GLUTARALDEHYDE SOLUTION 25%

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
GLUTARALDEHYDE SOLUTION 25%

OTHER NAMES
C5-H8-O2, OHC-(CH2)3-CHO, cidex, glutaral, "glutaric dialdehyde", glutardialdehyde, "1, 5-pentanedial", "1, 5-pentanedial", "1, 5-pentanedione", "1, 5-pentanedione", "potentiated acid glutaraldehyde", pentandial, "1, 3 diformal propane", "1, 3-diformylpropane", "1, 3-diformylpropane",

PROPER SHIPPING NAME
CORROSIVE LIQUID, TOXIC, N.O.S.(contains glutaraldehyde)

PRODUCT USE
■ Reducing agent.
Used as a fixative for light or electron microscopy.
Sterilization of instruments, rubber, or plastic equipment which cannot be heat sterilized.
As a tanning agent for leather. Developer for processing X-ray film. Aqueous solutions of glutaraldehyde may be "activated" by the addition of sodium carbonate to greatly enhance antimicrobial (sporocidal, bactericidal/viricidal/fungicidal) activity for periods of up to 14 days.
Medicine

SUPPLIER
Company: S D FINE - CHEM LIMITED
Address:
315- 317, T.V.IND.ESTATE,
248 WORLI ROAD,
MUMBAI- 400 030, INDIA
technical@sdfine.com
Telephone: 91- 22 24959898
Telephone: 91- 22 24959899
Fax: 91- 22 24937232

Section 2 - HAZARDS IDENTIFICATION

HAZARD RATINGS

GHS Classification

continued...

Acute Aquatic Hazard Category 1
Acute Toxicity (Dermal) Category 3
Acute Toxicity (Inhalation) Category 2
Acute Toxicity (Oral) Category 2
Aspiration Hazard Category 1
Metal Corrosion Category 1
Respiratory Effects Category 3
Respiratory Sensitizer Category 1
Serious Eye Damage Category 1
Skin Corrosion/Irritation Category 1B
Skin Sensitizer Category 1

EMERGENCY OVERVIEW

HAZARD
DANGER
Determined by using GHS criteria:
H336 H300 H330 H311 H304 H334 H317 H290 H314 H318 H400
May cause drowsiness or dizziness
Fatal if swallowed
Fatal if inhaled
Toxic in contact with skin
May be fatal if swallowed and enters airways
May cause allergic or asthmatic symptoms or breathing difficulties if inhaled
May cause allergic skin reaction
May be corrosive to metals
Causes severe skin burns and eye damage
Causes serious eye damage
Very toxic to aquatic life

PRECAUTIONARY STATEMENTS

Prevention
Keep only in original container.
Do not breathe dust/fume/gas/mist/vapours/spray.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Contaminated work clothing should not be allowed out of the workplace.
Avoid release to the environment.
Wear protective gloves/protective clothing/eye protection/face protection.
Wear respiratory protection.
In case of inadequate ventilation wear respiratory protection.

Response
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
IF ON SKIN: Wash with plenty of soap and water.
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

continued...

IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
IF INHALED: If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Immediately call a POISON CENTER or doctor/physician.
Call a POISON CENTER or doctor/physician if you feel unwell.
Specific treatment is urgent (see MSDS).
Rinse mouth.
Do NOT induce vomiting.
If skin irritation or rash occurs: Get medical advice/attention.
If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.
Remove/Take off immediately all contaminated clothing.
Wash contaminated clothing before reuse.
Absorb spillage to prevent material damage.
Collect spillage.

Storage
Store in a well-ventilated place. Keep container tightly closed.
Store locked up.
Store in corrosive resistant container or with a resistant inner liner.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
glutaraldehyde	111-30-8	>20

Section 4 - FIRST AID MEASURES

SWALLOWED
- For advice, contact a Poisons Information Centre 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.
- Avoid giving milk or oils.
- Avoid giving alcohol.
- If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus.

EYE
■ If this product comes in contact with the eyes:
- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Continue flushing until advised to stop by the Poisons Information Centre 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.

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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 Centre.
• Transport to hospital, or doctor.

INHALED
• If fumes or combustion products are inhaled remove from contaminated area.
• Lay patient down. Keep warm and rested.
• Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
• Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
• Transport to hospital, or doctor, without delay.

NOTES TO PHYSICIAN
■ Any material aspirated during vomiting may produce lung injury. Therefore emesis should not be induced mechanically or pharmacologically. Mechanical means should be used if it is considered necessary to evacuate the stomach contents; these include gastric lavage after endotracheal intubation. If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.
For simple aldehydes:

BASIC TREATMENT

• Establish a patent airway with suction where necessary.
• Watch for signs of respiratory insufficiency and assist ventilation as necessary.
• Administer oxygen by non-rebreather mask at 10 to 15 l/min.
• Monitor and treat, where necessary, for pulmonary oedema .
• Monitor and treat, where necessary, for shock.
• DO NOT use emetics. Where ingestion is suspected rinse mouth and give up to 200 ml water (5 ml/kg recommended) for dilution where patient is able to swallow, has a strong gag reflex and does not drool.
• Give activated charcoal.

