HD Effluent Characterization Summary

1. **Process.** The Field Deployable Hydrolysis System (FDHS) mixes HD with water at a ratio of 1:13.5 (HD:water). The primary hydrolysis products of the HD:Water reaction are Thiodiglycol (CAS 111-48-8) and Hydrogen Chloride (CAS 7647-01-0). The resulting solution is transferred out of the FDHS into a Hastelloy container where it is tritrated to a pH of approximately 7 using 25% NaOH(aq).

2. **Hazard Identification.** Example Material Safety Data Sheets for the components are attached:

    a. HD
    b. 25 % NaOH
    c. Thiodiglycol
    d. Hydrogen Chloride

3. HD Hydrolysis data from ECBC Test

Notes: These data are generated from tests conducted at ECBC Chemical Analysis and Physical Proterties Branch. HD hydrolysate was gerenerated specifically for the testing as was neutralized after reaction to a pH of 7. A full test report is available if required.

LIQUID DENSITY

	Liquid Density (g/mL)		
Temperature (oC)	**HD/Water Product (pH 7)**	**HD/Water Product**	**Uncertainty**
16.0	1.0500	1.0328	±0.0005
25.0	1.0468	1.0301	±0.0002
35.0	1.0429	1.0429	±0.0011

VISCOSITY

	Viscosity (cSt)	
Temperature (oC)	**HD/Water Product (pH 7)**	**HD/Water Product**
25.0	1.0843±0.0001	1.1108±0.0005
35.0	0.8822±0.0008	0.9054±0.0005
50.0	0.6747±0.0001	0.6947±0.0011

4. HD Hydrolysis data from Aberdeen Chemical Agent Disposal Facility (ABCDF)

Notes: These data are averaged across twelve separate waste containers from the ABCDF process in order to reflect a representative sample. In the ABCDF process, NaOH was added to the waste to neutralize HCl, so the pH seen here is much higher than what would be seen in FDHS neutralent, and some other characteristics may be affected as well. Compounds that were detected in fewer than half of the waste containers have been omitted from this summary.

Specific Gravity	1.04
pH	12.50
	mg/L

Ammonia	3.20
Fluoride	0.60
Hexavalent Chromium	1.60
Organic Carbon, dissolved	18,100.00
Organic Carbon, total	18,000.00
Suspended Solids, total	702.50
	ppb
Copper	2,611.00
Iron	882,143.00
Lead	624.00
Mercury	51.00
Nickel	894.00
Zinc	3,170.00
1,2-Dichloroethane	93,302.00
Acetone	4,099.00
Methylene chloride	1,262.00
Tetrachloroethene	6,532.00
Trichloroethene	961.00
Vinyl chloride	7,767.00
1,4-Oxathiane	644,100.00
1,4-Dithiane	938,000.00
Thiodiglycol	37,000,000.00

5. The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this analysis must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Material Safety Data Sheet

Distilled Mustard (HD)

Revised: 20 September 2013

Section I - General Information

Manufacturer's Address:
U.S. Army Edgewood Chemical Biological Center (ECBC)
ATTN: RDCB-DPC-RH
Aberdeen Proving Ground, MD 21010-5424
Business Phone: 410-436-4411 or 4414, Monday through Friday during the hours of 8:00 AM to 4:30 PM EDT

CAS Registry Number: 505-60-2

Chemical Name: Bis- (2-chloroethyl) sulfide

Trade name and synonyms:
H; HD; HS
Mustard Gas
Sulfur mustard; Sulphur mustard gas
Sulfide, bis (2-chloroethyl)
Bis (beta-chloroethyl) sulfide
1,1'-thiobis(2-chloroethane)
1-chloro-2 (beta-chloroethylthio) ethane
Beta, beta'-dichlorodiethyl sulfide
2,2'dichlorodiethyl sulfide
Di-2-chloroethyl sulfideBeta, beta'-dichloroethyl sulfide
2,2'-dichloroethyl sulfide
EA 1033
Iprit
Kampstoff "Lost"; Lost
S-Lost; S-yperite; Schewefel-lost
Senfgas
Yellow Cross Liquid
Yperite;Y

Chemical Family: Chlorinated sulfur compound

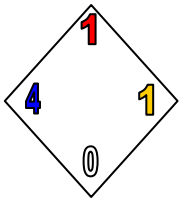
Molecular Formula and Structural Formula:

$C_4 H_8 Cl_2 S$

$C1CH_2CH_2SCH_2CH_2Cl$

NFPA 704 Signal:

Health - 4
Flammability - 1
Reactivity - 1
Special - 0



Section II - Ingredients

Ingredients/Name: Sulfur Mustard
Percentage by Weight: 100%

Section III - Physical Data

Boiling Point: 218 ^{o}C (424.4 ^{o}F); at atmospheric pressure HD starts to decompose below the boiling point.

Vapor Pressure (torr): 0.106 @ 25 ^{o}C

Vapor Density (relative to air): 5.5

Solubility: HD is practically insoluble in water; solubility of HD in distilled water is 0.92 g HD/100 g @ 22 ^{o}C. HD is freely soluble in fats and oils, gasoline, kerosene, most organic solvents and chemical warfare agents.

Specific Gravity (H_20=1): 1.27 @ 25 ^{o}C

Freezing/Melting Point (^{o}C): 14.45 ^{o}C

Liquid Density (g/mL): 1.2685 g/mL @ 25 ^{o}C

Volatility (mg/m^3): 906 @ 25 ^{o}C

Viscosity (Centipoise): 5.175 @ 20 ^{o}C

Molecular Weight: 159.07

Appearance and Odor: Pale yellow to dark brown oily liquid; colorless when pure. Garlic-like or horseradish odor.

