1. PRODUCT IDENTIFICATION

TRADE NAME
Hydrochloric acid

CHEMICAL FAMILY
Inorganic Acid

CHEMICAL NAME
Hydrochloric Acid

SYNONYMS
Aqueous hydrogen chloride, chlorohydric acid, Hydrogen chloride, Muriatic acid, Spirits of salt

CHEMICAL FORMULA
HCl

CHEMICAL ABSTRACTS No.
7647-01-0

EINECS No.
231-595-7

NIOSH No.
MW 4025000

HAZCHEM CODE
2R

UN No.
1789

2. COMPOSITION

HAZARDOUS COMPONENTS
Hydrochloric acid (HCl) is commercially available as a solution of up to 38% hydrogen chloride (m/m) dissolved in water.

EEC CLASSIFICATION [C; Xi]
Corrosive; Irritant.

RISK PHRASES
R34: Causes burns.
R36/37/38: Irritating to eyes and respiratory system and skin.

SAFETY PHRASES
S1/2: Keep locked up and out of reach of children.
S26: In case of contact with eyes, rinse with plenty of water, seek medical advice.
S28: After contact with skin, wash immediately with plenty of water.
S45: In case of accident or if you feel unwell, seek medical advice immediately, show label where possible.

EU COMMENTS:
Concentration greater than or equal to 25%: Corrosive. Causes burns. Irritating to the respiratory system. [C; R34-37].
Concentration less than 25% and greater than or equal to 10%: Irritant. Irritating to eyes, and respiratory system and skin. [Xi, R36/37/38].

The product label must indicate the percentage concentration of the solution.
3. HAZARD IDENTIFICATION

MAIN HAZARDS

Threshold limit values (TLVs) / American Conference of Governmental Industrial Hygienists (ACGIH) / 2002*

Ceiling Exposure Limit (TLV-C) : 5 ppm (7.5 mg/m$^3$)

(*Notice of intended change: The reduction of the TLV-C to 2 ppm, 3mg/m$^3$)

CHEMICAL HAZARDS

Hydrochloric acid may react explosively with potassium permanganate (1*,2*) or sodium, and contact of fuming hydrochloric acid with tetraselenium tetranitride is also explosive. Passing hydrogen chloride into alcoholic hydrogen cyanide in preparation of alkyliminoformate chlorides proceeds explosively (3*), and other hazard-free methods are available (4*). An extremely exothermic decomposition reaction may occur with 1,1-difluoroethylene particularly at high vessel loadings (5*).

Rubidium acetylide ignites in contact with hydrochloric acid, and caesium acetylide ignites in contact with gaseous hydrogen chloride or concentrated hydrochloric acid. Hydrogen chloride also ignites in contact with fluorine, and concentrated aqueous solutions produce flame. Aluminium-titanium alloys ignite or incandesce on heating in hydrogen chloride. Hexalithium disilicide incandesces in concentrated hydrochloric acid, and silanes (which ignite) are evolved with the dilute acid.

Filling a glass drying tap on a hydrochloric acid storage tank with silica gel instead of calcium sulphate resulted in fracturing of the tap (6*), and the accidental addition of concentrated hydrochloric acid to a tank of sulphuric acid caused the tank to burst violently (7*). The safe dehydration of hydrochloric acid which releases a lot of gas (8*) avoids the possibility of layer formation in an unstirred flask (9*).  

BIOLOGICAL HAZARDS

Hydrochloric acid and high concentrations of the gas are highly corrosive to the skin and mucous membranes. Considerable variation in species sensitivity to hydrochloric acid exists (11*). The health effects of occupational exposure have reviewed (10-12*).

HEALTH EFFECTS - EYES

Low concentrations of vapour or mist (10-35 ppm) can be immediately irritating, causing redness.(2) Concentrated vapour, mist or splashed liquid can cause severe irritation, burns and permanent blindness.(4)

HEALTH EFFECTS - SKIN

Hydrochloric acid liquid can cause skin burns, and may produce keloid and retractile scarring (29*). Facial burns may result in serious and disfiguring scars. Frequent contact with the dilute acid may cause dermatitis (14*), and photosensitisation may result from industrial contact.

