ethyleneamines is low. The oral LD50 for rats is in the range of 1000 to 4500 mg/kg for the ethyleneamines.
In general, the low-molecular weight polyamines have been positive in the Ames assay, increase sister chromatid exchange in Chinese hamster ovary (CHO) cells, and are positive for unscheduled DNA synthesis although they are negative in the mouse micronucleus assay. It is believed that the positive results are based on its ability to chelate copper.
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.
Contact allergies quickly manifest themselves as contact eczema, more rarely as urticaria or Quincke's edema. The pathogenesis of contact eczema involves a cell-mediated (T lymphocytes) immune reaction of the delayed type.
TRIETHYLENETETRAMINE
TETRAETHYLENEPENTAMINE
Triethylenetetramine (TETA) is a severe irritant to skin and eyes and induces skin sensitisation.
TETA is of moderate acute toxicity LD50(oral, rat) > 2000 mg/kg bw, LD50(dermal, rabbit) = 550 - 805 mg/kg bw. Acute exposure to saturated vapour via inhalation was tolerated without impairment. Exposure to to aerosol leads to reversible irritations of the mucous membranes in the respiratory tract.
Following repeated oral dosing via drinking water only in mice but not in rats at concentration of 3000 ppm there were signs of impairment. The NOAEL is 600 ppm [92 mg/kg bw (oral, 90 days)]. Lifelong dermal application to mice (1.2 mg/mouse) did not result in tumour formation.
There are differing results of the genetic toxicity for TETA. The positive results of the in vitro tests may be the result of a direct genetic action as well as a result of an interference with essential metal ions. Due to this uncertainty of the in vitro tests, the genetic toxicity of TETA has to be assessed on the basis of in vivo tests.
The in vivo micronucleus tests (i.p. and oral) and the SLRL test showed negative results.
There are no human data on reproductive toxicity (fertility assessment). The analogue diethylenetriamine had no effects on reproduction. TETA shows developmental toxicity in animal studies if the chelating property of the substance is effective. The NOEL is 830 mg/kg bw (oral).
Experience with female patients suffering from Wilson´s disease demonstrated that no miscarriages and no foetal abnormalities occur during treatment with TETA..
In rats, there are several studies concerning developmental toxicity. The oral treatment of rats with 75, 375 and 750 mg/kg resulted in no effects on dams and fetuses, except slight increased fetal body weight After oral treatment of rats with 830 or 1670 mg/kg bw only in the highest dose group increased foetal abnormalities in 27/44 fetus (69,2 %) were recorded, when simultaneously the copper content of the feed was reduced. Copper supplementation in the feed reduced significant the fetal abnormalities of the highest dose group to 3/51 (6,5 %

foetus. These findings suggest that the developmental toxicity is produced as a secondary consequence of the chelating properties of TETA.
The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin. Repeated exposures may produce severe ulceration.
TETRAETHYLENEPENTAMINE

TOXICITY	IRRITATION
Oral (rat) LD50 3990 mg/kg	Skin (rabbit) 495 mg SEVERE
Dermal (rabbit) LD50 660 mg/kg	Skin (rabbit) 5 mg/24h SEVERE
	Eye (rabbit) 5 mg Moderate
	Eye (rabbit) 100 mg/24h Moderate

The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Tetraethylenepentamine (TEPA) has a low acute toxicity when administered orally to rats (LD50 =3250 mg/kg). In an acute inhalation toxicity study with saturated vapor and whole body exposure, the LC50 was calculated to be >9.9 ppm (highest dose tested). TEPA is corrosive to the skin and eyes of rabbits. TEPA is a skin sensitiser in the guinea pig. Dermal acute toxicity LD50 values in the rabbit range from 660 - 1260 mg/kg. The higher toxicity via the dermal route is most likely due to the corrosive nature of TEPA to the skin whereas TEPA would be neutralized by stomach acid.
The results of a 28-day repeated dose dermal toxicity study of TEPA indicated a systemic toxicity NOEL of 200 mg/kg/day and a dermal toxicity NOEL (local) of 50 mg/kg/day. The dermal LOAEL was 100 mg/kg/day. In addition, in a repeat dose study of TETA administered in drinking water to male and female rats for 90-92 days, the NOEL was 276 mg/kg/day in males and 352 mg/kg/day in females, the highest dose administered with the NIH-31 diet (several diets were used to study the effects of copper deficiency versus toxicity directly to TEPA). In this same study in mice the NOEL was 487 mg/kg/day in males and 551 mg/kg/day in females, the highest dose administered. A lifetime study was conducted via dermal administration in fifty male mice with a solution of 35% TEPA. There were 20 cases of hyperkeratosis, 13 cases of epidermal necrosis and no evidence of dermal hyperplasia.
There were no data available for TEPA for reproductive and developmental toxicity. As a result, data on triethylenetetramine (TETA) was used to address these endpoints. TETA data showed no effects on reproductive organs in rats up to 276 mg/kg/day (males) and 352 mg/kg/day (females) and in mice (up to 500 mg/kg/day) when administered in drinking water. TETA was not considered a developmental toxicant via dermal administration in rabbits at maternally toxic doses up to 125 mg/kg/day but showed developmental toxicity in rats at maternally toxic doses of 830 or 1660 mg/kg/day via drinking water. The maternal and foetal toxicity was most likely due to copper deficiency and zinc toxicity at these levels. Subsequent studies where the diet was supplemented with copper resulted in a decrease of foetal abnormalities. There were no standard fertility studies available. However, there were no effects on the gonads observed in a 90-day drinking water study in rats and mice as described above.
In the Ames Salmonella assay, TEPA was found to be positive both with and without metabolic activation. TEPA was found to increase sister chromatid exchange in CHO cells and was considered positive in a UDS assay using rat hepatocytes. TEPA was not considered genotoxic in the mouse micronucleus assay and had equivocal results in the two dominant lethal assays in Drosophila melanogaster. Again, it is believed that the positive results are based upon TEPA's ability to chelate copper.