Section IV - Fire and Explosion Data

Flashpoint: 105 ^{o}C

Flammability Limits (% by volume): Unknown

Extinguishing Media: Water, fog, foam and CO_2. Avoid use of extinguishing methods that will cause splashing or spreading of HD.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving HD should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, fire-fighting personnel should wear full firefighter protective clothing (flame resistant) during chemical agent fire-fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full facepiece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where fire fighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII).

Do not breathe fumes. Skin contact with agent must be avoided at all times. Although the fire may destroy most of the agent, care must still betaken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with the agent liquid or vapor can be fatal.

Section V - Health Hazard Data

Airborne Exposure Limits (AEL) [2]:

Worker Population Limit (WPL) 8-hr TWA [1] mg/m^3	STEL 15-min TWA [1] mg/m^3	IDLH [1] mg/m^3	General Population Limit (GPL) 12-hr TWA [1] mg/m^3
0.0004	0.003	0.7	0.00002

[1] These values can be found in the DA, Pamphlet 385-61, Toxic Chemical Agent Safety Standards, 13 November 2012.
[2] To date, the Occupational Safety and Health Administration (OSHA) have not promulgated a permissible exposure concentration for HD.

Routes of Entry: The routes of entry for mustard agents are inhalation and ingestion, as well as eye and skin contact.

Effects of Exposure: HD is a vesicant (causing blisters) and alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues, which are especially sensitive. The rate of detoxification of HD in the body is very slow and repeated exposures produce a cumulative effect.

HD is a human carcinogen as cited by the International Agency for Research on Cancer (IARC). HD has also been shown to be mutagenic in animals.

Signs and Symptoms: The acute signs and symptoms following mustard exposure are not immediate; they are delayed in appearance. The duration of the latent period and the degree of injury are both dependent on the severity of exposure as well as organs affected. The delay of onset is dose-dependent and may range from hours to days. The latency period for ocular (eye) effects is shorter than that for other tissues.

Mild eye exposure symptoms to mustard include inflammation, conjunctivitis possibly with lacrimation, grittiness in the eye, and erythema (reddening) of the lids and conjunctiva. Severe symptoms include photophobia, blepharospasm, pain, corneal erosion, iritis, conjunctival vascularization, ulceration and corneal opacification (blindness).

Skin exposure to mustard vapor is marked by delayed appearance. Mild symptoms include erythema, edema, itching, burning and pain. Severe symptoms include vesication or blisters. Liquid mustard exposure on skin may result in an area of gray-white necrotic skin surrounded by erythema and vesication.

Inhalation of mustard vapor causes damage primarily to the nasopharygeal, larygeal and tracheobronchial mucosa.

Respiratory symptoms to mustard vapor vary in degree of onset and intensity related to the degree of exposure. Mild symptoms to the airway include hoarseness, inflammation of the respiratory mucosa, congestion, coughing and edema. Severe symptoms include necrosis, sloughing of the mucosa and chemical pneumonia. Repeated exposures or prolonged inhalation can cause bronchiectasis or chronic bronchitis.

Gastrointestinal symptoms of intense mustard exposure include nausea and vomiting.

Like other alkylating agents, systemic absorption results in injury to the bone marrow, lymph nodes, and spleen producing leukopenia and thrombocytopenia. Other systemic effects include: fever; CNS depression; bradycardia or cardiac irregularities; hemoconcentration; and shock.

Chronic Exposure: Chronic mustard-induced illnesses are most common in the eyes, skin, respiratory tract or bone marrow. Delayed, recurrent keratoconjunctivitis of the eyes has been documented in some cases as long as 45 years from original exposure. Healing of mustard blisters may result in skin exfoliation and areas of hypo- or hyperpigmentation. Exposure can cause chronic lung impairment (productive cough, shortness of breath, chest pain, frequent pulmonary infections and bronchitis). Prolonged human exposure has been associated with cancer of the tongue, paranasal sinus, larynx, bronchus, lung, and mediastinum (cavity between the right and left lung). Tumors observed have been of squamous (scale like) or undifferentiated (altered) cell types. Consider the possibility of skin cancer because of the frequency of this lesion in animal studies. Since sulfur mustard agent is similar in its effects to nitrogen mustard, which has been associated with human leukemia, this disease might also be expected to occur in humans chronically exposed to mustard.

Toxicity Estimates:

Vapor (Inhalation/Ocular)[1]
ECt50 (Mild) = 25 mg-min/m^3
ECt50 (Severe)[2] = 75 mg-min/m^3 {3}
LCt50 = 1000 mg-min/m^3

Vapor (Percutaneous)[4,5]
ECt50 (Mild) = 50 mg-min/m^3
ECt50 (Severe)[2] = 500 mg-min/m^3
LCt50 = 10000 mg-min/m^3

Liquid (Percutaneous)
ED50 (Severe) = 600 mg/70 kg man
LD50 = 1400 mg/70 kg man

[1] Estimates for inhalation vapor exposure are based on a minute volume (MV) of 15 liters. The exposure time is 2 minutes. The concentration-time profile for lethality is described by the toxic load model ($C^n t=k$). The toxic load exponent (n) for lethality is 1.5.
[2] Based on ocular (eye) effects.
[3] FM 3-11.9, Potential Military Chemical/Biological Agents and Compounds, 10 January 2005.
[4] Personnel are masked.
[5] Values for percutaneous vapor are for moderate temperatures (85 ^oF and below). The effective dosages for hot temperatures (85 ^oF and above) will be less by at least a factor of 2.