ADVANCED TREATMENT

• Consider orotracheal or nasotracheal intubation for airway control in unconscious patient or where respiratory arrest has occurred.
• Consider intubation at first sign of upper airway obstruction resulting from oedema.
• Positive-pressure ventilation using a bag-valve mask might be of use.
• Monitor and treat, where necessary, for arrhythmias.
• Start an IV D5W TKO. If signs of hypovolaemia are present use lactated Ringers solution. Fluid overload might create complications.
• Drug therapy should be considered for pulmonary oedema.
• Hypotension with signs of hypovolaemia requires the cautious administration of fluids. Fluid overload might create complications.
• Treat seizures with diazepam.
• Proparacaine hydrochloride should be used to assist eye irrigation.

EMERGENCY DEPARTMENT

• Laboratory analysis of complete blood count, serum electrolytes, BUN, creatinine, glucose, urinalysis, baseline for serum aminotransferases (ALT and AST), calcium, phosphorus and magnesium, may assist in establishing a treatment regime. Other useful analyses include anion and osmolar gaps, arterial blood gases (ABGs), chest radiographs and electrocardiographs.
• Positive end-expiratory pressure (PEEP)-assisted ventilation may be required for acute parenchymal injury or adult respiratory distress syndrome.

continued...

• Treat bronchospasm in a similar manner to that employed for reactive airway disease. Severe exposures may require inhaled corticosteroids.
• Sodium bicarbonate may correct acidosis.
• Haemodialysis may assist in severely symptomatic patients.
• Consult a toxicologist as necessary.
BRONSTEIN, A.C. and CURRANCE, P.L.
EMERGENCY CARE FOR HAZARDOUS MATERIALS EXPOSURE: 2nd Ed. 1994.
for corrosives:

BASIC TREATMENT

• Establish a patent airway with suction where necessary.
• Watch for signs of respiratory insufficiency and assist ventilation as necessary.
• Administer oxygen by non-rebreather mask at 10 to 15 l/min.
• Monitor and treat, where necessary, for pulmonary oedema .
• Monitor and treat, where necessary, for shock.
• Anticipate seizures.
• Where eyes have been exposed, flush immediately with water and continue to irrigate with normal saline during transport to hospital.
• DO NOT use emetics. Where ingestion is suspected rinse mouth and give up to 200 ml water (5 ml/kg recommended) for dilution where patient is able to swallow, has a strong gag reflex and does not drool.
• Skin burns should be covered with dry, sterile bandages, following decontamination.
• DO NOT attempt neutralisation as exothermic reaction may occur.

ADVANCED TREATMENT

• Consider orotracheal or nasotracheal intubation for airway control in unconscious patient or where respiratory arrest has occurred.
• Positive-pressure ventilation using a bag-valve mask might be of use.
• Monitor and treat, where necessary, for arrhythmias.
• Start an IV D5W TKO. If signs of hypovolaemia are present use lactated Ringers solution. Fluid overload might create complications.
• Drug therapy should be considered for pulmonary oedema.
• Hypotension with signs of hypovolaemia requires the cautious administration of fluids. Fluid overload might create complications.
• Treat seizures with diazepam.
• Proparacaine hydrochloride should be used to assist eye irrigation.

EMERGENCY DEPARTMENT

• Laboratory analysis of complete blood count, serum electrolytes, BUN, creatinine, glucose, urinalysis, baseline for serum aminotransferases (ALT and AST), calcium, phosphorus and magnesium, may assist in establishing a treatment regime.
• Positive end-expiratory pressure (PEEP)-assisted ventilation may be required for acute parenchymal injury or adult respiratory distress syndrome.
• Consider endoscopy to evaluate oral injury.
• Consult a toxicologist as necessary.
BRONSTEIN, A.C. and CURRANCE, P.L. EMERGENCY CARE FOR HAZARDOUS MATERIALS EXPOSURE: 2nd Ed

Section 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA
• Alcohol stable foam.
• Dry chemical powder.
• BCF (where regulations permit).
• Carbon dioxide.
• Water spray or fog - Large fires only.

continued...

Section 5 - FIRE FIGHTING MEASURES

FIRE FIGHTING
• Alert Fire Brigade and tell them location and nature of hazard.
• Wear full body protective clothing with breathing apparatus.
• 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.

FIRE/EXPLOSION HAZARD
• Combustible.
• Slight fire hazard when exposed to heat or flame.
• Heating may cause expansion or decomposition leading to violent rupture of containers.
• On combustion, may emit toxic fumes of carbon monoxide (CO).
• May emit acrid smoke.
• Mists containing combustible materials may be explosive.
Combustion products include: carbon dioxide (CO2), aldehydes, other pyrolysis products typical of burning organic material.
May emit corrosive fumes.

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

Personal Protective Equipment
Gas tight chemical resistant suit.

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS
• Clean up all spills immediately.
• Avoid breathing vapours and contact with skin and eyes.
• Control personal contact by using protective equipment.
• Contain and absorb spill with sand, earth, inert material or vermiculite.
• Wipe up.
• Place in a suitable, labelled container for waste disposal.

MAJOR SPILLS
• Clear area of personnel and move upwind.
• Alert Fire Brigade and tell them location and nature of hazard.
• 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 labelled containers for recycling.
• Neutralise/decontaminate residue.
• Collect solid residues and seal in labelled 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.