TOXICITY	IRRITATION
TRIETHYLENETETRAMINE	
Oral (rat) LD50 2500 mg/kg	Skin (rabbit) 490 mg Open SEVERE
Dermal (rabbit) LD50 805 mg/kg	Skin (rabbit) 5 mg/24 SEVERE
	Eye (rabbit); 49 mg - SEVERE
Eye (rabbit)20 mg/24 h - Moderate	

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

PENTAETHYLENEHEXAMINE

Oral (rat) LD50 1600 mg/kg	Nil Reported

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

The material may produce respiratory tract irritation, and result in damage to the lung including reduced lung function.

The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.

Although pentathylenehexamine was positive in multiple strains of Salmonella typhimurium in the Ames assay in the presence of metabolic activation, this chemical has not been evaluated in any mammalian genotoxicity assays. Structurally-related polyamines similar to pentaethylenehexamine have received limited testing for carcinogenic activity; in dermal studies in mice triethylenetetramine and tetraethylenepentamine did not produce tumors.

The chelating properties of this chemical might influence its toxicity as a polyamine.

Pentaethylenehexamine was tested for mutagenicity in Salmonella typhimurium TA98, TA100, TA1535, and TA1537 using the preincubation method at a concentration of 100-6,666 ug/plate in distilled water. Pentaethylenehexamine was negative without metabolic activation but produced mutations when incubated with S-9 from the liver of Aroclor 1254-induced rats

The genotoxicity of pentaethylenehexamine was assessed in Drosophila melanogaster using the sex-linked recessive lethal (SLRL) assay. The results of this experiment were described as equivocal using a feeding exposure of 25,000 ppm and negative using an injection exposure of 500 ppm

one possible pathway for pentaethylenehexamine metabolism may involve oxidative deamination by polyamine oxidase. Oxidative deamination of primary amines produces ammonia and an aldehyde, which is usually further oxidized to a carboxylic acid or is reduced to an alcohol

Pentaethylenehexamine and other polyamines have been investigated as potential chelating agents in the rat. In one study, eight male Sprague-Dawley rats received an ip injection of 1 ml of 0.9% saline solution and urine was collected for the next 24 hours. One day later, rats were given an ip injection of 1 mmol/kg pentaethylenehexamine hexahydrochloride (PENTAEN) in 0.9% saline and urine was collected for 24 hours. Analysis of the basal copper excretion versus the chelator-induced copper excretion showed that PENTAEN caused approximately a 7.8-fold increase in the daily urinary copper excretion in the rat. In a related study, PENTAEN increased the urinary excretion of cadmium in rats that had been loaded with cadmium at least 4 days prior to PENTAEN treatment

It has been suggested that the chelating properties of the polyamines, tetraethylenepentamine and triethylenetetramine, may be associated with their mutagenic activity because these compounds inhibit hepatic copper superoxide dismutase which prevents oxidative damage.

CARCINOGEN

BROMINE COMPOUNDS (ORGANIC OR INORGANIC)	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	P65-MC

SKIN

tetraethylenepentamine	US AIHA Workplace Environmental Exposure Levels (WEELs) - Skin	Notes	skin; DSEN
triethylenetetramine	US AIHA Workplace Environmental Exposure Levels (WEELs) - Skin	Notes	skin

Section 12 - ECOLOGICAL INFORMATION

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

This material and its container must be disposed of as hazardous waste.
Avoid release to the environment.
Refer to special instructions/ safety data sheets.