Emergency and First Aid Procedures:

NOTE: Prior to rendering first aid, take steps for self protection such as donning a protective mask and other protective equipment. Decontaminate the individual as indicated below.

Vapor Exposure: Immediately don a protective mask. Move to a clean air environment and decontaminate by removing all clothing and shampooing or rinsing the hair to prevent vapor off gassing.

Liquid Skin Exposure: Move away from the area of contamination and don a protective mask. Immediately remove all contaminated clothing and spot decontaminate the affected area of the skin with Reactive Skin Decontamination Lotion (RSDL) for at least a two-minute contact time, followed by a soap-and-water wash or shower. This is the preferred skin decontaminant for immediate spot decontamination. Two permissible alternative skin decontaminants include a) soap and water and b) 0.5% sodium hypochlorite solution. (NOTE: RSDL has been shown to be superior across the broad spectrum of agents to both soap and water and also to 0.5% sodium hypochlorite solutions. Do not use 0.5% sodium hypochlorite solution to rinse off RSDL, or in any combination with the lotion; this can lead to skin irritation and inflammation that may increase the absorbed dose of agent. RSDL is FDA-approved only for initial spot decontamination, not for full body decontamination. RSDL is also approved only for use on intact skin, not on wounds, eyes, or mucous membranes. For rinsing the eyes, mucous membranes, or open wounds, use water or saline only.)

Full-body decontamination should be performed with soap and water. Wash the skin surface and hair in warm or tepid water at least three times. The rapid physical removal of a chemical agent is essential. Scrubbing of exposed skin with a stiff brush or bristles is discouraged, because skin damage may occur and may increase absorption of agent. Use liquid soap (discard and replace the soap container after use), copious amounts of water, and mild to moderate friction with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse with copious amounts of warm or tepid water. Shampoo can be used to wash the hair. If tepid water is not available, but cold water is, use cold water. Do not delay decontamination to obtain tepid or warm water.

If 0.5% sodium hypochlorite solution is used on skin instead of soap and water, it should also be applied with mild to moderate friction, with a single-use sponge or washcloth in the first and second applications. The third wash should be a rinse with copious amounts of warm or tepid water.

Eye Contact: Immediately move away from the area of contamination and begin flushing eyes, mucous membranes, or open wounds with sterile saline or water. Flush the eyes immediately with sterile saline or water by tilting the head to the side, pulling the eyelids apart with gloved fingers and pouring slowly into the eyes. A Morgan lens may also be used for continuous eye irrigation. Transfer the patient to a medical facility **Immediately.**

Ingestion: Do not induce vomiting. First symptoms are likely to be gastrointestinal. Seek medical attention **Immediately. Do not handle vomited material to avoid further contamination.**

Inhalation: If breathing is difficult, administer oxygen. If breathing has stopped and there is no pulse, begin CPR while awaiting EMS response. Because of the potential of rescuer exposure to facial contamination or to agent in expired air, avoid mouth-to-mouth resuscitation. Dial 911 to request immediate transport of the individual to a medical treatment facility for evaluation and treatment.

NOTE: The U.S. Army Public Health Command is responsible the medical guidance provided in this MSDS. Questions concerning medical guidance provided in the this MSDS may be addressed to USAPHC, ATTN: Program 66/Surety Medicine, 5158 Blackhawk Road, Bldg E-1570, Aberdeen Proving Ground, Maryland 21010-5403.

Section VI - Reactivity Data

Stability: A small amount of degradation occurs when stored in steel containers for over 50 years. This degradation appears to be caused by the formation of solid deposits “heels” comprised of a six membered ring cyclic sulfonium ion {1-(2-chloroethyl)-1, 4-dithianium chloride}, HD and Fe, which are detected at the bottom of containers.

Decomposition Temperature: 180 ^{o}C

Rate of Hydrolysis: HD on or under water undergoes hydrolysis only if dissolved. The rate of HD hydrolysis is controlled by the rate of mass transfer and is very slow.

Hydrolysis Products: Hydrogen chloride, thiodiglycol and sulfonium ion aggregates one of which is also very toxic.

Action on Metals and Other Materials: Very little when pure. The corrosion rate of HD on steel is 0.0001 in./month @ 65 ^{o}C using munitions grade HD.

Hazardous Polymerization: Does not occur.

Section VII - Spill, Leak, And Disposal Procedures

Steps to Be Taken In Case Material Is Released or Spilled: Only personnel in full protective clothing (See Section VIII) will be allowed in an area where HD is spilled. See Section V for emergency and first aid instructions.

Recommended Field Procedures: The HD should be contained using vermiculite, diatomaceous earth, clay or fine sand and neutralized as soon as possible using copious amounts of nominal 5% sodium hypochlorite solution. Scoop up all material and place in an approved DOT container. Cover the contents with decontaminating solution as above. The exterior of the container will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the STEL (See Sections V and VIII).

If 5% sodium hypochlorite solution is not available then the following decontaminants may be used instead and are listed in the order of preference: **Calcium Hypochlorite and Super Tropical Bleach Slurry (STB).

****WARNING:** DO NOT USE PURE SOLID, UNDILUTED CALCIUM HYPOCHLORITE (HTH); it will COMBUST UPON CONTACT with liquid mustard.

Leaking munitions should be processed in accordance with established chemical demilitarization SOPs, see "DA Pam 385-61, Toxic Chemical Agent Safety Standards".

Recommended Laboratory Procedures: Use a minimum of 65 grams of 5.25% bleach decontamination solution for each gram of HD. Agitate for at least the first hour, and allow 24 hours for the reaction to complete. Adjust the resulting solution pH to between 10 and 12.