HEALTH EFFECTS - INGESTION

Hydrochloric acid solutions can cause corrosive burns to mouth, throat, oesophagus and stomach. Symptoms may include difficulty in swallowing, intense thirst, nausea, vomiting, diarrhoea and in severe cases, collapse and death. Small amounts of acid which enter the lungs during ingestion or vomiting (aspiration) can cause serious lung injury and death.
HEALTH EFFECTS - INHALATION

The major effects of acute exposure to hydrogen chloride are usually limited to the upper respiratory tract and are severe enough to lead to prompt withdrawal (13\textsuperscript{*}). Exposure to the gas causes cough, burning of the throat and choking feeling, inflammation and ulceration of the nose, throat and larynx (14\textsuperscript{*}). Exposure to higher concentrations, as may occur if a worker is prevented from escaping, may cause laryngeal spasm, and oedema of the lungs and vocal cords (15\textsuperscript{*}).

Prolonged or repeated exposure may cause dental discolouration and erosion (15\textsuperscript{*} - 17\textsuperscript{*}). Pulmonary function changes in naive but not chronically exposed workers suggests acclimatisation occurs (18\textsuperscript{*}). Gastritis and chronic bronchitis have also been reported in exposed workers (19\textsuperscript{*}).

In humans, exposure to 50 - 100 ppm for 1 hour is barely tolerable, 35 ppm for a short while causes throat irritation, and 10 ppm was tolerable (20\textsuperscript{*}), although immediate irritation has been reported at concentrations over 5 ppm (21\textsuperscript{*}). Bleeding nose and gums, ulceration of nasal and oral mucosa, and painful shaving due to tender facial skin was reported in workers exposed to mists from heated metal pickling solutions (22\textsuperscript{*}).

In animal studies reported effects of exposure to high concentration of hydrogen chloride include damage to the lungs and blood vessels, lung collapse, and lesions of the liver and other organs(23\textsuperscript{*}), coughing, wheezing, frothing, slowing of movement, increased respiratory rate, and death due to respiratory tract effects (24\textsuperscript{*}). Repeated exposure to low concentrations of the gas (34 ppm) had no immediate toxic effects and produced no morphological changes (23\textsuperscript{*}). Exposure to 100 ppm, 6 hours/day for 50 days caused slight unrest and irritation of the nose and eyes in several species (25\textsuperscript{*}), while repeated exposure at higher concentrations caused weight loss (23\textsuperscript{*}). Lesions in the nasal cavity of mice has also been reported (26\textsuperscript{*}).

Inhalation of weak hydrochloric acid into the bronchi of rabbits caused inflammatory processes like those occurring in "flu or due to chemical weapons (27\textsuperscript{*}). Differing responses to irritant gases such as hydrogen chloride between rodents and nonhuman primates suggest that the former may be an inadequate model for evaluating the toxicity of irritant gases to humans (28\textsuperscript{*}).

ADDITIONAL MEDICAL INFORMATION

CARCINOGENICITY

No carcinogenic response was noted in inhalation experiments with rats (31\textsuperscript{*}). Mortality rate from lung cancer was found to be significantly alleviated in workers exposed to sulphuric and hydrochloric acid mists during steel-pickling operations (32\textsuperscript{*}).

MUTAGENICITY

No information is available concerning the mutagenicity of hydrochloric acid.

TERATOGENICITY AND EMBRYOTOXICITY

No human information is available. Insufficient information is available to evaluate an animal report.

REPRODUCTIVE HAZARDS

No information is available concerning the reproductive hazards of hydrochloric acid.

4. FIRST AID MEASURES
PRODUCT IN EYE

Immediately flush the contaminated eye(s) with gently flowing water for at least 30 minutes, holding the eyelid(s) open. Neutral saline solution may be used as soon as it is available. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting. Take care not to rinse contaminated water into the non-affected eye. If irritation persists, repeat flushing. Transport victim to hospital as soon as possible.

PRODUCT ON SKIN

Remove contaminated clothing immediately, drench the contaminated area with running water for at least 30 minutes. Do not interrupt flushing. If necessary, keep emergency vehicle waiting. Transport victim to hospital as soon as possible. Completely decontaminate clothing, shoes and leather goods before re-use or discard.