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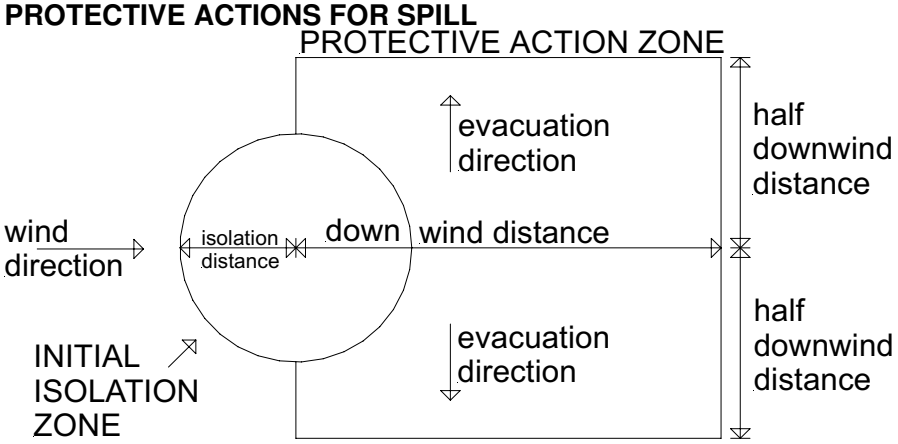
PROTECTIVE ACTIONS FOR SPILL



From IERG (Canada/Australia)

Isolation Distance	25 metres
Downwind Protection Distance	250 metres
IERG Number	37

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 154 is taken from the US DOT emergency response guide book.
6 IERG information is derived from CANUTEC - Transport Canada.

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:
glutaraldehyde 5ppm

irreversible or other serious effects or symptoms which could impair an individual's ability to take protective action is:
glutaraldehyde 1ppm

other than mild, transient adverse effects without perceiving a clearly defined odour is:
glutaraldehyde 0.2ppm

American Industrial Hygiene Association (AIHA)

Ingredients considered according to the following cutoffs

Very Toxic (T+)	>= 0.1%	Toxic (T)	>= 3.0%

continued...

R50	>= 0.25%	Corrosive (C)	>= 5.0%
R51	>= 2.5%		
else	>= 10%		

where percentage is percentage of ingredient found in the mixture

Personal Protective Equipment advice is contained in Section 8 of the MSDS.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- DO NOT allow clothing wet with material to stay in contact with skin.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
- 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. 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.

SUITABLE CONTAINER

- Glass container is suitable for laboratory quantities.
- Lined metal can, lined metal pail/ can.
- Plastic pail.
- Polyliner drum.
- Packing as recommended by manufacturer.
- Check all containers are clearly labelled 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, porcelain or stoneware, there must be sufficient inert cushioning material in contact with inner and outer packages unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.

STORAGE INCOMPATIBILITY

- Incidents involving interaction of active oxidants and reducing agents, either by design or accident, are usually very energetic and examples of so-called redox reactions.
- Flammable and/or toxic gases are generated by the combination of aldehydes with azo, diazo compounds, dithiocarbamates, nitrides, and strong reducing agents.
- Many aldehydes are incompatible with strong acids, amines, strong oxidisers, and alkaline materials.
- Several medium range aldehydes ignite in air, particularly if exposure is increased by sorption on paper or cloth - ignition often occurs within 2 hours.

Glutaraldehyde:

- is a strong reducing agent

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• reacts with water forming an aqueous polymer solution
• reacts violently with strong oxidisers, strong acids, bromine, ketones
• is incompatible wit caustics, ammonia, amines, acetophenone, acetyl benzene, xylidenes
• the activated form (an alkaline solutions) react readily with alcohol, ketones, amines, hydrazines and proteins.
• Avoid strong bases.
• Avoid reaction with oxidising agents.

STORAGE REQUIREMENTS
• Store in original containers.
• Keep containers securely sealed.
• Store in a cool, dry, well-ventilated area.
• Store away from incompatible materials and foodstuff containers.
• Protect containers against physical damage and check regularly for leaks.
• Observe manufacturer's storing and handling recommendations.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

X	X	+	X	X	+

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

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	Peak ppm	Peak mg/m³	Notes
Australia Exposure Standards	glutaraldehyde (Glutaraldehyde)	0.1	0.41	Sen

MATERIAL DATA
GLUTARALDEHYDE:
■ Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.
OSHA (USA) concluded that exposure to sensory irritants can:
• cause inflammation
• cause increased susceptibility to other irritants and infectious agents
• lead to permanent injury or dysfunction
• permit greater absorption of hazardous substances and

continued...

• acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

Odour threshold for glutaraldehyde: 0.04 ppm.

The recommended ceiling of exposure, for both the activated and unactivated forms, is based on the reported irritation threshold of glutaraldehyde in humans. A significant risk of irritation to the eyes, skin and throat has been demonstrated for exposures of 0.3 ppm. Ongoing subchronic inhalation studies are presently being reviewed.

Animal experiments demonstrate that solutions containing 25% or more of glutaraldehyde cause a significant degree of skin irritation and eye injury.

PERSONAL PROTECTION

EYE

• Safety glasses with unperforated side shields may be used where continuous eye protection is desirable, as in laboratories; spectacles are not sufficient where complete eye protection is needed such as when handling bulk-quantities, where there is a danger of splashing, or if the material may be under pressure
• Chemical goggles.whenever there is a danger of the material coming in contact with the eyes; goggles must be properly fitted
• Full face shield (20 cm, 8 in minimum) may be required for supplementary but never for primary protection of eyes; these afford face protection.
• Alternatively a gas mask may replace splash goggles and face shields.
• Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59].

HANDS/FEET

• Elbow length PVC gloves.
• When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.

