



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards and EC Standards

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: DEUTERIUM CHLORIDE
CHEMICAL NAME: Deuterium Chloride
FORMULA: Deuterium Chloride = DCI
SYNONYMS: Deuterated Hydrochloric Acid; Hydrochloric Acid-d

MANUFACTURER: SPECTRA GASES, INC.
ADDRESS: 3434 Route 22 West
 Branchburg, NJ 08876, U.S.A.
PHONE: 908/252-9300
FAX: 908/252-0811
WEB SITE: www.spectra-gases.com

SPECTRA GASES EMERGENCY CONTACT: 800/932-0624 8:30 am - 7:00 pm (EST)
24 HOUR EMERGENCY CONTACT, CHEMTREC: 800/424-9300, 202/484-7616
DATE OF PREPARATION: December 10, 2001
MSDS NUMBER: 1055
PRODUCT USE: Chemical Lasers; Laboratory Research

SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

COMPOSITION: Deuterium Chloride 100%
CAS NUMBER: Deuterium Chloride: 7698-05-7
EINECS NUMBER: Deuterium Chloride: 231-715-8
EXPOSURE LIMITS:

OSHA PELs:	ACGIH TLVs:	NIOSH RELs:
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There are no exposure limits for Deuterium Chloride. It is recommended that the following limits for the chemically related compound and decomposition product of this gas, Hydrogen Chloride be used:

STEL = 5 ppm (ceiling)	STEL = 5 ppm (ceiling)	STEL = 5 ppm (ceiling)
		IDLH = 50 ppm

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This is a colorless, non-flammable, toxic, corrosive gas with a sharp, suffocating odor. This gas is very corrosive to all tissues, subsequently releases of this product should be responded to with extreme caution. Serious inhalation overexposure can be fatal. Deuterium Chloride is heavier than air, and pockets of the gas can accumulate in low-lying areas. Deuterium Chloride fumes strongly in moist air, producing a dense, white cloud of hydrochloric acid mist. Vapor clouds of the gas may be controlled using a water fog. Deuterium Chloride has a pungent odor; the odor of this product may provide a good warning of a release of this gas. Persons responding to releases of Deuterium Chloride must protect themselves appropriately.

ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: WARNING - If rescue personnel need to enter an area suspected of having a toxic level of Deuterium Chloride, they should be equipped with Self-Contained Breathing Apparatus (SCBA), and, if available, a full-body chemically resistant suit. Acute overexposure to this gas may cause the following health effects:

EYE CONTACT: Minor contact with this gas will cause tearing and irritation, including swelling and redness. Severe over-exposure to the eyes can cause burns and possibly, blindness. Release of a high-pressure gas may result in airborne objects.

INGESTION: Ingestion of this gas is not a likely route of industrial exposure.

INHALATION: Deuterium Chloride is extremely corrosive. Minor inhalation exposure of this gas can cause irritation to the lungs, nose, throat and mucous membranes, resulting in coughing and breathing difficulty. Serious inhalation overexposures can cause burns to the nose, throat, mucous membranes and lungs. Symptoms include burning sensation in lungs, coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting. Severe inhalation over-exposure may result in pulmonary edema (an accumulation of fluid in the lungs), a potentially fatal condition. High concentrations of Deuterium Chloride gas may cause an oxygen deficient atmosphere. Exposure to high concentrations may cause unconsciousness, and under some circumstances, death. (continued on following page)

SECTION 3. HAZARD IDENTIFICATION (Continued)

INHALATION (continued): Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of overexposure, death may occur. It should be noted that before adverse health effects of suffocation could occur, the effects of overexposure to Deuterium Chloride will be felt.

SKIN CONTACT: Depending on the concentration and duration of overexposure, skin contact may lead to severe burns or dermatitis (red, cracked, irritated skin). There is some information that this gas may be absorbed via intact skin, although no information on the symptoms from this route of exposure.

OTHER HEALTH EFFECTS: Contact with rapidly expanding gases (which are released from under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain caused by frostbite can quickly subside, masking the injury. In addition, the sudden release of a pressurized gas (such as may occur in the event of a valve failure), presents a severe hazard of mechanical injury.