Test for presence of active chorine by use of acidic potassium iodide solution to give free iodine color by placing three millileters (ml) of decontaminated solution in a test tube. Add several crystals of potassium iodine and swirl to dissolve. Add 3 ml of 50 wt.% sulfuric acid: water and swirl. Immediate iodine color shows the presence of active chlorine. If negative, add additional bleach to the decontaminated solution, wait two hours and test again for active chlorine.

10% HTH may also be used to decontaminate HD. Follow all steps given above.

Scoop up all materials and clothing and place in an approved DOT container. The exterior of the container will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of contents according to Federal, state and local regulations. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the STEL (See Sections V and VIII).

NOTE: Surfaces contaminated with HD, then rinsed and decontaminated may evolve sufficient HD vapor to produce a physiological response. HD on laboratory glassware may be oxidized by its vigorous reaction with

concentrated nitric acid.

Waste Disposal Method: Open pit burning or burying of HD or items containing or contaminated with HD in any quantity is prohibited. Waste HD and associated decontamination solutions may be Resource Conservation and Recovery Act (RCRA) regulated hazardous wastes due to a State listing of the chemical agent, or the characteristics of the waste, to include contaminates. An evaluation of the Federal and State waste disposal regulations must be conducted to determine the appropriate disposal method.

Section VIII - Special Protection Information

Exposure Limits for Respiratory Protection for HD:

Unprotected Workers:

Concentration (mg/m^3)	Time Limits
Less than or equal to 0.0004[1]	8 hours
Up to or less than 0.0016	2 hours[2]

Protected Workers:

Type of Respiratory Protection Worn (based on air monitoring results):

1. M40 Military Mask, CBRN NIOSH Approved Full Face Air Purifying Respirator

Concentration (mg/m^3)	Time Limits
$\leq$ 0.003	Time limit will be kept at a minimum to perform the operation, and will be dictated by the local Heat Stress Program for personal protective equipment and clothing[3]

2. Pressure Demand Supplied Air Respirator with Full Face Respirator

Concentration (mg/m^3)	Time Limits[4]
0.0004 to 0.7[5]	Time limit will be kept at a minimum to perform the operation, and will be dictated by the local Heat Stress Program for personal protective equipment and clothing.

3. Pressure Demand Supplied Air Respirator with Full Face Respirator in combination with an Auxiliary Self-contained Breathing Apparatus (SCBA) or just SCBA

Concentration (mg/m3)	Time Limits[4]
Greater than 0.7	These concentrations should be expected only in emergency situations. Operations should not be conducted at these concentrations.

[1] As an 8-hr TWA average.
[2] Maximum continuous time at this concentration. Equivalent to 8-hr TWA. Source: DA, Pamphlet 385-61, Toxic Chemical Agent Safety Standards, 13 November 2012.
[3] The M40 mask may be used for escape from environments containing concentrations above the STEL. The M40 mask may used for routine entry with real-time monitoring for the STEL and historical monitoring for the WPL. The M40 mask will not be used for routine protection above the STEL or in the absence of WPL monitoring.
[4] For SCBA wearers, time limit is constrained by life of the air cylinder (maximum of 30 to 45 minutes). For Air Supply wearers, time limits should be kept to a minimum. Should use of the auxiliary SCBA be necessary, time

limit will be constrained by the life of the breathing air cylinder, and egress from the area must be performed before its expiration.
[5] The Immediately Dangerous to Life and Health Value.

Ventilation

Local Exhaust: Mandatory. Must be filtered or scrubbed to limit exit concentrations. Air emissions shall meet local, state and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke producing devices will be performed in assessing the ability of the hood to contain agent HD.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection between agent area and other areas through the ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hoods.

Protective Gloves: Butyl Rubber gloves M3 and M4
Norton, Chemical Protective Glove Set

Eye Protection: As a minimum, safety glasses with side shields will be worn. For splash hazards use goggles and face shield. Maintain eyewash facilities in work area.

Other Protective Equipment: For laboratory operations, wear lab coats, gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals. In the case of a spill, the minimum protective clothing should be Level B after the site has been evaluated, otherwise Level A.

Monitoring: Available monitoring equipment for agent HD is the M8/M9 detector paper, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and Real Time Analytical Platform (RTAP). Real-time, low-level monitors (with alarm) are required for HD operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions to Be Taken in Handling and Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and, as appropriate, shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday.

Other Precautions: HD should be stored in containers made of glass for Research, Development, Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent containers will be stored in a

single containment system with in a laboratory hood or in double containment system.

For additional information see "AR 385-10, The Army Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT".

Section X - Transportation Data

NOTE: Forbidden for transport other than via military (Technical Escort Unit) transport according to 49 CFR Part 173.7(b), DOD 4500.9-R and AR 50-6.

Proper Shipping Name: Toxic by inhalation liquid, n.o.s. (Bis- (2-chloroethyl) sulfide)

UN ID Number: UN3381

DOT Hazard Class: 6.1, Packing Group I, Inhalation Hazard Zone A

DOT Label: Poison Inhalation Hazard or Toxic Inhalation Hazard. See 49 CFR 172.400a(a)(3) for exceptions to unit packaging labeling and 173.7(b) for other exceptions when material is transported by Technical Escort Units.

NOTE: "Poison" and "Toxic" are used interchangeably for all markings, labels and placards in continental US transportation. "Toxic" is required for international transportation.