NOTE:

• The material may produce skin sensitisation in predisposed individuals. Care must be taken, when removing gloves and other protective equipment, to avoid all possible skin contact.
• Contaminated leather items, such as shoes, belts and watch-bands should be removed and destroyed.

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.

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Application of a non-perfumed moisturiser is recommended.
Latex rubber gloves are not recommended. [NIOSH]

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

GLOVE SELECTION INDEX
■ Glove selection is based on a modified presentation of the:
" Forsberg Clothing Performance Index" .
The effect(s) of the following substance(s) are taken into account in the computer- generated selection: glutaraldehyde

■ Protective Material

BUTYL	A
NEOPRENE	A
VITON	A
PVC	B

A: Best Selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to Dangerous Choice for other than short term immersion

NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation. -

* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

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	A- AUS	-
1000	50	-	A- AUS
5000	50	Airline *	-
5000	100	-	A- 2
10000	100	-	A- 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. For further information consult your
Occupational Health and Safety Advisor.

continued...

ENGINEERING CONTROLS
■ Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Correct fit is essential to obtain adequate protection. Supplied-air type respirator may be required in special circumstances. Correct fit is essential to ensure 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, vapours, 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 favourable 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

APPEARANCE
Colourless oily liquid; pungent odour.Mixes with water, alcohol and benzene. Glutaraldehyde is available as 50% and 25% solutions in water. Alkaline solutions of glutaraldehyde, also known as "activated glutaraldehyde", form polymeric films after a few hours.
Glutaraldehyde is an aliphatic dialdehyde that undergoes most of the typical aldehyde reactions to form acetals, cyanohydrins, oximes, hydrazones and bisulfite complexes. Glutaraldehyde in solutions is susceptible

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to aerial oxidation to give the corresponding carboxylic acid. Glutaraldehyde reacts with proteins by a cross-linking reaction which is mainly between the NH2 groups, and which depends upon time, pH and temperature. The reaction is less efficient under alkaline conditions.
Glutaraldehyde polymerises in water to a glassy form which regenerates the dialdehyde on vacuum distillation.
In solution, glutaraldehyde partially polymerises to oligomers to give a mixture of variable composition. The degree of polymerisation increases with pH and temperature. Above pH 9, polymerisation proceeds comparatively rapidly and solutions eventually lose their sporicidal activity.
When heated to elevated temperatures (> 400°C), glutaraldehyde in aqueous solution will decompose thermally to form carbon oxides and hydrocarbons. In standard thermal stability tests in the laboratory, aqueous glutaraldehyde showed no exothermic decomposition when heated to 340°C

PHYSICAL PROPERTIES
Mixes with water.
Corrosive.
Toxic or noxious vapours/gas.

State	LIQUID	Molecular Weight	100.12
Melting Range (°C)	- 14	Viscosity	Not Available
Boiling Range (°C)	187- 9 decomposes	Solubility in water (g/L)	Miscible
Flash Point (°C)	Not Available	pH (1% solution)	Not available.
Decomposition Temp (°C)	Not Available	pH (as supplied)	Not available
Autoignition Temp (°C)	Not available.	Vapour Pressure (kPa)	2.26 @ 20C
Upper Explosive Limit (%)	Not Available	Specific Gravity (water=1)	0.72 @ 20C
Lower Explosive Limit (%)	Not Available	Relative Vapour Density (air=1)	3.4
Volatile Component (%vol)	Not applicable.	Evaporation Rate	Not available

Section 10 - CHEMICAL STABILITY AND REACTIVITY INFORMATION

CONDITIONS CONTRIBUTING TO INSTABILITY
• Presence of incompatible materials.
• Product is considered stable.
• Hazardous polymerisation will not occur.
For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED
■ The material can produce 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.
■ The material can produce severe chemical burns within the oral cavity and gastrointestinal tract following ingestion.
■ Swallowing of the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis; serious consequences may result. (ICSC13733).
■ Exposure to aldehydes causes neurological symptoms such as headache, drowsiness, dizziness, seizures, depression and coma. Cardiovascular involvement may result in increased heart rate, collapse and low blood pressure; respiratory effects include throat spasms, irritation, difficulty swallowing, pulmonary oedema and an asthma-like condition. Gastrointestinal signs include nausea, blood in vomit, diarrhoea, ulcers and abdominal pain. Massive exposures may damage the kidney and liver.

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EYE
■ The material can produce chemical burns to the eye following direct contact. Vapours or mists may be extremely irritating.
■ The material can produce severe chemical burns to the eye following direct contact. Vapours or mists may be extremely irritating.
■ If applied to the eyes, this material causes severe eye damage.