HMIS RATINGS: HEALTH: = 3; FLAMMABILITY: = 0; REACTIVITY: = 1

PPE: Level H (see Section 8, Exposure Controls/Personal protective Equipment)

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Inhalation

TARGET ORGANS: Respiratory System, Eyes, Skin

SYMPTOMS: Dermatitis may result from repeated skin contact with this gas. Repeated overexposures by inhalation can result in erosion of tooth enamel. Repeated over-exposure to Deuterium Chloride can result in emphysema.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Pre-existing dermatitis, other skin conditions, and respiratory disorders may be aggravated by over-exposure to this gas.

CARCINOGENICITY: Deuterium Chloride is not found on the FEDERAL OSHA Z LIST, IARC, NTP, CAL/OSHA, or Carcinogenicity lists and therefore is neither considered to be nor suspected to be a cancer-causing agent by these agencies.

SECTION 4. FIRST AID MEASURES

EYE CONTACT: If this gas contaminates the eyes, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Administer anesthetic eye drops after one minute of flushing if victim suffers from spasms to the eyes, in order to facilitate irrigation. In the event of a severe overexposure, victim should consult with an ophthalmologist. In the event of mechanical injury, cover eye with bandage and seek appropriate medical attention.

INGESTION: Ingestion is an unlikely route of exposure for this gas.

INHALATION: Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. In the event of severe, immediate effects or delayed symptoms which develops after exposure, victim must seek appropriate medical attention.

SKIN CONTACT: If this gas contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim should seek appropriate medical attention if symptoms persist. In case of frostbite, place the frostbitten part in warm water. **DO NOT USE HOT WATER.** If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT: Not Applicable

AUTOIGNITION: Not Applicable

FLAMMABLE RANGE: Not Applicable

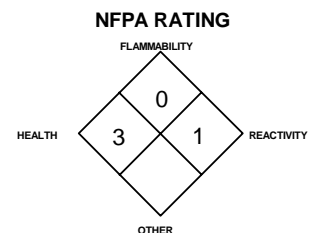
NFPA RATINGS:

HEALTH: = 3 FLAMMABILITY: = 0

REACTIVITY: = 1 SPECIAL: None

EXTINGUISHING MEDIA: This is non-flammable; use fire-extinguishing media appropriate for the surrounding materials.

SPECIAL FIRE-FIGHTING PROCEDURES: Non-flammable. Use extinguishing media appropriate for surrounding fire. In the event of fire, cool containers of this product with water spray to prevent failure.



See Section 16 for
Definition of Ratings

SECTION 5. FIRE FIGHTING MEASURES (Continued)

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas is extremely corrosive and can severely irritate or burn the skin, eyes, and other contaminated tissues; subsequently, it presents a serious health hazard to firefighters. Deuterium Chloride will react with most metals, liberating flammable hydrogen gas. Exposure to high heat, as in a fire situation, can cause the cylinder to rupture.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Not sensitive.

HAZARDOUS COMBUSTION PRODUCTS: Hydrogen chloride gas.

SECTION 6. ACCIDENTAL RELEASE MEASURES

FIRST RESPONSE: In the event of a leak of this product, operator should close the gas source, if possible to do so safely. Evacuate immediate area. In the event of a significant release from a single cylinder, the North American Response Guidebook (Guidebook #125) recommends 330-660 feet initial isolation from release for similarly corrosive, toxic gases.

TRAINED RESPONSE TEAM: Personal Protective Equipment should include chemically resistant suit, gloves, and Self-Contained Breathing Apparatus (SCBA). The use of chemically-resistant clothing should be considered at the discretion of site incident commander. A water fog or mist can be used to control the vapor cloud resulting from the release. Do not direct a water spray directly at the source of release. Do not flush contaminated water down the sewer system. Flush into a retention area and neutralize with soda ash or limestone. Dilute with large amounts of water, then dispose of according to local regulations.

ENTRY TO AREA: Monitor the surrounding area for toxic gas level. Deuterium Chloride levels should be below the limits shown in Section 2 (Composition and Information on Ingredients), before personnel are allowed in the area without Self-Contained Breathing Apparatus.