DOT Marking: Toxic by inhalation liquid, n.o.s. (Bis- (2-chloroethyl) sulfide) UN3381, Inhalation Hazard Zone A

DOT Placard: Poison Inhalation Hazard or Toxic Inhalation Hazard

Emergency Accident Precautions and Procedures: See Sections IV, VII and VIII.

Precautions to Be Taken in Transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents.

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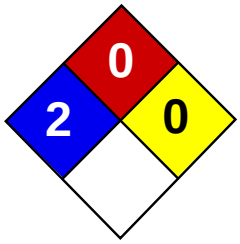
Chemicals & Laboratory Equipment



Material Safety Data Sheet
Sodium Hydroxide, 25% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium Hydroxide, 25%

Catalog Codes: SLS4210

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Sodium hydroxide; Water

CI#: Not applicable.

Synonym:

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium hydroxide	1310-73-2	25
Water	7732-18-5	75

Toxicological Data on Ingredients: Sodium hydroxide LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant), of eye contact (irritant), of ingestion. Hazardous in case of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Non-corrosive for skin. Non-irritant for skin. Non-sensitizer for skin. Non-permeator by skin. Non-irritating to the eyes. Non-hazardous in case of ingestion. Non-hazardous in case of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe

skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Finish by rinsing thoroughly with running water to avoid a possible infection. Cold water may be used.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid.

Large Spill:
Corrosive liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of acetic acid. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep container dry. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes Keep away from incompatibles such as acids.

Storage:
Alkalis may be stored in heavy duty gauge steel containers. Corrosive materials should be stored in a separate safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Sodium hydroxide CEIL: 2 (mg/m3) from ACGIH [1995] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Odorless.

Taste: Alkaline. Bitter. (Strong.)

Molecular Weight: Not applicable.

Color: Clear Colorless.

pH (1% soln/water): Basic.

Boiling Point: The lowest known value is 100°C (212°F) (Water).

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: Weighted average: 1.15 (Water = 1)

Vapor Pressure: The highest known value is 17.535 mm of Hg (@ 20°C) (Water).

Vapor Density: The highest known value is 0.62 (Air = 1) (Water).

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Extremely reactive or incompatible with acids.

Corrosivity:
Highly corrosive in presence of aluminum. Slightly corrosive to corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant), of ingestion. Hazardous in case of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 8: Corrosive liquid.

Identification: : Sodium hydroxide, solution (Sodium hydroxide) : UN1824 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Sodium hydroxide Massachusetts RTK: Sodium hydroxide TSCA 8(b) inventory: Sodium hydroxide; Water

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC): R35- Causes severe burns.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 12:05 PM

Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume

Material Safety Data Sheet

HAZARDOUS

Catalog Number: 103039

Revision date: 10-Mar-2005
Australia Hazardous Statement: **Hazardous according to criteria of NOHSC**

1. COMPANY DETAILS

Supplier:	MP Biomedicals Australasia Pty Limited Unit 12, 167 Prospect Hwy. Seven Hills, NSW 2147 Aust.
Telephone Number:	(02) 9838 7422
Fax Number:	(02) 9838 7390
Emergency telephone number:	(02) 9838 7422: hours: 8.30 AM to 5.00 PM
Australian Business Number (ABN):	31 106 467 109

2. IDENTIFICATION

Product name:	THIODIGLYCOL
Catalog Number:	103039
Synonyms:	2,2' Thiodiethanol, 2,2'- Thio-bis [ethanol]
UN/Id No:	No UN Number allocated
Proper shipping name:	No Dangerous goods class allocated
IATA Hazard Label(s):	No Dangerous goods class allocated
Hazard Class	No Dangerous goods class allocated
Subsidiary risk:	No Subsidiary Risk allocated
Emergency Action Code (Hazchem code):	No Hazchem Code allocated
Poisons schedule No. (Aust)/Toxic Substance (NZ):	No Poisons Schedule Number allocated
Recommended use:	Research product for non-human use

Component	**Australia (AICS):**
THIODIGLYCOL 111-48-8 (100)	Present

3. PHYSICAL DESCRIPTION/PROPERTIES

Physical state:	Liquid
Formula:	C4H1OO2S
Molecular weight:	122.2
Boiling point/range:	284 °C
Melting point/range:	-18 °C
Density:	ca. 1.18 g/cm3 at 20 °C
Vapor pressure:	< 1 hPa at 20 °C
Solubility (in water):	Completely miscible
Flash point:	160 °C (DIN 51758)
Autoignition temperature:	Not determined

Flammable limits in air - lower (%):	Not determined
Flammable limits in air - upper (%):	Not determined

4. INGREDIENTS

Components	CAS Number	Weight %	EC No.	Classification
THIODIGLYCOL	111-48-8	100	203-874-3	Xi

5. HAZARDS IDENTIFICATION

Australia Hazardous Statement: Hazardous according to criteria of NOHSC

Indication of Danger:
Xi - Irritant.

Risk Phrases:
R36 - Irritating to eyes.

Safety Phrases:
S36 - Wear suitable protective clothing.

Category of Danger: Irritant , STENCH , Lachrymator

Poisons schedule No. (Aust)/Toxic Substance (NZ): No Poisons Schedule Number allocated

6. HEALTH HAZARD INFORMATION

HEALTH EFFECTS

EMERGENCY OVERVIEW:	May cause irritation to the eyes, skin and respiratory system. Combustible material
Principle routes of exposure:	Skin
Inhalation:	Irritating to respiratory system
Ingestion:	Irritating to mouth, throat and stomach
Skin contact:	Irritating to skin.
Eye contact:	Contact with eyes may cause irritation Vapors extremely irritating to eyes an respiratory tract
Statements of hazard	May Cause Eye, Skin and Respiratory Tract irritation. COMBUSTIBLE MATERIAL AND VAPOR. CAUSES EYE IRRITATION.