SKIN
■ The material can produce chemical burns following direct contactwith the skin.
■ Skin contact with the material may be harmful; systemic effects may result following absorption.
■ The material can produce severe chemical burns following direct contactwith the skin.
■ The material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterised by redness, swelling and blistering.
■ Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED
■ Inhalation of aerosols (mists, fumes), generated by the material during the course of normal handling, may produce severely toxic effects. Relatively small amounts absorbed from the lungs may prove fatal.
■ The material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage.
■ Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by sleepiness, reduced alertness, loss of reflexes, lack of co-ordination, and vertigo.
■ Inhalation hazard is increased at higher temperatures.
■ The strong irritant effect on eyes, nasal passages, upper respiratory tract and skin of pure glutaraldehyde appear to be slightly enhanced following activation.
Irritation of the nose and throat and general tightness of the chest have been experienced by workers exposed to glutaraldehyde vapours. Cases cited in the scientific literature include:
• Swedish hospital workers exposed to concentrations less than 0.2 ppm experienced irritation of the nose and throat;
• hospital staff experienced irritation of the nose and throat after working with 2% glutaraldehyde solution;
• four endoscopy nurses experienced asthma and rhinitis after working with 2% aqueous glutaraldehyde;
• an endoscopy technician employed in preparing 2% aqueous glutaraldehyde from a 50% stock solution experienced nose bleeding in addition to irritation of the nose and throat
• hospital workers exposed to glutaraldehyde at atmospheric concentrations up to 0.5 ppm v/v included nose and throat irritation, chest tightness and coughing;
• In the survey carried out by the South Australian Occupational Health and Safety Commission in 1993, nine cases of nose and/or throat irritation and two cases of lower respiratory tract irritation were reported in hospital workers
When mice were exposed at 8 ppm of alkalinised glutaraldehyde for 24 hours they reacted with distinct nervous behaviour - the symptoms disappeared after a few hours. Livers of mice exposed at 33 ppm for 24 hours showed signs of toxic hepatitis.
Many acute inhalational toxicity studies did not produce systemic toxicity, but the results showed that exposure of the test animals to glutaraldehyde vapours at low concentrations leads to irritant effects such as laboured and audible breathing and wetness and encrustation around the nose and eyes. In the studies resulting in mortality, congestion of the lungs, kidneys and adrenals was observed.
Groups of six male and six female Fischer 344 rats were exposed to glutaraldehyde vapour concentrations of 10.6, 23.0 or 42.7 ppm v/v. Clinical observations during the four-hour exposure and immediately afterwards included excess lachrymation and salivation, audible and mouth breathing, and wetness
and encrustation around the eyes. Wetness and encrustation around the nose and mouth were observed in the animals exposed to the two higher doses. A slow righting reflex was observed during exposure in one male and one female rat exposed to 42.7 ppm, and decreased motor activity was observed during the 14-day post-exposure period in all surviving animals in the 23.0 and 42.7 ppm groups. During exposure, body weights and food and water consumption were reduced compared with the control group. All symptoms decreased or disappeared during days 8-14 of the post-exposure period. The cause of death was apparently lung damage. Breathing difficulties were observed in most animals during exposure, and at necropsy, colour changes of the lungs were noted in the

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male and female rats exposed to 42.7 and 23.0 ppm. No gross lesions of the nasal cavity, larynx or trachea were observed at necropsy.
Under the conditions of the study, a four-hour LC50 of 23.5 ppm v/v (96 mg/L) resulted for the male rats , and 40.1 ppm (164 mg/L) for the females . This high toxicity of glutaraldehyde was attributed partly to the presence of more toxic higher molecular weight species formed during vapour generation, but no supporting evidence has been submitted to substantiate this claim.
Acute inhalation studies in test animals showed that the vapour from glutaraldehyde solutions was a severe eye irritant at low vapour concentrations, for example, at 3 ppm v/v.
One respiratory irritation animal study was available for assessment, with the study showing that the breathing rate of mice was significantly reduced at all vapour concentrations (1.64-36.7 ppm), no level of tolerance being achieved. Information available from acute inhalation studies has shown that glutaraldehyde is a respiratory irritant in test animals at the lowest vapour concentrations measured (2 ppm).
The three short term (nine-day or two-week) repeated dose toxicity studies showed that glutaraldehyde produced significant mortality in rats by inhalation at approximately 2 ppm v/v, and respiratory irritation at levels down to approximately 0.2 ppm. Lesions of the nasal cavity and larynx were observed in the studies, occurring at 0.5 ppm in one nine-day study. Atrophy of the liver was observed, at 3.1 ppm, in one of the studies. The signs of irritation observed were similar to those seen in the acute inhalational studies, that is, laboured breathing and discharge/encrustation around the eyes and nose. The results observed in the nine-day study carried out at ambient temperature were similar to those observed in a preliminary nine-day study conducted by heating glutaraldehyde solution to generate vapour.
In two subchronic rat studies (13 or 14 weeks), lesions of the nasal cavity and signs of irritation were observed at lower concentrations, with a no-observed adverse effect level (NOAEL) of 125 ppb v/v in one study and signs of nasal irritation at 49 ppb in the other.
The results of corresponding two-week and 13-week studies in mice demonstrated that mice were more sensitive than rats, with mortality at 1.6 ppm and 500 ppb in the two and 13-week studies respectively. Nasal irritation was observed in the 13-week study at 62.5 ppb, the lowest dose tested. The results highlighted the acute toxicity and irritancy of glutaraldehyde by inhalation at low vapour concentrations, and the harmful effects of repeated or prolonged exposure to the vapours.
■ Acute effects from inhalation of high vapour concentrations may be chest and nasal irritation with coughing, sneezing, headache and even nausea.
■ Exposure to aldehydes causes neurological symptoms such as headache, drowsiness, dizziness, seizures, depression and coma. Cardiovascular involvement may result in increased heart rate, collapse and low blood pressure; respiratory effects include throat spasms, irritation, difficulty swallowing, pulmonary oedema and an asthma-like condition. Gastrointestinal signs include nausea, blood in vomit, diarrhoea, ulcers and abdominal pain. Massive exposures may damage the kidney and liver.