REPAIR/FOLLOW-UP: If leak was in user's gas handling equipment or system, ensure cylinder is closed, system is purged and all high pressure is vented before attempting repairs. If leak was from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier.

THIS IS A TOXIC, CORROSIVE GAS. Protection of all personnel and the area must be maintained. All responders must be adequately protected from exposure.

SECTION 7. HANDLING AND STORAGE

STORAGE: Cylinders should be stored upright (with valve protection caps or plugs in place) and firmly secured to prevent falling or being knocked over. Cylinders should be stored in dry, well-ventilated areas. Protect from salt or other corrosive materials. Storage should be away from heavily traveled areas, walkways, elevators, platform edges or other objects or situations that could damage the cylinder wall. Do not store in a manner that will block emergency exits, fire extinguishers or other safety equipment. Do not allow storage temperature to exceed 125°F (52°C). Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Store empty cylinders away from full cylinders. Consideration should be taken to install leak detection and alarm equipment for storage areas. **NOTE:** Use only DOT or ASME code cylinders designed for compressed gas storage. Cylinders must not be recharged except by or with the consent of owner.

PHYSICAL HAZARD: Deuterium Chloride becomes extremely corrosive when it comes into contact with moisture. Hydrochloric acid will corrode gas handling systems and other metal structures, possibly causing leaks and damage to expensive equipment. Hydrochloric acid will react with most metals to liberate flammable hydrogen gas, which may pose a fire hazard in the event of an emergency.

HANDLING: **This gas can be dangerous and should only be handled by trained personnel.** Wearing contact lenses is not recommended when handling this gas. Spectra Gases, Inc., strongly recommends that Deuterium Chloride only be handled in areas with extensive venting capabilities, preferably a gas handling cabinet or under a fume hood. Eye wash stations/safety showers should be near areas where this product is used or stored. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. Monitoring may be considered for areas in which this gas is used. Detection of Deuterium Chloride odor should trigger immediate response and corrective action. Contaminated clothing should be removed and laundered separately before reuse.

Before using this gas, meticulous leak checking using inert gas is strongly recommended, particularly after new connections are made. Cylinder valves should be inspected regularly for physical damage or corrosion (apparent by discoloration or rust). Care should be taken to inspect the following valve locations for corrosion: neck (where valve inserts into cylinder); bonnet nut (where handle attaches to valve body). Close valve after each use and when empty.

(continued on following page)

SECTION 7. HANDLING AND STORAGE (Continued)

HANDLING (continued): Use only compatible materials for cylinders, process lines, and other Deuterium Chloride-handling equipment. Stainless steel, silicon aluminum bronze, nickel and monel are the recommended metals for pure Deuterium Chloride service. All equipment in Deuterium Chloride service should be kept scrupulously dry to limit corrosion. When working with Deuterium Chloride, always use a pressure reducing regulator (constructed of above materials) to lower pressure to a safe working level. All gaskets and washers used in Deuterium Chloride service should be made of Teflon or KEL-P. A purge system should be in place so that all atmospheric contaminants and residual Deuterium Chloride can be purged from piping and regulators before and after use or repairs.

Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure regulator to safely discharge product from cylinder. Use a check valve to prevent reverse flow into cylinder. Once cylinder has been connected to properly purged process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage or open the valve, causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps.

Do not heat cylinders by any means to increase the discharge rate of product from the cylinder. Never apply flame or localized heat directly to any part of the cylinder. Cylinders should not be artificially cooled as certain types of steel undergo property changes when cryogenically cooled, thus making the cylinder unstable. The failure of a valve can result in violent release of the pressurized gas, creating a severe mechanical injury hazard.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Purge gas handling equipment with inert gas and relieve pressure before attempting repairs.

SPECIAL PRECAUTIONS: Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers*. Local regulations may require specific equipment for storage and use.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Forced ventilation systems for the general work area should be provided. Because of the high hazard associated with Deuterium Chloride, stringent control measures may be necessary. Spectra Gases, Inc. recommends that cylinders in use be secured within a ventilated enclosure such as a gas cabinet. Ductwork should be constructed of non-metallic material, or should be lined to resist corrosion. Employee exposure should be monitored and reduced to the lowest practical levels using ventilation or other appropriate engineering controls.