GESAMP/EHS COMPOSITE LIST - GESAMP Hazard Profiles

Name / Cas No / RTECS No	EHS	TRN	A1a	A1b	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3
Tetraethylene pentamine / CAS:112-57-2 /	1302	689	0		0	NR	3	NI	0	2	(3)	3	3	S		D	3

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

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information

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.

Spilled material may be disposed of in a secure landfill after neutralizing, or dissolved in a flammable solvent and inc
Extreme caution should be taken when neutralizing.
Decontaminate empty containers with dilute acid.
Return empty containers to supplier or bury empty containers at an authorised landfill.
The product is resistant to biodegradation in a biological wastewater treatment plant.
A large spill could be toxic to the biomass in a treatment plant or could be toxic to fish.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols:	None	Hazard class or Division:	8
Identification Numbers:	UN2320	PG:	III
Label Codes:	8	Special provisions:	IB3, T4, TP1
Packaging: Exceptions:	154	Packaging: Non-bulk:	203
Packaging: Exceptions:	154	Quantity limitations: Passenger aircraft/rail:	5 L
Quantity Limitations: Cargo aircraft only:	60 L	Vessel stowage: Location:	A
Vessel stowage: Other:	52.		

Hazardous materials descriptions and proper shipping names:
Tetraethylenepentamine

Air Transport IATA:

ICAO/IATA Subrisk:	None	UN/ID Number:	2320
Packing Group:	III	Special provisions:	None
		Cargo Only	
		Packing Instructions:	856
Maximum Qty/Pack:	60 L	Passenger and Cargo	
Passenger and Cargo		Packing Instructions:	852
Maximum Qty/Pack:	5 L	Passenger and Cargo Limited Quantity	
Passenger and Cargo Limited Quantity		Packing Instructions:	Y841
Maximum Qty/Pack:	1 L		

Shipping Name: TETRAETHYLENEPENTAMINE

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	None
UN Number:	2320	Packing Group:	III
EMS Number:	F-A,S-B	Special provisions:	None
Limited Quantities:	5 L	Marine Pollutant:	Yes

Shipping Name: TETRAETHYLENEPENTAMINE

Section 15 - REGULATORY INFORMATION

tetraethylenepentamine (CAS: 112-57-2) is found on the following regulatory lists;
"Canada Ingredient Disclosure List (SOR/88-64)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","GESAMP/EHS Composite List - GESAMP Hazard Profiles","IMO IBC Code Chapter 17: Summary of minimum requirements","IMO MARPOL 73/78 (Annex II) - List of Noxious Liquid Substances Carried in Bulk","International Council of Chemical Associations (ICCA) - High Production Volume List","US - New Jersey Right to Know Hazardous Substances","US - Pennsylvania - Hazardous Substance List","US AIHA Workplace Environmental Exposure Levels (WEELs)","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA High Production Volume Program Chemical List","US FDA Indirect Food Additives: Adhesives and Components of Coatings - Substances for Use Only as Components of Adhesives - Adhesives","US Inventory of Effective Food Contact Substance Notifications","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory"
Regulations for ingredients
triethylenetetramine (CAS: 112-24-3) is found on the following regulatory lists;
"Canada - Ontario Occupational Exposure Limits","Canada Domestic Substances List (DSL)","Canada Ingredient Disclosure List (SOR/88-64)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","GESAMP/EHS Composite List - GESAMP Hazard Profiles","IMO IBC Code Chapter 17: Summary of minimum requirements","IMO MARPOL 73/78 (Annex II) - List of Noxious Liquid Substances Carried in Bulk","IMO Provisional Categorization of Liquid Substances - List 3: (Trade-named) mixtures containing at least 99% by weight of components already assessed by IMO, presenting safety hazards","US - New Jersey Right to Know Hazardous Substances","US - Pennsylvania - Hazardous Substance List","US AIHA Workplace Environmental Exposure Levels (WEELs)","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA High Production Volume Program Chemical List","US EPA Master Testing List - Index I Chemicals Listed","US FDA Indirect Food Additives: Adhesives and Components of Coatings - Substances for Use Only as Components of Adhesives - Adhesives","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory"
pentaethylenehexamine (CAS: 4067-16-7) is found on the following regulatory lists;
"Canada Domestic Substances List (DSL)","GESAMP/EHS Composite List - GESAMP Hazard Profiles","IMO IBC Code Chapter 17: Summary of minimum requirements","US DOT Coast Guard Bulk Hazardous Materials - List of Flammable and Combustible Bulk Liquid Cargoes","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE
■ Inhalation may produce health damage*.
■ Cumulative effects may result following exposure*.
■ Limited evidence of a carcinogenic effect*.
■ Possible respiratory sensitiser*.
* (limited evidence).

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

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