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.
Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.
Inhaling this product is more likely to cause a sensitisation reaction in some persons compared to the general population.
Skin contact with the material is more likely to cause a sensitisation reaction in some persons compared to the general population.
Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.
Activated glutaraldehyde retains the skin sensitising properties (allergic contact dermatitis) of pure glutaraldehyde. A well-conducted guinea pig maximisation test showed that both the 2% aqueous solution and the 2% alkalinised solution of glutaraldehyde are skin sensitisers, with the former the stronger sensitiser.
The results of a mouse-ear swelling test confirmed that glutaraldehyde is a skin sensitiser. The skin sensitising properties of the chemical are also demonstrated by human evidence in the scientific literature.
Dilute solutions of glutaraldehyde (0.1%, 0.2% and 0.5%) were applied under an occluded patch for 48 hours to the backs of 109 male and female persons, all 12 years of age or more. Ten patches were sequentially applied, followed by challenge at a fresh site on the back. With 0.5% solution, there were seven cases of erythema and nine of slight irritation. On challenge, one case of erythema and oedema and one case of slight irritation resulted. With both the 0.1% and 0.2% solutions, one case of erythema of two of slight irritation resulted,

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but there was no reaction on challenge. Under the conditions of the study, 0.5% glutaraldehyde was a skin irritant in humans, and a skin sensitiser in 1-2% of the test population. The more dilute solutions (0.1% and 0.2%) indicated signs of skin irritation but no sensitisation.
Occupational asthma is a respiratory disease characterised by variable bronchial obstruction and variable hyperactivity caused by specific agents inhaled at work and rhinitis is a disease that invokes inflammation of the nasal mucous membrane, characterised by periods of nasal discharge, sneezing and congestion. Respiratory sensitisation is an immune status resulting from an immune response to an antigen, which may be a finding in the diagnosis of occupational asthma and/or rhinitis. A number of cases of respiratory disease such as occupational asthma and rhinitis have been linked with exposure to glutaraldehyde in the workplace, with some cases concerning workers with no past history of allergic response. Difficulties have arisen in determining whether the response in each case is due to an irritant effect or to an allergic hypersensitivity. The type of allergic mechanism that causes asthma after exposure to glutaraldehyde is not yet known, and no specific antibody has been identified. From various cited case studies, there is sufficient evidence to conclude that occupational asthma and rhinitis can result from exposure to glutaraldehyde in the workplace. Whether the responses have been due to an irritant effect or to allergic hypersensitivity is less clear. Lung function measurements were carried out after provocation testing in several of the cases, with a delayed onset of asthma in four cases. Delayed nasal discharge and sneezing occurred in one case. As asthmatic reactions caused by irritation generally occur immediately after exposure and are transient, these cases provide some evidence for respiratory sensitisation and are therefore of concern. In several, but not all, of the cases, the affected workers were atopic. Atopy appears to be a significant risk factor in the onset of asthma after exposure to antigens that cause asthma by IgE-mediated mechanisms, for example, high molecular weight antigens, but there is no evidence that it is a risk factor in asthma caused by antigens which do not induce an IgE-mediated response, for example, low molecular weight antigens such as glutaraldehyde. A summary of cases and discussion above highlight the difficulty in determining whether the occupational asthma seen is a result of respiratory sensitisation.
Long term exposure has been reported to cause chronic fatigue.
In a 90-day study rats exposed to 49 ppb showed perinasal wetness and significantly reduced body weight gain. No damage of the nasal mucosa was evident at 49 ppb or 194 ppb although several serum enzyme levels were raised. In a second study lasting 13-weeks, rats and mice exposed to high levels of glutaraldehyde (1 ppm) for 6 hours daily, 5 days per week, showed nasal passage lesions.
No evidence of internal organ toxicity was produced in subchronic drinking water studies using rats, mice and dogs at concentrations up to 1000 ppm.
Genotoxicity studies using several assays have generally given varying results. Developmental toxicity studies appear to demonstrate that glutaraldehyde does not produce foetal toxicity, embryotoxicity or teratogenic effects at maternally nontoxic doses. In a chronic 2-year study using rats exposed to glutaraldehyde in drinking water there was some evidence of oncogenic potential in female rats only as evidenced by an increased incidence of larger granular cell lymphocytic leukaemia. The pattern of response was indicative of a modifying influence on the expression of spontaneous and commonly occurring neoplasms. There was no evidence for non-oncogenic large organ toxicity.
Repeated application of aqueous solutions to rat skin (20 applications) over 28 days at concentrations of up to 150 mg/kg/day produced mild inflammatory effects without producing systemic toxicity.

TOXICITY AND IRRITATION
■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY	IRRITATION
Oral (rat) LD50: 134 mg/kg	Skin (human): 6 mg/3d- int- SEVERE
Inhalation (rat) LC50: 480 mg/m³/4h	Skin (rabbit): 13 mg open- Mild
Dermal (rabbit) LD50: 403 mg/kg	Skin (rabbit): 2 mg/24h- SEVERE
	Eye (rabbit): 1 mg- SEVERE
	Eye (rabbit): 0.25mg/24h- SEVERE