RESPIRATORY PROTECTION: Maintain exposure levels of Deuterium Chloride below the levels listed in Section 2 (Composition / Information on Ingredients). Use supplied air respiratory protection if Deuterium Chloride levels exceed exposure limits, or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards, standards of Canada, the European Standard EN149, and EC member states. It is recommended that the NIOSH respiratory protection recommendations for Hydrogen Chloride be used as it is chemically related and the major decomposition product of Deuterium Chloride.

CONCENTRATION of HYDROGEN CHLORIDE

Up to 50ppm

RESPIRATORY EQUIPMENT

Any chemical cartridge respirator with cartridge(s) providing protection against the compound of concern, or any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front, or back-mounted canister, or any powered, air-purifying respirator with cartridge(s), or any supplied-air respirator, or any self-contained breathing apparatus with a full facepiece.

Emergency or Planned Entry into Unknown Concentration or IDLH Conditions Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Escape Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister, or Any appropriate escape-type, self-contained breathing apparatus.

The IDLH concentration for Hydrogen Chloride is 50 ppm.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION (Continued)

EYE PROTECTION: Use approved safety goggles or safety glasses, with side-shields, and faceshield, as described in OSHA 29 CFR 1910.133 or by the European Standard EN166. Eye wash stations/safety showers should be available.

SKIN PROTECTION: Work (such as leather) gloves are recommended when handling cylinders of this gas. Use appropriate gloves for spill response. Wear PVC, Teflon®, Kel-F®, or Neoprene Rubber gloves for industrial use.

OTHER PROTECTIVE EQUIPMENT: Use body protection appropriate for task. In some circumstances of use, chemically-resistant clothing appropriate for use with corrosive materials may be appropriate. Safety shoes are recommended when handling cylinders.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

MOLECULAR WEIGHT: 37.47

GAS DENSITY: Not determined.

BOILING POINT @ 1 atm: -85°C (-121°F)

FREEZING/MELTING POINT @ 1 atm: -114°C (-173.2°F)

SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F): 1.3

SOLUBILITY IN WATER vol/vol at 0°C (32°F) and 1 atm: 0.823

SPECIFIC VOLUME @ 21.1°C (70°F): Not determined.

CRITICAL PRESSURE: Not determined.

VAPOR PRESSURE @ 70°F (21.1°C): 613 psi (4227 kPa)

ODOR THRESHOLD: Not determined.

APPEARANCE, ODOR AND STATE: Colorless gas with a sharp, suffocating odor.

WARNING PROPERTIES FOR THIS GAS: The odor is a distinctive warning property associated with this gas. Additionally, a white cloud may show the location of the leak.

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Deuterium Chloride can fume to form hydrochloric acid mist in air.

CONDITIONS TO AVOID: Cylinders should not be exposed to temperatures in excess of 125°F (52°C).

MATERIALS WITH WHICH GAS IS INCOMPATIBLE: Deuterium Chloride is not compatible with most metals, bases, amines, alkali metals, copper and copper alloys, aluminum and steel.

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen Chloride. Deuterium Chloride will react with water to form acidic solutions.

B) HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: Currently, there are no toxicological data for Deuterium Chloride.

CARCINOGENICITY: Is not listed by any agency tracking carcinogenic potential.

IRRITANCY OF PRODUCT: This gas is severely irritating to contaminated tissue, depending on the duration of contact.

SENSITIZATION OF PRODUCT: Deuterium Chloride is not a skin or respiratory sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Deuterium Chloride on the human reproductive system.

Mutagenicity: Deuterium Chloride is not expected to mutagenic effects in humans.

Embryotoxicity: Deuterium Chloride is not expected to cause embryotoxic effects in humans.

Teratogenicity: Deuterium Chloride is not expected to cause teratogenic effects in humans.

Reproductive Toxicity: Deuterium Chloride is not expected to cause adverse reproductive effects in humans.

A mutagen is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical that causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical that causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance that interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) have not been determined for Deuterium Chloride.