PRODUCT INGESTED

Never give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing. Have victim rinse mouth thoroughly with water. DO NOT INDUCE VOMITING. Have victim drink 240 to 300 ml of water. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Repeat administration of water. Transport victim to hospital as soon as possible.

PRODUCT INHALED

Take proper precautions to ensure your own safety before attempting rescue; e.g., wear appropriate protective equipment, use the "buddy" system. Remove source of contamination or move victim to fresh air. If unconscious, do not give anything to drink, give artificial ventilation and chest compression or place in the recovery position as necessary. If conscious make the casualty lie or sit down quietly, give medical oxygen if available. Lung congestion may occur - a conscious casualty with breathing difficulties should be placed in a sitting position. Immediately transport victim to an emergency medical facility. Symptoms may be delayed up to 48 hours after exposure.

FIRST AID COMMENTS

Consult a physician and/or the nearest Poison Control Centre for all exposures except minor instances of inhalation or skin contact. All first aid procedures should be periodically reviewed by a physician familiar with the material and its conditions of use in the workplace.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Hydrochloric acid is not combustible. Use extinguishing agents compatible with acid and appropriate for the burning material. Use water spray to cool containers involved in a fire to prevent rupture.(14) Use water spray or fog to reduce or direct vapours. Do not direct water spray at source of leak.(14)

SPECIAL HAZARDS

Contact with common metals produces hydrogen gas which may form explosive mixtures in air.(14)

PROTECTIVE CLOTHING

Gas-tight chemical safety goggles or face shield. Impervious gloves, coveralls, boots, and/or other resistant protective clothing to prevent all possible skin contact. Neoprene, Viton and butyl rubber are suitable materials
for protective clothing. An impervious acid-resistant full-body encapsulating suit and respiratory protection may be required. See section 8.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS

Restrict access to area until completion of clean-up. Ensure clean-up is conducted by fully-trained personnel only.

Wear adequate personal protective equipment:-
Gas-tight chemical safety goggles or face shield. Impervious gloves, coveralls, boots, and/or other resistant protective clothing to prevent all possible skin contact. Neoprene, Viton and butyl rubber are suitable materials for protective clothing. An impervious acid-resistant full-body encapsulating suit and respiratory protection may be required. See section 8.

Ventilate area.

ENVIRONMENTAL PRECAUTIONS

Keep now neutralised material out of sewers, storm drains, surface waters and soil. Notify government occupational health and safety and environmental authorities.

CLEAN-UP METHODS

Small spills

Contain and soak up spill with absorbent material which does not react with spilled chemical. Put material in suitable, covered, labelled containers. Neutralise spill area with lime or soda ash and flush area with water. Do not get water inside containers. Contaminated absorbent material may pose the same hazards as the spilled product.

Large spills

Avoid contact with spilled material. Keep upwind and out of low areas. Avoid inhaling vapour. Prevent material from entering sewers, waterways or confined spaces. Stop or reduce leak if it can be done without risk. Recover spilled HCl if feasible. Contain spill with earth, sand, or absorbent material which does not react with spilled material. Collect material in suitable, covered, labelled containers. Dispose of contaminated product and materials used in cleaning in a manner approved for this chemical. After removal, neutralise spill area with lime or soda ash and flush spill area with water to an approved sewer.

Water fog or spray may be necessary to knock down vapours.
Contact fire and emergency services and supplier for additional advice.

7. HANDLING AND STORAGE

SUITABLE MATERIALS

Rubber-lined steel, Haveg, Hastelby and tantalum, are the most commonly used corrosion-resistant materials of construction. Rubber, glass, plastic and ceramic ware are also resistant to corrosion.

UNSuitABLE MATERIALS
Very corrosive to metals.

HANDLING PRECAUTIONS

Prevent release of vapour or mist into the workplace air. Always ensure adequate ventilation in handling areas. When diluting or preparing solutions, slowly add acid to water to avoid boiling or splattering. Use the smallest possible amounts in designated areas with adequate ventilation. Have emergency equipment (for fires, spills, leaks, etc.) readily available. Label containers. Keep containers closed when not in use. Empty containers may contain residues which are hazardous. For detailed handling for tank cars and trucks see reference 16.

