

TETRAHYDROFURAN

GHS Safety Data Sheet

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Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

TETRAHYDROFURAN

OTHER NAMES

C4-H8-O, CH₂-CH₂-CH₂-CH₂-O, "butane, 1, 4-epoxy-", "butane, 1, 4-epoxy-", "butylene oxide", "cyclotetramethylene oxide", "diethylene oxide", hydrofuran, "furan, tetrahydro-", oxacyclopentane, oxolane, "tetramethylene oxide", THF, furanidine,

PROPER SHIPPING NAME

TETRAHYDROFURAN

PRODUCT USE

Solvent for high polymers, especially polyvinyl chloride, and in histological techniques.

As reaction medium for Grignard and metal hydride reactions.

In the synthesis of butyrolactone, succinic acid, 1,4-butanediol diacetate.

May be used for fabrication of articles for packaging, transporting, or storing of food if residual amount does not exceed 1.5% of the film.

SUPPLIER

Company: S D FINE- CHEM LIMITED

Address:

315- 317, T.V. INDUSTRIAL ESTATE,

248, WORLI,

MUMBAI- 400030.INDIA.

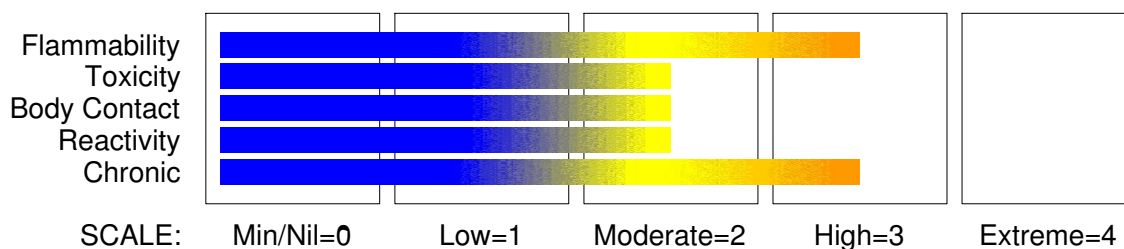
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HAZARD RATINGS



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Section 2 - HAZARDS IDENTIFICATION

GHS Classification

Acute Toxicity (Oral) Category 5
Eye Irritation Category 2A
Flammable Liquid Category 2
Reproductive Toxicity Category 1B
Respiratory Irritation Category 3
Skin Corrosion/Irritation Category 2



EMERGENCY OVERVIEW

HAZARD

DANGER
Determined by using GHS criteria:
H335 H225 H303 H315 H319 H360
May cause respiratory irritation
Highly flammable liquid and vapour
May be harmful if swallowed
Causes skin irritation
Causes serious eye irritation
May damage the unborn child

PRECAUTIONARY STATEMENTS

Prevention

Wash hands thoroughly after handling.
Ground/bond container and receiving equipment.
Use only non-sparking tools.
Obtain special instructions before use.
Wash thoroughly after handling.
Do not handle until all safety precautions have been read and understood.
Take precautionary measures against static discharge
Wear protective gloves and eye/face protection.
Keep container tightly closed.
Use personal protective equipment as required.
Use explosion-proof electrical/ventilating/lighting/equipment
Keep away from heat/sparks/open flame - No smoking.

Response

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If exposed or concerned: Get medical attention advice.
If skin irritation occurs, seek medical advice/attention.
If eye irritation persists, get medical advice/attention.
Wear eye/face protection.
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
In case of fire, use alcohol-type foam for extinction.

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Section 2 - HAZARDS IDENTIFICATION

If on skin or hair: remove/take off immediately all contaminated clothing. Rinse with water/shower.

IF ON SKIN: Gently wash with plenty of soap and water.

Wash/Decontaminate removed clothing before reuse.

Remove/Take off immediately all contaminated clothing

Storage

Store locked up.

Disposal

Dispose of contents and container in accordance with relevant legislation.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
tetrahydrofuran	109-99-9	>95
* The use of a stabilizer is required to inhibit the formation of peroxides, for example		
2, 6- di- tert- butyl- 4- methylphenol	128-37-0	0.025
p- cresol	106-44-5	0.05
hydroquinone	123-31-9	0.05

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.

EYE

- If this product comes in contact with the eyes:
- Wash out immediately with fresh 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.
 - If pain persists or recurs seek medical attention.
 - Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

- If skin contact occurs:
- Immediately remove all contaminated clothing, including footwear.
 - Flush skin and hair with running water (and soap if available).
 - Seek medical attention in event of irritation.

INHALED

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

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Section 4 - FIRST AID MEASURES

- 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

Treat symptomatically.