SECTION 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Deuterium Chloride will fume in air to form hydrochloric acid, which will slowly biodegrade to other organic compounds.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Due to the corrosive and toxic nature of this gas, animals exposed to Deuterium Chloride will experience tissue damage, burns, and may be killed. Plants contaminated with this product may be adversely affected or destroyed.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Deuterium Chloride is very soluble in water, and even low concentrations of Deuterium Chloride in water are detrimental to aquatic life. If a release of Deuterium Chloride occurs near a river or other body of water, the release has the potential to kill fish and other aquatic life. The following aquatic toxicity data are available for Hydrochloric Acid, which would be formed upon contact with water:

TLm (sunfish) = 96 hours/ pH 3.6/ 20°C	LC ₅₀ (starfish) 48 hours = 100-300 mg/L/ 48 hours
TLm (goldfish) = 96 hours/ pH 4/ 20°C	LC ₅₀ (cockle) = 330-1000 mg/L
TLm (<i>Gambusia affinis</i> , mosquito fish) 96 hours = 282 ppm (fresh water)	LC ₅₀ (<i>Carassium auratus</i> , goldfish) = 178 mg/L (1-2 hour survival time)
TLm (stickleback) = 96 hours/ pH 4.6/ 20°C	LC ₅₀ (shore crab) 48 hours = 240 mg/L
LC (<i>Lepomis macrochirus</i> , bluegill sunfish) 48 hours = 3.6 mg/L	LC ₅₀ (<i>Lepomis macrochirus</i> /bluegill sunfish) 96 hours = pH 3.0-3.5
LC ₅₀ (shrimp) 48 hours = 100-330 ppm (salt water)	LC ₁₀₀ (trout) 24 hours = 10 mg/L

MOBILITY: Deuterium Chloride will fume to hydrochloric acid, which, especially in the presence of water, will be mobile in soil (the rate of infiltration will depend on the amount of water/moisture present in the soil).

PERSISTENCE AND BIODEGRADABILITY: Persistence: If spilled in soil, Deuterium Chloride will convert to hydrochloric acid, which, as it moves through the soil, will dissolve soil materials, particularly if of carbonate base. The acid will be somewhat neutralized, but is expected to transport to the ground water table. In water, Deuterium Chloride disassociates almost 100% with the hydrogen ion captured by the water molecules to form the hydronium ion. Biodegradation: Deuterium Chloride will biodegrade

POTENTIAL TO BIOACCUMULATE: Currently, there are no data on the potential of bioaccumulation for Deuterium Chloride.

OZONE-DEPLETION POTENTIAL: Deuterium Chloride is not a Class I or Class II ozone depleting chemical (40 CFR Part 82).

SECTION 13. DISPOSAL CONSIDERATIONS

UNUSED PRODUCT / EMPTY CONTAINER: Do not dispose of unused product. Return used product in cylinders to: Spectra Gases, Inc., 80 Industrial Drive, Alpha, NJ 08865 or Spectra Gases, Inc., 1261 Activity Drive, Vista, CA 92083.

DISPOSAL INFORMATION: Small quantities of Deuterium Chloride may be disposed of by slowly venting through a solid activated charcoal or soda lime scrubber. For large quantities of Deuterium Chloride, a 15% sodium hydroxide solution or other alkali and water solution is recommended. Neutralization should only be done by appropriately trained and experienced personnel. Disposal shall be done in accordance with U.S. Federal, State and local regulations, regulations of the provinces of Canada or EC member states.

SECTION 14. TRANSPORT INFORMATION

U.S. SHIPPING INFORMATION:

U.S. DOT PROPER SHIPPING NAME: Compressed gas, toxic, corrosive, n.o.s. (Deuterium Chloride)

HAZARD CLASS NUMBER and DESCRIPTION: 2.3 (Toxic Gas) 8 (Corrosive)

UN IDENTIFICATION NUMBER: UN 3304

U.S. DOT SHIPPING LABEL(S) REQUIRED: Class 2.3, Toxic Gas (primary hazard)
Class 8, Corrosive (subsidiary hazard)

PLACARD (When required): Toxic Gas

SPECIAL PROVISION: Shipments of this gas must be described as Poisonous by Inhalation, Hazard Zone C, per 49 CFR, 173.116(a).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position in a well-ventilated truck (never transport in passenger compartment of a vehicle). Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder.