STORAGE PRECAUTIONS

Store in a cool, dry, well-ventilated area, out of direct sunlight and away from heat sources. Drums should be vented when received and then at least weekly to relieve internal pressure (14). Store away from incompatible materials such as oxidising materials, reducing materials, strong bases. Use corrosion-resistant structural materials and lighting and ventilation systems in the storage area. Floors should not allow liquids to penetrate. Wood and other organic/combustible materials should not be used on floors, structural materials and ventilation systems in the storage area. Use containers which are securely labelled and protected from damage. Use the type of container recommended by the chemical manufacturer or supplier. Storage tanks should be above ground and surrounded with dikes capable of holding the entire contents. Limit the quantity of material in storage. Restrict access to the storage area. Post warning signs where appropriate. Keep storage area separate from populated work areas. Inspect periodically for deficiencies such as damage or leaks.

8. EXPOSURE CONTROLS/PERSOAL PROTECTION

OCCUPATIONAL EXPOSURE STANDARDS

HSE No data available
MAK 7 mg/m³
ACGIH 7.5 mg/m³ (2002 Notice of intended change: The reduction of the TLV-C to 2 ppm, 3 mg/m³)

UK EXPOSURE LIMITS

Long-term (8 hr. TWA value) 7 mg/m³
Short-term (10 min TWA value) 7 mg/m³

ENGINEERING CONTROL MEASURES

Engineering methods to control hazardous conditions are preferred. Methods include mechanical ventilation (dilution and local exhaust), process or personnel enclosure, control of process conditions, and process modification (e.g. substitution of less hazardous material). Administrative controls and personal protective equipment may also be required. Because of the high potential hazard associated with this substance, stringent control measures such as enclosure or isolation are recommended when dealing with large quantities. Use corrosion-resistant ventilation systems separate from other exhaust ventilation systems. Exhaust directly to the outside. Local exhaust ventilation is usually required. Consider down-draft general exhaust ventilation in potential high concentration areas such as unloading stations, cylinder, drum or carboy filling stations, treatment vats, and waste disposal areas (16). Cleaning of contaminated exhaust air before release to the outdoors is usually necessary. Supply sufficient replacement air to make up for air removed by exhaust systems. Engineering designs are reviewed in reference 16.

PERSONAL PROTECTION - RESPIRATORY

NIOSH RECOMMENDATIONS FOR HYDROGEN CHLORIDE (GAS) CONCENTRATIONS IN AIR (11):
UP TO 50 PPM: SAR; or SCBA; or chemical cartridge respirator with cartridge(s) to protect against hydrogen chloride.

UP TO 100 PPM: SAR operated in a continuous flow mode; or full-face piece SCBA; or full-face piece SAR; or gas mask with canister to protect against hydrogen chloride; or full-face piece chemical cartridge respirator with cartridge(s) to protect against hydrogen chloride; or powered air-purifying respirator with cartridge(s) to protect against hydrogen chloride.

ABBREVIATIONS:
SAR = supplied-air respirator;
SCBA = self-contained breathing apparatus.

PERSONAL PROTECTION - HAND
Neoprene, Viton or butyl rubber gloves.

PERSONAL PROTECTION - EYE
Gas-tight chemical safety goggles. A face shield may also be necessary.

PERSONAL PROTECTION - SKIN
Impervious gloves, coveralls, boots, and/or other resistant protective clothing to prevent all possible skin contact. Neoprene, Viton and butyl rubber are suitable materials for protective clothing. An impervious acid-resistant full-body encapsulating suit and respiratory protection may be required in some operations. Have a safety shower/eye-wash fountain readily available in the immediate work area.

RESISTANCE OF MATERIALS FOR PROTECTIVE CLOTHING
Guidelines for hydrochloric acid (12) :-

VERY GOOD: Neoprene, nitrile blended polyvinyl chloride (PVC)

GOOD: Chlorinated polyethylene, Viton coated neoprene, natural rubber, nitrile, Viton, Saranex, butyl coated neoprene, chlorobutyl, polycarbonate, neoprene blended PVC, styrene-butadiene rubber (SBR)

FAIR/POOR: PVC, polyurethane, neoprene blended SBR, SBR coated neoprene.