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.

FIRE FIGHTING

- Alert Fire Brigade and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or water course.
- Consider evacuation (or protect in place).
- Fight fire from a safe distance, with adequate cover.
- If safe, switch off electrical equipment until vapour fire hazard removed.
- Use water delivered as a fine spray to control the fire and cool adjacent area.
- Avoid spraying water onto liquid pools.
- Do not approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

FIRE/EXPLOSION HAZARD

- Liquid and vapour are highly flammable.
- Severe fire hazard when exposed to heat, flame and/or oxidisers.
- Vapour may travel a considerable distance to source of ignition.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).

Combustion products include: carbon dioxide (CO₂), other pyrolysis products typical of burning organic material.

WARNING: Long standing in contact with air and light may result in the formation of potentially explosive peroxides.

FIRE INCOMPATIBILITY

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

Section 6 - ACCIDENTAL RELEASE MEASURES

EMERGENCY PROCEDURES

MINOR SPILLS

- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid breathing vapours and contact with skin and eyes.

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Section 6 - ACCIDENTAL RELEASE MEASURES

- Control personal contact by using protective equipment.
- Contain and absorb small quantities with vermiculite or other absorbent material.
- Wipe up.
- Collect residues in a flammable waste container.

MAJOR SPILLS

- Clear area of personnel and move upwind.
- Alert Fire Brigade and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or water course.
- Consider evacuation (or protect in place).
- No smoking, naked lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse /absorb vapour.
- Contain spill with sand, earth or vermiculite.
- Use only spark-free shovels and explosion proof equipment.
- Collect recoverable product into labelled containers for recycling.
- Absorb remaining product with sand, earth or vermiculite.
- Collect solid residues and seal in labelled drums for disposal.
- Wash area and prevent runoff into drains.
- If contamination of drains or waterways occurs, advise emergency services.

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:

tetrahydrofuran 2000 ppm

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

tetrahydrofuran 1000 ppm

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

tetrahydrofuran 250 ppm

The threshold concentration below which most people will experience no appreciable risk of health effects:

tetrahydrofuran 200 ppm

American Industrial Hygiene Association (AIHA)

Ingredients considered according to the following cutoffs

Very Toxic (T+)	$\geq 0.1\%$	Toxic (T)	$\geq 3.0\%$
R50	$\geq 0.25\%$	Corrosive (C)	$\geq 5.0\%$
R51	$\geq 2.5\%$		
else	$\geq 10\%$		

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

- May form explosive peroxides on standing or following concentration by distillation.
- Review of stocks and testing for peroxide content by given tested procedures at 3

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Section 7 - HANDLING AND STORAGE

-monthly intervals is recommended, together with safe disposal of peroxidic samples.
[Peroxide-containing residues can often be rendered innocuous by pouring into an excess of sodium carbonate solution].

- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- DO NOT enter confined spaces until atmosphere has been checked.
- Avoid smoking, naked lights, heat or ignition sources.
- When handling, DO NOT eat, drink or smoke.
- Vapour may ignite on pumping or pouring due to static electricity.
- DO NOT use plastic buckets.
- Earth and secure metal containers when dispensing or pouring product.
- Use spark-free tools when handling.
- Avoid contact with incompatible materials.
- Keep containers securely sealed.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately.
- 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.

DO NOT allow clothing wet with material to stay in contact with skin.

The substance accumulates peroxides which may become hazardous only if it evaporates or is distilled or otherwise treated to concentrate the peroxides. The substance may concentrate around the container opening for example.

Purchases of peroxidisable chemicals should be restricted to ensure that the chemical is used completely before it can become peroxidised.

- A responsible person should maintain an inventory of peroxidisable chemicals or annotate the general chemical inventory to indicate which chemicals are subject to peroxidation. An expiration date should be determined. The chemical should either be treated to remove peroxides or disposed of before this date.
- The person or laboratory receiving the chemical should record a receipt date on the bottle. The individual opening the container should add an opening date.
- Unopened containers received from the supplier should be safe to store for 18 months.
- Opened containers should not be stored for more than 12 months.

SUITABLE CONTAINER

- Packing as supplied by manufacturer.
- Plastic containers may only be used if approved for flammable liquid.
- Check that containers are clearly labelled and free from leaks.
- For low viscosity materials (i) : Drums and jerry cans must be of the non-removable head type. (ii) : 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)
- For manufactured product having a viscosity of at least 250 cSt. (23 deg. C)
- Manufactured product that requires stirring before use and having a viscosity of at least 20 cSt (25 deg. C)
 - (i) : Removable head packaging;
 - (ii) : Cans with friction closures and
 - (iii) : low pressure tubes and cartridges may be used.
- Where combination packages are used, and the inner packages are of glass, there must be sufficient inert cushioning material in contact with inner and outer packages
- In addition, where inner packagings are glass and contain liquids of packing group I there must be sufficient inert absorbent to absorb any spillage, unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.