Components	Australian Exposure Standards - Carcinogens	Australia - Exposure Standards - Short
THIODIGLYCOL	Not Listed	Not Listed

Components	Australia - Exposure Standards - Skin E	Australia - Exposure Standards - Time W
THIODIGLYCOL	Not Listed	Not Listed

FIRST AID

General advice:	In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
Inhalation:	Move to fresh air. Call a physician immediately.
Skin contact:	Rinse immediately with plenty of water for at least 15 minutes Call a physician immediately
Ingestion:	Do not induce vomiting without medical advice.
Eye contact:	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician immediately Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician
Protection of first-aiders:	No information available
Notes to physician:	None
Medical conditions aggravated by exposure:	None known

7. PRECAUTIONS FOR USE

Section 8 Notes: TWA - The time-weighted average airborne concentration over an eight-hour working day, for a five-day working week over an entire working life. According to current knowledge this concentration should neither impair the health or, not cause undue discomfort to, nearly all workers.

Engineering measures: Ensure adequate ventilation.

PERSONAL PROTECTIVE EQUIPMENT

Respiratory protection: Self-contained breathing apparatus
Hand protection: Pvc disposable gloves
Skin and body protection: Impervious clothing
Eye protection: Goggles
Hygiene measures: Avoid contact with skin, eyes and clothing.

8. SAFE HANDLING INFORMATION

Storage:

ROOM TEMPERATURE

Handling:	Use only in area provided with appropriate exhaust ventilation.
Safe handling advice:	Wear personal protective equipment. Remove and wash contaminated clothing before reuse.
Technical measures/storage conditions:	Keep away from heat and sources of ignition Keep container tightly closed in a dry and well-ventilated place. Keep containers tightly closed in a cool, well-ventilated place.
Stability:	Stable under recommended storage conditions.
Polymerization:	None under normal processing.
Hazardous decomposition products:	Sulphur oxides
Materials to avoid:	-
Conditions to avoid:	Exposure to air or moisture over prolonged periods.

Spills and Disposal:

Personal precautions: Use personal protective equipment. Remove all sources of ignition.

Environmental precautions: Do not flush into surface water or sanitary sewer system.

Methods for cleaning up: Soak up with inert absorbent material.

Waste from residues / unused products: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority. Residue from fires extinguished with this material may be hazardous.

Contaminated packaging: Do not re-use empty containers

Fire/Explosion Hazards:

Suitable extinguishing media: Use dry chemical, CO2, water spray or "alcohol" foam

Specific hazards: combustible material

Unusual hazards: None known

Special protective equipment for firefighters: Wear self contained breathing apparatus for fire fighting if necessary.

Specific methods: Water mist may be used to cool closed containers.

9. TOXICOLOGICAL INFORMATION

Product Information

Acute toxicity

Components	RTECS Number:	Selected LD50s and LC50s
THIODIGLYCOL	KM2975000	Oral LD50 Rat : 6610 mg/kg Dermal LD50 Rabbit : 20 mL/kg

Chronic toxicity: Chronic exposure may cause nausea and vomiting, higher exposure causes unconsciousness.

Local effects: Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.

Specific effects: May include moderate to severe erythema (redness) and moderate edema (raised skin), nausea, vomiting, headache.

Carcinogenic effects: No data is available on the product itself.

Mutagenic effects: No data is available on the product itself.

Reproductive toxicity: No data is available on the product itself.

10. ECOLOGICAL INFORMATION

Mobility: No data available

Bioaccumulation: No data available

Ecotoxicity effects: No data available

Aquatic toxicity: May cause long-term adverse effects in the aquatic environment.

Components	U.S. DOT - Appendix B - Marine Pollutan	U.S. DOT - Appendix B - Severe Marine Pollutants	United Kingdom - The Red List:
THIODIGLYCOL	Not Listed	Not Listed	Not Listed

Components	Germany VCI (WGK)	World Health Organization (WHO) - Drinking Water	Ecotoxicity - Fish Species Data
THIODIGLYCOL	Not Listed	Not Listed	Not Listed

Components	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Microtox Data	Ecotoxicity - Water Flea Data
THIODIGLYCOL	Not Listed	Not Listed	Not Listed

Components	EPA - ATSDR Priority List	EPA - HPV Challenge Program Chemical List	California - Priority Toxic Pollutants
THIODIGLYCOL	Not Listed	indicator 0; Fully sponsored	Not Listed

Components	California - Priority Toxic Pollutants	California - Priority Toxic Pollutants
THIODIGLYCOL	Not Listed	Not Listed

11. TRANSPORT INFORMATION

IMDG/IMO

IMDG - Hazard Classifications	Not Applicable
IMDG - Marine Pollutants	Not Applicable
IMDG - Marine Pollutants	Not Applicable
IMDG - Regulated Substances	Not Applicable
IMDG - Severe Marine Pollutants	Not Applicable

IMO-labels:

Packing group:	None
Proper shipping name:	Not Regulated
UN/Id No:	Not regulated

ADR/RID

Australia Hazardous Statement:	Hazardous according to criteria of NOHSC
Hazard Class	No Dangerous goods class allocated
Item:	THIODIGLYCOL
ADR/RID-labels:	No Dangerous goods class allocated
UN/Id No:	Not regulated
Emergency Action Code (Hazchem code):	Not required
Proper shipping name:	Not Regulated

ICAO:

Hazard Class	No Dangerous goods class allocated
Packing group:	None
Proper shipping name:	Not Regulated

12. REGULATORY INFORMATION

International inventories:

THIODIGLYCOL

Australia (AICS):	Present
Inventory - China:	Present
EU EINECS List -	203-874-3; C4H10O2S
Korean KECL:	KE-33763

Philippines PICCS: Present
Contains: THIODIGLYCOL

Indication of Danger:
Xi - Irritant.