9. PHYSICAL AND CHEMICAL PROPERTIES

<table>
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<tr>
<th>PROPERTY</th>
<th>VALUE</th>
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<tbody>
<tr>
<td>APPEARANCE</td>
<td>Concentrated hydrochloric acid is a colourless or slightly yellow, fuming liquid.</td>
</tr>
<tr>
<td>ODOUR</td>
<td>A pungent, choking odour.</td>
</tr>
<tr>
<td>pH</td>
<td>1.1 (0.1 N solution); strongly acidic (10)</td>
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<tr>
<td>BOILING POINT/RANGE</td>
<td>90°C @ 101kPa (30% HCl solution); forms constant boiling mixture at 20% HCl (10)</td>
</tr>
<tr>
<td>MELTING POINT/RANGE</td>
<td>-50°C (30% HCl solution) (10)</td>
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</table>
FLASH POINT Not applicable
FLAMMABILITY Not applicable
AUTOFLAMMABILITY Not applicable
EXPLOSIVE PROPERTIES None
OXIDISING PROPERTIES None
VAPOUR PRESSURE 16.5 mm Hg (2.2 kPa) at 20°C (30% HCl solution) (10)
SPECIFIC GRAVITY min 1.152 @20°C (30% HCl solution)
SOLUBILITY - WATER Soluble in all proportions (10)
SOLUBILITY - SOLVENT Very soluble in alcohols; soluble in ether and benzene; insoluble in hydrocarbons (6)
VISCOSITY 2 centipoise (2 mPa.s) at 25°C
VAPOUR DENSITY 1.268 (air = 1) (8)

10. STABILITY AND REACTIVITY

STABILITY Stable.

HAZARDOUS POLYMERIZATION
HCl itself does not polymerize. Reaction of HCl with some incompatible materials can cause polymerization.

STABILITY AND REACTIVITY COMMENTS
Large amounts of heat can be released when concentrated HCl is mixed with water or with organic solvents

CONDITIONS TO AVOID

CORROSIVITY TO METALS
Very corrosive to most metals.

INCOMPATIBLE MATERIALS

MATERIALS TO AVOID:

METALS - can react generating flammable hydrogen gas.
BASES (e.g. sodium hydroxide, amines) - react violently generating heat and pressure.
ALDEHYDES, EPOXIDES - HCl may cause violent polymerization, generating heat and pressure.
REDUCING AGENTS - reaction may produce heat, fire and flammable hydrogen gas.
OXIDIZING AGENTS - may react generating heat and toxic or corrosive chloride gases.
EXPLOSIVES - contact may generate heat which could cause detonation.
ACETYLIDES, BORIDES, CARBIDES, SILICIDES - may react producing flammable gas (e.g., acetylene).
CYANIDES, SULFIDES - may react to release toxic gas (HCN or H₂S).
PHOSPHIDE - may react to release toxic, flammable phosphine gas. See reference 10 for further information.

HAZARDOUS DECOMPOSITION PRODUCTS
HCl is thermally stable up to temperatures of about 1500°C (2730°F).(15) At higher temperatures it breaks down to form hydrogen and chlorine.(6)
11. TOXICOLOGICAL INFORMATION

No human information is available. Insufficient information is available to evaluate an animal report.

ACUTE TOXICITY

Hydrochloric acid and high concentrations of the gas are highly corrosive to the skin and mucous membranes.

SKIN AND EYE CONTACT

Low concentrations of vapour or mist (10-35 ppm) can be immediately irritating, causing redness. Concentrated vapour, mist or splashed liquid can cause severe irritation, burns and permanent blindness.

Hydrochloric acid liquid can cause skin burns, and may produce keloid and retractile scarring. Facial burns may result in serious and disfiguring scars.

SUB-CHRONIC TOXICITY

Frequent contact with the dilute acid may cause dermatitis and photosensitisation may result from industrial contact.

CARCINOGENICITY

No carcinogenic response was noted in inhalation experiments with rats. Mortality rate from lung cancer was found to be significantly alleviated in workers exposed to sulphuric and hydrochloric acid mists during steel-pickling operations.

MUTAGENICITY

No information is available concerning the mutagenicity of hydrochloric acid.

REPRODUCTIVE TOXICITY

No information is available concerning the reproductive hazards of hydrochloric acid.