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Section 7 - HANDLING AND STORAGE

STORAGE INCOMPATIBILITY

Avoid strong acids, bases.

Segregate from strong oxidisers.

Avoid reaction with oxidising agents.

WARNING: Long standing in contact with air and light may result in the formation of potentially explosive peroxides.

Avoid contact with oxygen, air, light and heat.

Contact with lithium aluminium hydride or with sodium or potassium hydroxide can be hazardous when peroxides are present. Product may polymerise in the presence of cationic initiators such as Lewis acids or strong proton acids.

Segregate from:

lithium aluminium hydride, sodium or potassium hydroxide, cationic initiators such as Lewis acids or strong proton acids.

In the absence of inhibitors tetrahydrofuran is subject to auto-oxidation with the formation of 2-hydroperoxide. When heated this tends to decompose smoothly but if allowed to accumulate over a considerable period it transforms to other peroxidic species which violently decompose.

Copper(I) chloride has been recommended to remove trace amounts of peroxide. An attempt to remove peroxides by shaking with solid ferrous sulfate, prior to distillation, did not prevent explosion of the distillation residue. Alkali treatment does not appear to be safe.

Peroxides may be destroyed by passage through activated carbon at 20-66 C with contact time in excess of 2 min.

[Bretherick's Handbook of Reactive Chemical Hazards]

STORAGE REQUIREMENTS

Rotate all stock to prevent ageing. Use on FIFO (First In-First Out) basis.

- Store in original containers in approved flame-proof area.
- No smoking, naked lights, heat or ignition sources.
- DO NOT store in pits, depressions, basements or areas where vapours may be trapped.
- Keep containers securely sealed.
- Store away from incompatible materials in a cool, dry well ventilated area.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storing and handling recommendations.

Vent tanks through flame arrestors.

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

The following materials had no OELs on our records

- | | |
|---|----------------|
| • tetrahydrofuran: | CAS:109- 99- 9 |
| • 2, 6- di- tert- butyl- 4- methylphenol: | CAS:128- 37- 0 |
| • p- cresol: | CAS:106- 44- 5 |
| • hydroquinone: | CAS:123- 31- 9 |

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EMERGENCY EXPOSURE LIMITS

Material	Revised IDLH Value (mg/m3)	Revised IDLH Value (ppm)
tetrahydrofuran		2, 000 [LEL]
p- cresol		250 [Unch]
hydroquinone	50	

NOTES

Values marked LEL indicate that the IDLH was based on 10% of the lower explosive limit for safety considerations even though the relevant toxicological data indicated that irreversible health effects or impairment of escape existed only at higher concentrations.

ODOUR SAFETY FACTOR (OSF)

OSF=50 (TETRAHYDRO FURAN)

Exposed individuals are reasonably expected to be warned, by smell, that the Exposure Standard is being exceeded.

Odour Safety Factor (OSF) is determined to fall into either Class A or B.

The Odour Safety Factor (OSF) is defined as:

OSF= Exposure Standard (TWA) ppm/ Odour Threshold Value (OTV) ppm

Classification into classes follows:

Class	OSF	Description
A	550	Over 90% of exposed individuals are aware by smell that the Exposure Standard (TLV- TWA for example) is being reached, even when distracted by working activities
B	26- 550	As " A" for 50- 90% of persons being distracted
C	1- 26	As " A" for less than 50% of persons being distracted
D	0.18- 1	10- 50% of persons aware of being tested perceive by smell that the Exposure Standard is being reached
E	<0.18	As " D" for less than 10% of persons aware of being tested

MATERIAL DATA

Odour Threshold Value: 30.5 ppm (detection), 61 ppm (recognition)

THF is an upper respiratory irritant at concentrations exceeding 400 ppm.

At concentrations in the order of 25000 ppm THF is narcotic to both animals and humans. The TLV-TWA is thought to minimise the potential for upper respiratory tract irritation and to provide a sufficient margin of safety against THF-induced systemic injury. However given the epithelial changes found in the respiratory epithelium of rats exposed to 200 ppm, 4 hours/day, 5 days/week and in view of the well-known differences in rodent and human anatomy which contribute to upper airway absorbed doses, this margin of safety remains under review.