■ 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

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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.
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.
Animal studies indicate that the oral LD50 of glutaraldehyde in rats, mice and guinea pigs, is approximately 50-250 mg/kg, and that the acute dermal toxicity in rabbits, rats and mice is approximately 1000-4500 mg/kg, with skin absorption at high concentrations. Glutaraldehyde has a high acute inhalational toxicity in rats and mice and lung damage has been reported. Four-hour LC50 values of 23.5 and 40.1 ppm have been obtained for the male and female rat respectively, but the glutaraldehyde solution had to be heated in order to generate glutaraldehyde vapour at high enough concentrations. Repeat acute inhalational toxicity studies at both ambient and elevated temperatures are being carried out.
Glutaraldehyde is corrosive to the skin and eyes of rabbits at high concentrations, with signs of skin irritation evident at 2%, and eye irritation at 0.2%. Exposure to glutaraldehyde vapours in acute inhalational studies resulted in nasal irritation and respiratory difficulties. Joint irritation was seen in rabbits after intra-articular administration. The skin sensitisation effect of glutaraldehyde was demonstrated in tests with guinea pigs.
Short term (nine day or two-week) repeated dose inhalational rat studies resulted in significant mortality at approximately 2 ppm v/v, and nasal irritation at levels down to approximately 0.2 ppm. Lesions of the nasal cavity and larynx were observed at 0.5 ppm and, in a nine-day study, atrophy of the liver was observed at 3.1 ppm. Signs of irritation included laboured breathing and discharge and encrustation around the eyes and nose.
The results of the material balance and pharmacokinetic studies with solutions of glutaraldehyde up to 7.5% showed that prolonged skin contact can lead to absorption via the skin. This is supported by the results of in vitro testing with human skin tissue.
The pharmacokinetic studies indicated that the dermal absorption rates were low and that the elimination times of absorbed glutaraldehyde were long. The material balance studies did not identify any specific target site for distribution.
Glutaraldehyde is metabolised principally to CO2 via oxidation to glutaric acid, but the mechanism for complete metabolism and the identification of all metabolites is yet to be determined.
As a cross-linking agent, glutaraldehyde reacts readily with proteins, with a number of complex reaction products formed by a mechanism not yet fully understood.
The metabolism of glutaraldehyde probably involves initial oxidation to the corresponding carboxylic acids by aldehyde dehydrogenase, and then further oxidation via an acidic intermediate to CO2.
The glutaric acid formed by oxidation is probably metabolised by synthesis of a Coenzyme A thioester to give glutaryl CoA, which is then oxidised by glutaryl CoA dehydrogenase to give glutaconyl CoA, leading to eventual degradation to acetate and then to CO2.
Glutaraldehyde reacts readily with proteins as a cross-linking agent, the reaction being rapid and pH-dependent (rate increases at pH > 9). Glutaraldehyde initially reacts with amino acids to give Schiff bases with reactive amino groups. Further reaction occurs to give a number of complex reaction products, with the mechanism of the cross-linking process not yet fully understood.
Little information is available on the interaction between glutaraldehyde and DNA. It has been reported that glutaraldehyde only reacts with DNA at >60°C. It has also been reported that only some components of DNA react with glutaraldehyde.

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:

GLUTARALDEHYDE:
■ Very toxic to aquatic organisms.
■ 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.

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■ Glutaraldehyde is a hydrophilic substance that will be mainly associated with the aquatic compartment, with minor amounts partitioning to the atmosphere, following release to the environment. Hydrolysis is slow, but glutaraldehyde, like other aldehydes, undergoes aerial oxidation in solution. It biodegrades rapidly in aerobic and anaerobic aquatic environments at subcidal concentrations (below 10 mg/L) and will not bioaccumulate. Tropospheric degradation is also rapid.
Glutaraldehyde is moderately to highly toxic to algae and has a moderately toxic effect on Daphnia reproduction Glutaraldehyde is not expected to bioconcentrate in the food chain. In water glutaraldehyde undergoes moderate biodegradation to produce glutamic acid. Much of glutaraldehyde releases are to water. In the water it fully dissolves and disperses. In the water it is broken down by bacteria (unless very high concentrations) within a few days. When glutaraldehyde is released to the air it is quickly reacted by photochemical processes to be broken down within hours. Since it is very water soluble, any unreacted material will be removed from the atmosphere by rain and fog
Environmental Transport
Industrial emissions of glutaraldehyde can produce elevated, concentrations in the atmosphere around the source. Because of its short life expectancy in the atmosphere glutaraldehyde is expected to be confined to the local area within which it is emitted. Glutaraldehyde that makes its way into the ground or water is degraded within days. Most glutaraldehyde that is released to the water goes into a public sewage facility. At the public sewage facilities it is very diluted, and the microorganisms are able to digest it, with out any impact.
Hydrolysis
The hydrolysis of [1,5-14C]-glutaraldehyde has been examined in sterile aqueous solutions at pH 5, 7 and 9.3 The study was conducted at 25°C in the dark at a nominal concentration of 10 mg/L. The parent compound degraded slowly in pH 5 and 7 buffer solutions during the 31 day study, with extrapolated half-lives of 508 and 102 days respectively. At pH 9, degradation proceeded more rapidly (half-life 46 days) with the formation of a cyclic dimer of glutaraldehyde.
Photodegradation
Photochemical processes will be important in removing glutaraldehyde from the atmosphere. Formaldehyde vapours are reported to undergo direct photochemical transformation in the troposphere, as well as photo-oxidative degradation (reaction with hydroxyl radicals). Half-life in the sunlit troposphere is a few hours. Hydrophilicity of glutaraldehyde will ensure removal of unreacted residues from the atmosphere by dissolution in rain.
Metabolism in soils and aquatic systems
The behaviour of glutaraldehyde in soil adsorption tests indicates ready metabolism in soils, with half-lives of a few days. Aerobic studies in aquatic systems confirm the limited persistence. Radiolabelled glutaraldehyde (10 ppm) was incubated in Sacramento River water/sediment (ratio 5) for 30 days. The sediment was the same as that used in the adsorption test. Radiocarbon was mainly found in the aqueous phase (at least 90%) in the first four hours of the study, but declined to below 20% by 14 days, when about 20% of applied radiocarbon was in the sediment and 48% had been liberated as carbon dioxide. At termination, about 10% remained substantially bound to sediment and 80% could be accounted for as carbon dioxide in headspace and water. Analysis by HPLC indicated that glutaraldehyde was oxidised rapidly to glutaric acid, which mineralises. The pseudo first-order half-life was 10.6 hours.
Relative hazard to the environment
On an environmental spectrum of 0 - 3 Glutaraldehyde registers 1.5. A score of 3 represents a very high hazard to the environment and 0 a negligible hazard.
■ Prevent, by any means available, spillage from entering drains or water courses.
■ DO NOT discharge into sewer or waterways.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
glutaraldehyde	LOW		LOW	HIGH