Risk Phrases: R36 - Irritating to eyes.

Safety Phrases: S36 - Wear suitable protective clothing.

Poisons schedule No. (Aust)/Toxic Substance (NZ): Not required

13. OTHER INFORMATION

Prepared by: Health & Safety
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End of Safety Data Sheet

Material Safety Data Sheet

Hydrogen Chloride

Section 1. Chemical product and company identification

Product name : Hydrogen Chloride

Supplier : AIRGAS INC., on behalf of its subsidiaries
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Product use : Synthetic/Analytical chemistry.

Synonym : Hydrochloric Acid; Anhydrous hydrochloric acid; Basilin; Chlorohydric acid; Hydrochloric acid gas; Hydrochloride; Muriatic acid; Salzsaeure; HCl; Hydrochloric acid, anhydrous; Hydrogen-chloride-anhydrous-; Acide chlorhydrique; Acido cloridrico; Chloorwaterstof; Chlorowodor; Chlorwasserstoff; NA 1789; Spirits of salt; UN 1050; UN 1789; UN 2186; Anhydrous hydrogen chloride; Hydrogen chloride (acid); Marine acid; Soldering acid; Spirit of salt; Spirits of salts

MSDS # : 001028

Date of Preparation/Revision : **4/1/2013.**

In case of emergency : 1-866-734-3438

Section 2. Hazards identification

Physical state : Gas. [COLORLESS TO SLIGHTLY YELLOW LIQUEFIED COMPRESSED GAS WITH AN IRRITATING ODOR; OR COLORLESS FUMING GAS WITH A PUNGENT, IRRITATING ODOR]

Emergency overview : DANGER!

CAUSES SEVERE RESPIRATORY TRACT, EYE AND SKIN BURNS.
HARMFUL IF INHALED.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CONTENTS UNDER PRESSURE.

Do not puncture or incinerate container. Do not breathe gas. Do not get on skin or clothing. May cause target organ damage, based on animal data. Use only with adequate ventilation. Keep container closed. Do not get in eyes, on skin or on clothing. Avoid breathing gas. Wash thoroughly after handling.

Contact with rapidly expanding gases can cause frostbite.

Target organs : May cause damage to the following organs: lungs, upper respiratory tract, skin, eyes.

Routes of entry : Inhalation Dermal Eyes

Potential acute health effects

Eyes : Severely corrosive to the eyes. Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.

Skin : Severely corrosive to the skin. Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Toxic by inhalation. Severely corrosive to the respiratory system.

Ingestion : Ingestion is not a normal route of exposure for gases

Potential chronic health effects

Target organs : May cause damage to the following organs: lungs, upper respiratory tract, skin, eyes.

Medical conditions aggravated by over-exposure : Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

Section 3. Composition, Information on Ingredients

Name	CAS number	% Volume	Exposure limits
Hydrogen Chloride	7647-01-0	100	**ACGIH TLV (United States, 1/2009).** C: 2 ppm **NIOSH REL (United States, 6/2009).** CEIL: 7 mg/m³ CEIL: 5 ppm **OSHA PEL (United States, 11/2006).** CEIL: 7 mg/m³ CEIL: 5 ppm **OSHA PEL 1989 (United States, 3/1989).** CEIL: 7 mg/m³ CEIL: 5 ppm

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training.If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus.It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.

Skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : As this product is a gas, refer to the inhalation section.

Section 5. Fire-fighting measures

Flammability of the product : Non-flammable.

Products of combustion : Decomposition products may include the following materials: halogenated compounds

Fire-fighting media and instructions : Use an extinguishing agent suitable for the surrounding fire.

Apply water from a safe distance to cool container and protect surrounding area. If involved in fire, shut off flow immediately if it can be done without risk.

Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions : Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (section 8). Shut off gas supply if this can be done safely. Isolate area until gas has dispersed.

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up : Immediately contact emergency personnel. Stop leak if without risk. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Handling : Use only with adequate ventilation. Wash thoroughly after handling. High pressure gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Do not get in eyes, on skin or on clothing. Keep container closed. Do not get on skin or clothing. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Storage : Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Personal protection

Eyes : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Hands : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Personal protection in case of a large spill : Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product. Full chemical-resistant suit and self-contained breathing apparatus should be worn only by trained and authorized persons.

Product name

Hydrogen chloride

ACGIH TLV (United States, 1/2009).
C: 2 ppm
NIOSH REL (United States, 6/2009).
CEIL: 7 mg/m³
CEIL: 5 ppm
OSHA PEL (United States, 11/2006).
CEIL: 7 mg/m³
CEIL: 5 ppm
OSHA PEL 1989 (United States, 3/1989).
CEIL: 7 mg/m³
CEIL: 5 ppm

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

Molecular weight : 36.46 g/mole

Molecular formula : Cl-H

Boiling/condensation point : -85°C (-121°F)

Melting/freezing point : -113.9°C (-173°F)

Critical temperature : 51.5°C (124.7°F)

Vapor pressure : 613 (psig)

Vapor density : 1.3 (Air = 1)

Specific Volume (ft ^{3}/lb) : 10.5263

Gas Density (lb/ft ^{3}) : 0.095

Section 10. Stability and reactivity

Stability and reactivity : The product is stable.