INGREDIENT DATA

2,6-DI-TERT-BUTYL-4-METHYLPHENOL:

Because high dose levels are required to produce toxic effects and because

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

there is little evidence of either acute or chronic effects amongst workers the recommended TLV-TWA is identical to that proposed for nuisance particulates.

P-CRESOL:

Exposure limits with "skin" notation indicate that vapour and liquid may be absorbed through intact skin. Absorption by skin may readily exceed vapour inhalation exposure. Symptoms for skin absorption are the same as for inhalation. Contact with eyes and mucous membranes may also contribute to overall exposure and may also invalidate the exposure standard.

Odour Threshold Value: 0.00099 ppm (recognition)

Concentrations of cresol in air as low as 5 ppm are easily recognised.

The recommended TLV-TWA takes account of the closely analogous to the toxic action of phenol

Systemic absorption by all routes may induce convulsions with damage to the lungs and central nervous system. Exposure at or below the recommended TLV-TWA is thought to protect the worker from respiratory, cardiovascular, hepatic, renal and neurological toxicity. Workers or volunteers exposed to phenol at or below 5.2 ppm have experienced no ill-effects. Because phenol as a vapour, liquid or solid can penetrate the skin causing systemic effects, a skin notation is considered necessary. Although ACGIH has not recommended a STEL it is felt that ACGIH excursion limits (15 ppm limited to a total duration of 30 minutes with brief excursions limited to no more than 25 ppm) and NIOSH Ceiling values (15 minutes at 15.6 ppm) are sufficiently similar so as to provide the same margin of safety.

HYDROQUINONE:

The recommended TLV-TWA takes into account the toxicology of hydroquinone and experience of industrial exposures to benzenediols. Exposure at or below the limit is thought to minimise the risk to workers of eye injury, dermatitis and central nervous system effects. A short-term duration exposure value has not been recommended, because no quantitative data as to the levels of hydroquinone which produce eye irritation or more serious corneal changes has been identified.

PERSONAL PROTECTION



EYE

- Safety glasses with side shields.
- Chemical goggles.
- 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].

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

HANDS/FEET

Wear chemical protective gloves, eg. PVC.

Wear safety footwear or safety gumboots, eg. Rubber.

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: tetrahydrofuran

Protective Material CPI *.

PE/EVAL/PE	A
TEFLON	B
PVA	B
VITON/CHLOROBUTYL	C
BUTYL	C
CPE	C
NEOPRENE	C

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.

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS

For flammable liquids and flammable gases, local exhaust ventilation or a process enclosure ventilation system may be required. Ventilation equipment should be explosion -resistant.

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:

solvent, vapours, degreasing etc., evaporating from tank (in still air).

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) direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)

Air Speed:

0.25- 0.5 m/s (50- 100 f/min.)

0.5- 1 m/s (100- 200 f/min.)

1- 2.5 m/s (200- 500 f/min.)

Within each range the appropriate value depends on:

Lower end of the range

- 1: Room air currents minimal or favourable to capture
- 2: Contaminants of low toxicity or of nuisance value only.
- 3: Intermittent, low production.
- 4: Large hood or large air mass in motion

Upper end of the range

- 1: Disturbing room air currents
- 2: Contaminants of high toxicity
- 3: High production, heavy use
- 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, mobile liquid with an ether-like odour; mixes with water, alcohols, ketones, esters and hydrocarbons.

Forms potentially explosive peroxides upon long standing in air.

These peroxides may explode if concentrated by evaporation or distillation.

Saturation vapour concentration: 17.6% @ 25 C.

PHYSICAL PROPERTIES

Liquid.

Mixes with water.

Molecular Weight: 72.11

Melting Range (°C): - 108.5

Boiling Range (°C): 66

Specific Gravity (water=1): 0.891 @ 20 C

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Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

Solubility in water (g/L): Miscible
pH (1% solution): 5 (20% aqueous)
Volatile Component (%vol): 100
Relative Vapour Density (air=1): 2.5
Lower Explosive Limit (%): 1.8
Autoignition Temp (°C): 321
State: Liquid

pH (as supplied): Not applicable
Vapour Pressure (kPa): 19.1 @ 20 C
Evaporation Rate: 8.0 BuAc=1
Flash Point (°C): - 15
Upper Explosive Limit (%): 11.8
Decomposition Temp (°C): Not available
Viscosity: Not Available

log Kow (Prager 1995): 0.46
log Kow (Sangster 1997): 0.46
log Kow: 0.32-0.46
log Kow: 4.17
log Kow: 4.17
log Kow (Prager 1995): 1.94
log Kow (Sangster 1997): 1.98
log Kow: 1.92-1.94
log Kow: 0.5-0.59

Section 10 - CHEMICAL STABILITY AND REACTIVITY INFORMATION

CONDITIONS CONTRIBUTING TO INSTABILITY

- Presence of a stabilising inhibitor prevents/retards peroxide formation.
- Presence of incompatible materials.
 - Product is considered stable.
 - Hazardous polymerisation will not occur.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

Accidental ingestion of the material may be damaging to the health of the individual.