CAUTION: Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of Federal law (49 CFR 173.301).

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SECTION 14. TRANSPORT INFORMATION (Continued)
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CANADIAN SHIPPING INFORMATION:

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as dangerous goods; use the above U.S. DOT information for the preparation of Canadian Shipments.

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA):

IATA DESIGNATION: This gas is considered as dangerous goods, per the International Air Transport Association.

PROPER SHIPPING NAME: Compressed gas, toxic, corrosive, n.o.s. (Deuterium Chloride)

HAZARD CLASS NUMBER and DESCRIPTION: 2.3 (Toxic Gas) 8 (Corrosive)

UN IDENTIFICATION NUMBER: UN 3304

HAZARD LABEL(S) REQUIRED: Class 2.3, Toxic Gas (primary hazard)
Class 8, Corrosive (subsidiary hazard)

EMERGENCY CODE: 2CP

The following Packaging Information is applicable to this product:

PASSENGER AND CARGO AIRCRAFT				CARGO AIRCRAFT ONLY	
Limited Quantity		Packing Instruction	Max. Qty per Pkg	Packing Instruction	Max. Qty per Pkg
Packing Instruction	Max. Qty per Pkg				
FORBIDDEN! This commodity may be transported on passenger and on cargo aircraft, only with the prior approval of the appropriate authority of the State of origin under the written conditions established by the authority.					

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):

IMO DESIGNATION: This gas is considered as dangerous goods, per the International Maritime Organization.

PROPER SHIPPING NAME: Compressed gas, toxic, corrosive n.o.s. (Deuterium Chloride)

HAZARD CLASS NUMBER and DESCRIPTION: 2.3 (Toxic Gas) 8 (Corrosive)

UN IDENTIFICATION NUMBER: UN 3304

HAZARD LABEL(S) REQUIRED: Class 2.3, Toxic Gas (primary hazard)
Class 8, Corrosive (subsidiary hazard)

STOWAGE CATEGORY: Category D - Clear of Living Quarters

IMDG CODE: Page 172

MARINE POLLUTANT: Deuterium Chloride is not designated by the IMO to be a Marine Pollutant.

EUROPEAN SHIPPING INFORMATION:

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR): This gas is considered by the Economic Commission for Europe to be dangerous goods.

Additional information is as follows:

SUBSTANCE IDENTIFICATION NO.: Compressed gas, n.o.s. (Deuterium Chloride)

HAZARD IDENTIFICATION NO.: 268

LABEL: 6.1 + 8

CLASS AND ITEM NUMBER: 2, 1^oTC

SECTION 15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:**EPA - ENVIRONMENTAL PROTECTION AGENCY:**

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1990 (40 CFR Parts 117 and 302)

Reportable Quantity (RQ): Not applicable.

SARA TITLE III: Superfund Amendment and Reauthorization Act

SECTIONS 302/304: Emergency Planning and Notification (40 CFR Part 355)

Extremely Hazardous Substances: Deuterium Chloride is not listed.

Threshold Planning Quantity (TPQ): Not applicable.

Reportable Quantity (RQ): Not applicable.

SECTIONS 311/312: Hazardous Chemical Reporting (40 CFR Part 370)

IMMEDIATE HEALTH: Yes

PRESSURE: Yes

DELAYED HEALTH: Yes

REACTIVITY: Yes

FIRE: No

SECTION 313: Toxic Chemical Release Reporting (40 CFR 372)

Releases of Deuterium Chloride require reporting under Section 313 (as hydrochloric acid).

SECTION 15. REGULATORY INFORMATION (Continued)

U.S. FEDERAL REGULATIONS (continued):**EPA - ENVIRONMENTAL PROTECTION AGENCY (continued):****CLEAN AIR ACT:**

SECTION 112 (r): Risk Management Programs for Chemical Accidental Release
(40 CFR Part 68)

Threshold Planning Quantity (TPQ): Not applicable.

TSCA: Toxic Substances Control Act

Deuterium Chloride is listed on the TSCA Inventory.

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR Part 1910.119: Process Safety Management of Highly Hazardous Chemicals.

Threshold Planning Quantity (TPQ): Not applicable.