Incompatibility with various substances : Extremely reactive or incompatible with the following materials: alkalis and moisture. Highly reactive or incompatible with the following materials: metals.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Toxicity data

Product/ingredient name	Result	Species	Dose	Exposure
Hydrogen chloride	LC50 Inhalation Gas.	Rat	3124 ppm	1 hours
	LC50 Inhalation Gas.	Mouse	1108 ppm	1 hours

IDLH : 50 ppm

Chronic effects on humans : **CARCINOGENIC EFFECTS**: A4 (Not classifiable for humans or animals.) by ACGIH, 3 (Not classifiable for humans.) by IARC.
May cause damage to the following organs: lungs, upper respiratory tract, skin, eyes.

Other toxic effects on humans : Extremely hazardous by the following route of exposure: of skin contact (corrosive), of eye contact (corrosive), of inhalation (lung corrosive).

Specific effects

Carcinogenic effects : No known significant effects or critical hazards.

Mutagenic effects : No known significant effects or critical hazards.

Reproduction toxicity : No known significant effects or critical hazards.

Section 12. Ecological information

Aquatic ecotoxicity

Product/ingredient name	Test	Result	Species	Exposure
Hydrogen chloride	-	Acute LC50 282000 ug/L Fresh water	Fish - Western mosquitofish - Gambusia affinis - Adult	96 hours
	-	Acute LC50 260000 ug/L Marine water	Crustaceans - Common shrimp, sand shrimp - Crangon crangon - Adult	48 hours
	-	Acute LC50 240000 ug/L Marine water	Crustaceans - Green or Europeon shore crab - Carcinus maenas - Adult	48 hours

Products of degradation :

Environmental fate : Not available.

Environmental hazards : No known significant effects or critical hazards.

Toxicity to the environment : Not available.

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation.Return cylinders with residual product to Airgas, Inc.Do not dispose of locally.

Section 14. Transport information

Regulatory information	UN number	Proper shipping name	Class	Packing group	Label	Additional information
DOT Classification	UN1050	HYDROGEN CHLORIDE, ANHYDROUS	2.3	Not applicable (gas).		**Reportable quantity** 5000 lbs. (2270 kg) **Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: Forbidden. **Special provisions** 3
TDG Classification	UN1050	HYDROGEN CHLORIDE, ANHYDROUS	2.3	Not applicable (gas).		**Explosive Limit and Limited Quantity Index** 0 **ERAP Index** 25 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 38

Mexico Classification	UN1050	HYDROGEN CHLORIDE, ANHYDROUS	2.3	Not applicable (gas).		-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 15. Regulatory information

United States

U.S. Federal regulations :

United States inventory (TSCA 8b): This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: Hydrogen chloride
SARA 302/304 emergency planning and notification: Hydrogen chloride
SARA 302/304/311/312 hazardous chemicals: Hydrogen chloride
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Hydrogen chloride: Sudden release of pressure, Immediate (acute) health hazard, Delayed (chronic) health hazard

Clean Water Act (CWA) 307: No products were found.

Clean Water Act (CWA) 311: Hydrogen chloride

Clean Air Act (CAA) 112 regulated flammable substances: Hydrogen chloride

Clean Air Act (CAA) 112 regulated toxic substances: Hydrogen chloride

SARA 313

		Product name	CAS number	Concentration
Form R - Reporting requirements	:	Hydrogen Chloride	7647-01-0	100
Supplier notification	:	Hydrogen Chloride	7647-01-0	100

SARA 313 notifications must not be detached from the MSDS and any copying and redistribution of the MSDS shall include copying and redistribution of the notice attached to copies of the MSDS subsequently redistributed.

State regulations :

Connecticut Carcinogen Reporting: This material is not listed.
Connecticut Hazardous Material Survey: This material is not listed.
Florida substances: This material is not listed.
Illinois Chemical Safety Act: This material is not listed.
Illinois Toxic Substances Disclosure to Employee Act: This material is not listed.
Louisiana Reporting: This material is not listed.
Louisiana Spill: This material is not listed.
Massachusetts Spill: This material is not listed.
Massachusetts Substances: This material is listed.
Michigan Critical Material: This material is not listed.
Minnesota Hazardous Substances: This material is not listed.
New Jersey Hazardous Substances: This material is listed.
New Jersey Spill: This material is not listed.
New Jersey Toxic Catastrophe Prevention Act: This material is listed.
New York Acutely Hazardous Substances: This material is listed.
New York Toxic Chemical Release Reporting: This material is not listed.
Pennsylvania RTK Hazardous Substances: This material is listed.
Rhode Island Hazardous Substances: This material is not listed.

Canada

WHMIS (Canada) :

Class A: Compressed gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class E: Corrosive material

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

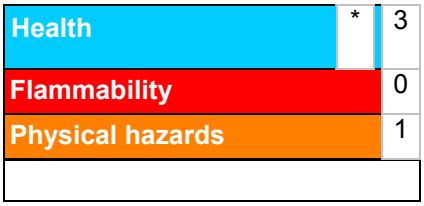
United States

Label requirements : CAUSES SEVERE RESPIRATORY TRACT, EYE AND SKIN BURNS.
HARMFUL IF INHALED.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CONTENTS UNDER PRESSURE.

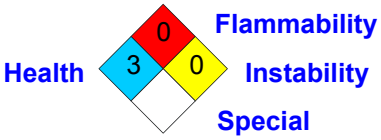
Canada

Label requirements : Class A: Compressed gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class E: Corrosive material

Hazardous Material Information System (U.S.A.) :



National Fire Protection Association (U.S.A.) :



Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.