EYE

Evidence exists, or practical experience predicts, that the material may cause eye irritation in a substantial number of individuals and/or may produce significant ocular lesions which are present twenty-four hours or more after instillation into the eye(s) of experimental animals.

Repeated or prolonged eye contact may cause inflammation characterised by temporary redness (similar to windburn) of the conjunctiva (conjunctivitis); temporary impairment of vision and/or other transient eye damage/ulceration may occur.

The application of a 20% aqueous solution of tetrahydrofuran to rabbit eyes produced irritation.

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

SKIN

Skin contact with the material may damage the health of the individual; systemic effects may result following absorption.

Limited evidence exists, or practical experience predicts, that the material either produces inflammation of the skin in a substantial number of individuals following direct contact, and/or produces significant inflammation when applied to the healthy intact skin of animals, for up to four hours, such inflammation being present twenty-four hours or

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more after the end of the exposure period. Skin irritation may also be present after prolonged or repeated exposure; this may result in a form of contact dermatitis (nonallergic). The dermatitis is often characterised by skin redness (erythema) and swelling (oedema) which may progress to blistering (vesiculation), scaling and thickening of the epidermis. At the microscopic level there may be intercellular oedema of the spongy layer of the skin (spongiosis) and intracellular oedema of the epidermis.

Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

Skin contact with tetrahydrofuran may produce smarting and reddening of the skin and after prolonged exposures, contact (non-allergic) dermatitis may result due to the degreasing effect of the substance.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterised by skin redness (erythema) thickening of the epidermis.

Histologically there may be intercellular oedema of the spongy layer (spongiosis) and intracellular oedema of the epidermis. Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

INHALED

Inhalation may produce health damage*.

Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be harmful.

Evidence shows, or practical experience predicts, that the material produces irritation of the respiratory system, in a substantial number of individuals, following inhalation.

In contrast to most organs, the lung is able to respond to a chemical insult by first removing or neutralising the irritant and then repairing the damage. The repair process, which initially evolved to protect mammalian lungs from foreign matter and antigens, may however, produce further lung damage resulting in the impairment of gas exchange, the primary function of the lungs. Respiratory tract irritation often results in an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system.

Overexposure to tetrahydrofuran, by inhalation, may result in irritation of the mucous membranes and may produce coughing, chest pains, nausea, dizziness, headache and narcosis. Exposure to high concentrations can affect the central nervous system due to the strong narcotic effect of the material. Concentrations greater than 25000 ppm were reported to produce anaesthesia in animals. Anaesthetic properties are poor as onset is delayed and recovery is slow. Pronounced hypotension and marked respiratory hypernea accompany narcosis. Other symptoms include muscular hypotonia and disappearance of corneal reflexes, followed by coma and death.

CHRONIC HEALTH EFFECTS

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

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

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is characterised by dyspnea, cough and mucus production.

There is some evidence that human exposure to the material may result in developmental toxicity. This evidence is based on animal studies where effects have been observed in the absence of marked maternal toxicity, or at around the same dose levels as other toxic effects but which are not secondary non-specific consequences of the other toxic effects. Repeated exposure to tetrahydrofuran (THF) and its congeners has been associated with cytolytic hepatitis and fatty degeneration of the liver. Inhalation of THF at concentrations greater than 3000 ppm, 8 hours/day for 20 days, produced irritation and evidence for hepatic and renal injury in animals. Male rats inhaling more than 5000 ppm THF for 12 weeks, 4 hours/day showed signs of systemic intoxication, skin and respiratory irritation, liver function disturbance and abnormalities in glucose function. Muscle acetylcholinesterase activity increased in a concentration-dependent manner in male rats that inhaled 200 ppm for 18 weeks, 6 hours/day. Hepatic protein and mixed function oxidase activity also increased. At 2000 ppm, liver function was inhibited. In a 13-week inhalation study, ataxia was reported in rats at 5000 ppm and narcosis in mice at 1800 ppm. Hepatocytomegaly developed in mice of both sexes at 5000 ppm while uterine atrophy and degeneration of the adrenal cortex was found in female mice. A case history suggests that interaction of THF and endoflurane (an anaesthetic) may provoke epileptic seizures following surgery. The parent compound of tetrahydrofuran, furan, is carcinogenic in rats based on an increased incidence of cholangiocarcinoma and hepatocellular neoplasms of the liver and increased incidences of mononuclear cell leukaemia. In male and female mice, furan induced hepatocellular neoplasms and benign pheochromocytomas of the of the adrenal gland. 1,4-Dioxane, another cyclic ether solvent, is carcinogenic in rats and guinea pigs , following oral administration, inducing malignant tumours of the liver in rats and malignant tumours of the liver of the gall-bladder in guinea pigs. 1,4-Dioxane is a promoter in two stage skin carcinogenic studies in mice. In a two-year inhalation study * there was evidence of carcinogenic activity of THF, in male rats, based on increased incidences of renal tube adenoma or carcinoma (combined) and in female mice based on an increased incidence of hepatocellular neoplasms. There was no evidence of carcinogenic activity in female rats or male mice exposed to 200, 600 and 1800 ppm THF by inhalation.