12. ECOLOGICAL INFORMATION

<table>
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<tr>
<th>AQUATIC TOXICITY - FISH</th>
<th>Dangerous to aquatic life in high concentrations. Notify local Health and Pollution Control authorities</th>
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<tr>
<td>AQUATIC TOXICITY - DAPHNIA</td>
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<td>AQUATIC TOXICITY - ALGAE</td>
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<tr>
<td>GERMAN WGK</td>
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13. DISPOSAL CONSIDERATIONS

DISPOSAL METHODS
This material is highly corrosive. Comply with State and Local regulations on disposal. Store material for disposal as indicated in Storage Conditions. Waste treatment procedures must only be performed by trained, experienced personnel using appropriate protective equipment in approved treatment facilities. Disposal of neutralized waste by secure landfill may be acceptable. Small quantities: Contaminated materials may be cautiously added to water and slowly neutralized with sodium or calcium carbonate. Caution: Neutralizing an acid spill will produce heat of reaction and vapours. The resulting neutralized solids may be treated as normal waste.\(^{13}\)

**DISPOSAL OF PACKAGING**

Empty containers may contain dangerous residues and are subject to proper waste disposal. Always obey hazard warnings.

**14. TRANSPORT INFORMATION**

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**15. REGULATORY INFORMATION**

**EEC CLASSIFICATION [C;Xi]** Corrosive; Irritant.

**RISK PHRASES**

- R34: Causes burns.
- R36/37/38: Irritating to eyes and respiratory system and skin.

**SAFETY PHRASES**

- S1/2: Keep locked up and out of reach of children.
- S26: In case of contact with eyes, rinse with plenty of water, seek medical advice.
- S28: After contact with skin, wash immediately with plenty of water.
- S45: In case of accident or if you feel unwell, seek medical advice immediately, show label where possible.

**EU COMMENTS:**

Concentration greater than or equal to 25%: Corrosive. Causes burns. Irritating to the respiratory system. [C;R34-37].
Concentration less than 25% and greater than or equal to 10%: Irritant. Irritating to eyes, and respiratory system and skin. [Xi, R36/37/38].

The product label must indicate the percentage concentration of the solution.

**NATIONAL LEGISLATION**


**16. OTHER INFORMATION**

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<td>LISTING - ACOIN</td>
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**APPENDIX**

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<td>MSDS 010/R2</td>
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<tr>
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<td>H H MARINGA</td>
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<tr>
<td>MSDS SERIAL No.</td>
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<td>MSDS SERIAL No.</td>
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<tr>
<td>APPROVED BY</td>
<td>VIC VAN ZYL – MANUFACTURING DIRECTOR</td>
</tr>
<tr>
<td>DATE OF APPROVAL</td>
<td>2012-02-27</td>
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**SOURCES OF INFORMATION**

1. Cheminfo Record Number: 13. and references contained therein. Numbers in parenthesis ( ) refer to this article.

2. Chemical Safety Data Sheets, Volume 3, Corrosives and Irritants. Published by the Royal Society of Chemistry, Information Services. Numbers in parenthesis ( *) refer to this article.


4. Solvay Chemicals International, PHC 1300-007-W-EN (WW), 2005

5. Solvay Chemicals International, PHC 1300-009-W-EN (WW), 2005
EXCLUSION OF LIABILITY

“All information and instructions provided in this Material Safety Data Sheet ("MSDS") in respect of the substance is given solely in terms of the provisions of the Occupational Health and Safety Act No 85 of 1993 and Regulations ("the Act"), is based on scientific and technical knowledge as at the date indicated on this MSDS, and is presented in good faith to be correct.

The information and instructions provided in this MSDS apply only to the substance in its present form and not to any formulation or mix, in which event it is the sole responsibility of the user of the substance as formulated and/or mixed to investigate and establish any danger which may arise out of its use, wherever such user may be situated.

It is the sole responsibility of the person in receipt of this MSDS, wherever such recipient may be situated, to ensure that the information provided is communicated to and understood by any person who may come in contact with the substance in any place and in any manner whatsoever. If such recipient produces formulations or mixes using the substance, then it is such recipient’s sole responsibility to comply with the provisions of the Act in respect of the provision of the necessary MSDS, or to comply with any other applicable legislation.”