U.S. STATE REGULATORY INFORMATION:

CALIFORNIA PROPOSITION 65: Deuterium Chloride is not a listed substance which the State of California requires warning under this statute.

Deuterium Chloride is covered under the following specific State regulations (more specific regulations exist in some States):

Alaska - Designated Toxic and Hazardous Substances: No.

California - Permissible Exposure Limits for Chemical Contaminants: No.

Florida - Substance List: No.

Illinois - Toxic Substance List: No.

Kansas - Section 302/313 List: No.

Massachusetts - Substance List: No.

Michigan - Critical Materials Register: No.

Minnesota - List of Hazardous Substances: No.

Missouri - Employer Information/Toxic Substance List: No.

New Jersey - Right to Know Hazardous Substance List: No.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.

Pennsylvania - Hazardous Substance List: No.

Rhode Island - Hazardous Substance List: No.

Texas - Hazardous Substance List: No.

West Virginia - Hazardous Substance List: No.

Wisconsin - Toxic and Hazardous Substances: No.

CANADIAN FEDERAL REGULATIONS:

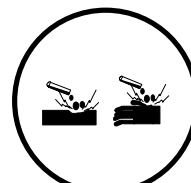
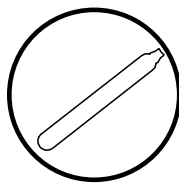
CANADIAN DSL INVENTORY STATUS: Deuterium Chloride is listed on the Canadian DSL Inventory.

OTHER CANADIAN REGULATIONS: Deuterium Chloride is categorized as a Controlled Product, Hazard Classes A, D1A and E, as per the Controlled Product Regulations. Deuterium Chloride is not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS SYMBOLS: **Class A:** Compressed Gas

Class D1A: Toxic Material/Immediate and Serious Effects

Class E: Corrosive Material

**EUROPEAN ECONOMIC COMMUNITY****REGULATIONS:**

EC LABELING AND CLASSIFICATION: Currently, Deuterium Chloride has not been classified, per the European Community Council Directive 67/548/EEC. The following is a self-classification.

EC EINECS/ELINCS NUMBER: 231-595-7

EC CLASSIFICATION: Toxic; Corrosive: [T; C]

EC RISK PHRASES: Causes severe burns. Toxic by inhalation. [R: 23, 35]

EC SAFETY PHRASES: Keep locked up and out of the reach of children.* **This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.* Keep container tightly closed and in a well ventilated place. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable protective clothing, gloves and eye/face protection. In case of accident or if you feel unwell, seek medical advice immediately (show label where possible). [S:(1/2)*, 7/9, 26, 36/37/39, 45]

EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOLS:

SECTION 16. OTHER INFORMATION

Information contained in this Material Safety Data Sheet is provided to our customers so they may comply with 29 CFR 1910.1200, Hazard Communication Standard, the Canadian WHMIS Standard, and the requirements of the European Community Directives. The intent of this Material Safety Data Sheet is to provide end users of this product with the health and physical hazards associated with possible exposure to this product. All statements, technical data and recommendations are based on readily available texts and data that Spectra Gases, Inc., believes to be reliable and accurate. Spectra Gases, Inc., makes no warranties, guarantees or representations of any kind with respect to this product or this data. It is the responsibility of the user to obtain and use the most recent version of this MSDS.

Further information about compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1 "Safe Handling of Compressed Gases in Containers"
AV-1 "Safe Handling and Storage of Compressed Gases"
"Handbook of Compressed Gases"

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA 91944-3519
619/670-0609

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

TLV - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit (**STEL**), and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

The DFG - MAK is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL.

NIOSH is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called **Recommended Exposure Levels (RELs)**. When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]). Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. Ecological Information: **EC** is the effect concentration in water.

REGULATORY INFORMATION:

U.S. and CANADA: This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label.

EUROPEAN: **EC** is the European Community (formerly known as the **EEC**, European Economic Community). **EINECS**: This is the European Inventory of Now-Existing Chemical Substances. The **ARD** is the European Agreement Concerning the International Carriage of Dangerous Goods by Road and the **RID** are the International Regulations Concerning the Carriage of Dangerous Goods by Rail.