* National Toxicology Program Technical Report Series No. 475.

TOXICITY AND IRRITATION

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

TOXICITY

Oral (human) LDLo: 50 mg/kg* [CCINFO]*
Oral (rat) LD50: 2816 mg/kg
Inhalation (human) TCLo: 25000 ppm
Inhalation (rat) LC50: 2100 ppm/3h

IRRITATION

Nil Reported

2,6-DI-TERT-BUTYL-4-METHYLPHENOL:

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

TOXICITY

Oral (woman) TDLo: 80 mg/kg
Oral (rat) LD50: 890 mg/kg

IRRITATION

Skin (human): 500 mg/48h - Mild
Skin (rabbit):500 mg/48h- Moderate
Eye (rabbit): 100 mg/24h- Moderate

The substance is classified by IARC as Group 3:

NOT classifiable as to its carcinogenicity to humans.

Evidence of carcinogenicity may be inadequate or limited in animal testing.

NOTE: Substance has been shown to be mutagenic in at least one assay, or belongs to a family of chemicals producing damage or change to cellular DNA.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterised by skin redness (erythema) and swelling the epidermis. Histologically there may be intercellular oedema of the spongy layer (spongiosis) and intracellular oedema of the epidermis.

P-CRESOL:

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

continued...

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Section 11 - TOXICOLOGICAL INFORMATION

TOXICITY

Oral (rat) LD50: 207 mg/kg

Dermal (rabbit) LD50: 301 mg/kg

The material may produce severe irritation to the eye causing pronounced inflammation.

Repeated or prolonged exposure to irritants may produce conjunctivitis.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterised by skin redness (erythema) thickening of the epidermis.

Histologically there may be intercellular oedema of the spongy layer (spongiosis) and intracellular oedema of the epidermis. Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

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.

HYDROQUINONE:

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

TOXICITY

Oral (human) LDLo: 29 mg/kg

Oral (human) TDLo: 170 mg/kg

Oral (rat) LD50: 320 mg/kg

IRRITATION

Skin (human): 2% - Mild

Skin (human): 5% - SEVERE

Contact allergies quickly manifest themselves as contact eczema, more rarely as urticaria or Quincke's oedema. The pathogenesis of contact eczema involves a cell-mediated (T lymphocytes) immune reaction of the delayed type. Other allergic skin reactions, e.g. contact urticaria, involve antibody-mediated immune reactions. The significance of the contact allergen is not simply determined by its sensitisation potential: the distribution of the substance and the opportunities for contact with it are equally important. A weakly sensitising substance which is widely distributed can be a more important allergen than one with stronger sensitising potential with which few individuals come into contact. From a clinical point of view, substances are noteworthy if they produce an allergic test reaction in more than 1% of the persons tested.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterised by skin redness (erythema) thickening of the epidermis.

Histologically there may be intercellular oedema of the spongy layer (spongiosis) and intracellular oedema of the epidermis. Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

The substance is classified by IARC as Group 3:

NOT classifiable as to its carcinogenicity to humans.

Evidence of carcinogenicity may be inadequate or limited in animal testing.