GESAMP/EHS COMPOSITE LIST - GESAMP Hazard Profiles

Name / Cas No / RTECS No	EHS	TRN	A1a	A1b	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3
-	110	362	0	NI	0	R	3	0	1	0	4	3	3	S		D	3

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CAS:111-30-8 / MA2450000 7

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

- Containers may still present a chemical hazard/ danger when empty.
- Return to supplier for reuse/ recycling if possible.

Otherwise:

- If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill.
- Where possible retain label warnings and MSDS and observe all notices pertaining to the product.

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 or process equipment to enter drains.
- It may be necessary to collect all wash water for treatment before disposal.
- In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.
- Where in doubt contact the responsible authority.
- Recycle wherever possible.
- Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.
- Treat and neutralise at an approved treatment plant. Treatment should involve: Neutralisation followed by: burial in a land-fill specifically licenced to accept chemical and / or pharmaceutical wastes or Incineration in a licenced apparatus
- Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

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Section 14 - TRANSPORTATION INFORMATION

Labels Required: CORROSIVE,TOXIC

HAZCHEM:
□ 2X

Land Transport UNDG:

Class or division:	8	Subsidiary risk:	6.1
UN No.:	2922	UN packing group:	II

Shipping Name:CORROSIVE LIQUID, TOXIC, N.O.S. (contains glutaraldehyde)

Air Transport IATA:

ICAO/IATA Class:	8 (6.1)	ICAO/IATA Subrisk:	None
UN/ID Number:	2922	Packing Group:	II
Special provisions:	A3		

Shipping Name: CORROSIVE LIQUID, TOXIC, N.O.S. *(CONTAINS GLUTARALDEHYDE)

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	6.1
UN Number:	2922	Packing Group:	II
EMS Number:	F- A, S- B	Special provisions:	274 944
Limited Quantities:	1 L		

Shipping Name: CORROSIVE LIQUID, TOXIC, N.O.S.(contains glutaraldehyde)

GESAMP hazard profiles for this material can be found in section 12 of the MSDS.

Section 15 - REGULATORY INFORMATION

REGULATIONS

glutaraldehyde (CAS: 111-30-8) is found on the following regulatory lists;
"Australia Exposure Standards","Australia Hazardous Substances","Australia Inventory of Chemical Substances (AICS)","Australia National Pollutant Inventory", "Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Appendix E (Part 2)","Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Appendix F (Part 3)","Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Schedule 2","Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Schedule 5","Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Schedule 6", "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"

Section 16 - OTHER INFORMATION

MSDS SECTION CHANGES

The following table displays the version number of and date on which each section was last changed.

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Section Name	Version	Date	Section Name	Version	Date	Section Name	Version	Date
Advice to Doctor	4	11- Jul- 2006	Storage (storage requirement)	4	11- Jul- 2006	Acute Health (inhaled)	4	11- Jul- 2006
First Aid (skin)	4	11- Jul- 2006	Storage (suitable container)	4	11- Jul- 2006	Acute Health (skin)	4	11- Jul- 2006
First Aid (swallowed)	4	11- Jul- 2006	Engineering Control	4	11- Jul- 2006	Acute Health (swallowed)	4	11- Jul- 2006
Fire Fighter (fire fighting)	4	11- Jul- 2006	Personal Protection (eye)	4	11- Jul- 2006	Chronic Health	4	11- Jul- 2006
Fire Fighter (fire/explosion hazard)	4	11- Jul- 2006	Personal Protection (hands/feet)	4	11- Jul- 2006	Toxicity and Irritation (Other)	4	11- Jul- 2006
Spills (major)	4	11- Jul- 2006	Personal Protection (other)	4	11- Jul- 2006	Environmental	4	11- Jul- 2006
Spills (minor)	4	11- Jul- 2006	Physical Properties	4	11- Jul- 2006	Disposal	4	11- Jul- 2006
Handling Procedure	4	11- Jul- 2006	Acute Health (eye)	4	11- Jul- 2006	Transport	4	11- Jul- 2006
Storage (storage incompatibility)	4	11- Jul- 2006						

The above information is believed to be accurate and represent the best information currently available to us, but does not represent any warranty expressed or implied of the properties of the product. User should make their own investigation to determine the suitability of the information for their particular purpose.

Issue Date: 13-May-2018