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Section 12 - ECOLOGICAL INFORMATION

Algae IC50 (72hr.) (mg/l): 225
log Kow (Prager 1995): 0.46
log Kow (Sangster 1997): 0.46

DO NOT discharge into sewer or waterways.

log Kow: 0.32-0.46

Half-life (hr) air: 38.4

Half-life (hr) H2O surface water: 1.57

Half-life (hr) soil: 1.5

Henry's atm m³/mol: 9.63E-03

Toxicity Fish: LC50(96)0.23-34.9mg/L

Fathead minnow LC50(96h): 2160 mg/L

Toxicity invertebrate: LC50(96)0.02-0.1mg/L

Bioaccumulation: little

Effects on algae and plankton: LC50(6)algae 0.1mg/L

Refer to data for ingredients, which follows:

2,6-DI-TERT-BUTYL-4-METHYLPHENOL:

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.

DO NOT discharge into sewer or waterways.

log Kow: 4.17

BOD 5 if unstated: 0.51

COD: 2.27

Bioaccumulation: little

log Kow: 4.17

BOD 5 if unstated: 0.51

COD: 2.27

Bioaccumulation: little

P-CRESOL:

Hazardous Air Pollutant:	Yes
Fish LC50 (96hr.) (mg/l):	19
Daphnia magna EC50 (48hr.) (mg/l):	12
Algae IC50 (72hr.) (mg/l):	6
Water solubility (g/l):	18
log Kow (Prager 1995):	1.94
log Kow (Sangster 1997):	1.98
log Pow (Verschuereen 1983):	1.92/1.94
Half- life Soil - High (hours):	16
Half- life Soil - Low (hours):	1
Half- life Air - High (hours):	15
Half- life Air - Low (hours):	1.5
Half- life Surface water - High (hours):	16
Half- life Surface water - Low (hours):	1
Half- life Ground water - High (hours):	672
Half- life Ground water - Low (hours):	2
Aqueous biodegradation - Aerobic - High (hours):	16
Aqueous biodegradation - Aerobic - Low (hours):	1
Aqueous biodegradation - Anaerobic - High (hours):	672
Aqueous biodegradation - Anaerobic - Low (hours):	240
Aqueous biodegradation - Removal secondary treatment - High (hours):	99.40%
Photolysis maximum light absorption - High (nano- m):	279

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Section 12 - ECOLOGICAL INFORMATION

Aqueous photolysis half- life - High (hours):	283
Photooxidation half- life water - High (hours):	11325
Photooxidation half- life water - Low (hours):	144
Photooxidation half- life air - High (hours):	15
Photooxidation half- life air - Low (hours):	1.5

Environmental toxicity is a function of the n-octanol/ water partition coefficient (log Pow, log Kow). Phenols with log Pow >7.4 are expected to exhibit low toxicity to aquatic organisms. However the toxicity of phenols with a lower log Pow is variable, ranging from low toxicity (LC50 values >100 mg/l) to highly toxic (LC50 values <1 mg/l) dependent on log Pow, molecular weight and substitutions on the aromatic ring. Dinitrophenols are more toxic than predicted from QSAR estimates. Hazard information for these groups is not generally available.

DO NOT discharge into sewer or waterways.

log Kow: 1.92-1.94

Henry's atm m³/mol: 9.60E-07

BOD 5 if unstated: 1.4-1.76,81%

COD: 2.4

ThOD: 2.52

BCF: 18

Toxicity Fish: LC50(96)8.9-55.9mg/L

Toxicity invertebrate: cell mult. inhib.31-62mg/L

Bioaccumulation: not sig

Nitrif. inhib.: 75% inhib at 11.4mg/L

Anaerobic effects: no degrad

Effects on algae and plankton: cell mult. inhib. algae 13-15mg/L

Degradation Biological: sig

processes Abiotic: Rxn OH*,slow photol,oxid

HYDROQUINONE:

Environmental toxicity is a function of the n-octanol/ water partition coefficient (log Pow, log Kow). Phenols with log Pow >7.4 are expected to exhibit low toxicity to aquatic organisms. However the toxicity of phenols with a lower log Pow is variable, ranging from low toxicity (LC50 values >100 mg/l) to highly toxic (LC50 values <1 mg/l) dependent on log Pow, molecular weight and substitutions on the aromatic ring. Dinitrophenols are more toxic than predicted from QSAR estimates. Hazard information for these groups is not generally available.

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.

DO NOT discharge into sewer or waterways.

The material is classified as an ecotoxin* because the Fish LC50 (96 hours) is less than or equal to 0.1 mg/l

* Classification of Substances as Ecotoxic (Dangerous to the Environment)

Appendix 8, Table 1

Compiler's Guide for the Preparation of International Chemical Safety Cards: 1993

Commission of the European Communities.

log Kow: 0.5-0.59

Koc: 9-50

BOD 5: 0.478-1,25-37%

COD: 1.83,90%

ThOD: 1.89

BCF: 40-65

Toxicity Fish: tox(24) 0.86-25mg/L

Toxicity invertebrate: TLm(96) insct 0.316mg/L

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Section 12 - ECOLOGICAL INFORMATION

Section 13 - DISPOSAL CONSIDERATIONS

- 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.
 - Dispose of by: Burial in a licenced land-fill or Incineration in a licenced apparatus (after admixture with suitable combustible material).
 - Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.
 - 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.
- Flush containers with water immediately on emptying to prevent formation of peroxides.

WASTE DISPOSAL PROCEDURES

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Section 14 - TRANSPORTATION INFORMATION



Labels Required: FLAMMABLE LIQUID
HAZCHEM: 2YE

UNDG:

Dangerous Goods Class: 3
UN Number: 2056
Shipping Name: TETRAHYDROFURAN

Subrisk: None
Packing Group: II

Air Transport IATA:

ICAO/IATA Class: 3
UN/ID Number: 2056
Special provisions: None
Shipping Name: TETRAHYDROFURAN

ICAO/IATA Subrisk: None
Packing Group: II

Maritime Transport IMDG:

IMDG Class: 3
UN Number: 2056
EMS Number: F- E, S- D
Shipping Name: TETRAHYDROFURAN

IMDG Subrisk: None
Packing Group: II
Special provisions: None

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Section 15 - REGULATORY INFORMATION

REGULATIONS

tetrahydrofuran (CAS: 109-99-9) is found on the following regulatory lists;
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

Denmark Advisory list for selfclassification of dangerous substances

Substance	CAS	Suggested codes
2, 6- di- tert- butyl- 4- methylphenol	128- 37- 0	Xn; R22 N; R50/53

REPRODUCTIVE HEALTH GUIDELINES

Established occupational exposure limits frequently do not take into consideration reproductive end points that are clearly below the thresholds for other toxic effects. Occupational reproductive guidelines (ORGs) have been suggested as an additional standard. These have been established after a literature search for reproductive no -observed-adverse effect-level (NOAEL) and the lowest-observed-adverse-effect-level (LOAEL). In addition the US EPA's procedures for risk assessment for hazard identification and dose-response assessment as applied by NIOSH were used in the creation of such limits. Uncertainty factors (UFs) have also been incorporated.

Ingredient	ORG	UF	Endpoi nt	CR	Adeq TLV
tetrahydrofuran	590 mg/m3	NA	D	NA	Yes

These exposure guidelines have been derived from a screening level of risk assessment and should not be construed as unequivocally safe limits. ORGS represent an 8-hour time -weighted average unless specified otherwise.

CR = Cancer Risk/10000; UF = Uncertainty factor:

TLV believed to be adequate to protect reproductive health:

LOD: Limit of detection

Toxic endpoints have also been identified as:

D = Developmental; R = Reproductive; TC = Transplacental carcinogen

Jankovic J., Drake F.: A Screening Method for Occupational Reproductive
American Industrial Hygiene Association Journal 57: 641-649 (1996).

MSDS SECTION CHANGES

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

Section Name	Version	Date	Section Name	Version	Date	Section Name	Version	Date
First Aid (eye)	4	5- Jan- 2006	Storage (storage requirement)	4	5- Jan- 2006	Acute Health (eye)	4	5- Jan- 2006
First Aid (inhaled)	4	5- Jan- 2006	Storage (suitable container)	4	5- Jan- 2006	Acute Health (inhaled)	4	5- Jan- 2006
First Aid (swallowed)	4	5- Jan- 2006	Engineering Control	4	5- Jan- 2006	Acute Health (skin)	4	5- Jan- 2006
Fire Fighter (fire fighting)	4	5- Jan- 2006	Personal Protection (eye)	4	5- Jan- 2006	Acute Health (swallowed)	4	5- Jan- 2006
Fire Fighter (fire/explosion hazard)	4	5- Jan- 2006	Personal Protection (hands/feet)	4	5- Jan- 2006	Chronic Health	4	5- Jan- 2006
Spills (major)	4	5- Jan- 2006	Personal Protection (other)	4	5- Jan- 2006	Environmental	4	5- Jan- 2006
Spills (minor)	4	5- Jan- 2006	Appearance	4	5- Jan- 2006	Disposal	4	5- Jan- 2006
Handling Procedure	4	5- Jan- 2006	Physical Properties	4	5- Jan- 2006	Transport	4	5- Jan- 2006
Storage (storage incompatibility)	4	5- Jan- 2006	Instability Condition	4	5- Jan- 2006			

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Section 16 - OTHER INFORMATION

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: 5-Jan-2018