



MATERIAL SAFETY DATA SHEET

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

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: DEUTERATED SILANE
CHEMICAL NAME: Deuterated Silicon Hydride
FORMULA: SiD₄
SYNONYMS: Silicon Deuteride; Monosilane, Deuterated

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 8:30am - 7:00pm (EST)
24 HOUR EMERGENCY CONTACT, CHEMTREC: 800/424-9300, 703-527-3887
DATE OF REVISION: April 12, 2004
MSDS NUMBER: 1047
PRODUCT USE: Various

SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

COMPOSITION: Silane (deuterated)
CAS NUMBER: 7803-62-5
EINECS NUMBER: 232-263-4
EXPOSURE LIMITS: (10,000 ppm = 1%)

OSHA PELs:	ACGIH TLVs:	NIOSH RELs:
TWA = 5 ppm (1989 Vacated PEL)	TWA = 5 ppm	TWA = 5 ppm

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: DANGER PYROPHORIC GAS!!! Deuterated Silane is a colorless, pyrophoric gas, with a choking effect, which is shipped under pressure. This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide. Deuterated Silane can react with water to form corrosive silicic acid. The primary health hazard associated with Deuterated Silane is the potential for severe thermal burns from contact with flames resulting from the spontaneous ignition of this gas. Depending on the severity of the burns, such exposures can be fatal. Flame or high temperature impinging on a localized area of the cylinder of this product can cause the cylinder to burst without activating the cylinder's relief devices. If Deuterated Silane is released at high pressure or high flow velocity, a delayed detonation may occur. Deuterated Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached. **Deuterated Silane is an extremely dangerous, pyrophoric gas. Deuterated Silane may cause serious burns, fires and explosions if mishandled. Deuterated Silane should only be handled by appropriately trained personnel. Please read the rest of this Material Safety Data Sheet carefully before handling this material.**

ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: DANGER! Deuterated Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached! If rescue personnel need to enter an area in which a release of Deuterated Silane has occurred, they should be equipped with Self-Contained Breathing Apparatus (SCBA) and fire-protective gear. Releases of this gas create a fire extreme hazard. Acute overexposure to this gas may cause the following health effects:

EYE CONTACT: Decomposition of Deuterated Silane will result in the production of amorphous silicon dioxide. Eye contact with particulates of amorphous silicon dioxide may be irritating. Depending on duration of contact, symptoms can include burning, itching, redness, swelling and excessive tearing. Serious overexposure to the eyes can result in burns from the silicic acid which forms upon contact with moisture in the eye. Release of a high-pressure gas may result in airborne objects.

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

SECTION 3. HAZARD IDENTIFICATION (Continued)

INHALATION: Inhalation of high concentrations of this gas can result in headache, nausea, dizziness, and irritation of the upper respiratory tract. Deuterated Silane reacts with water to form silicic acid, which can be irritating to the mucous membranes and the respiratory system. Severe Deuterated Silane over-exposures via inhalation may result in pulmonary edema. Decomposition of Deuterated Silane will result in the production of amorphous silicon dioxide. Though inhalation of amorphous silicon dioxide can be irritating to the nose and throat, such exposure does not present the potential for adverse health effects as inhalation of crystalline silicon dioxide.

SKIN CONTACT: Deuterated Silane reacts with water to form silicic acid, which can be irritating to the skin. Decomposition of Deuterated Silane will result in the production of amorphous silicon dioxide. Skin contact with particulates of amorphous silicon dioxide may be irritating.

OTHER HEALTH EFFECTS: The chief health hazard presented by Deuterated Silane is that it ignites so rapidly, personnel in the area of a release can receive severe thermal burns. Depending on the severity of the burns, such exposures can be fatal.

HMIS RATINGS: HEALTH HAZARD: = 1; FLAMMABILITY HAZARD: = 4; PHYSICAL HAZARD: = 3;

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Not Applicable

TARGET ORGANS: None.

SYMPTOMS: None.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Pre-existing respiratory conditions may be affected by low level exposure to the decomposition products of Deuterated Silane (amorphous silicon dioxide).

CARCINOGENICITY: Deuterated Silane is not found on the FEDERAL OSHA Z LIST, NTP, CAL/OSHA, or IARC 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

THERMAL BURNS: In the event personnel are burned as a result of a Disilane release, if burns are first degree or second degree with closed blisters, flush area with cold water until pain subsides. Apply loose, moist, sterile dressings, and bandage. Treat for shock. If burns are second degree with open blisters or third degree, apply loose, dry, sterile dressings and bandage. Treat for shock. Transport victim immediately to hospital or emergency center. Burns over an area of 20% or more of body are life-threatening, medical attention should be immediately sought.

EYE CONTACT: If the decomposition products (silicic acid, amorphous silicon dioxide) contaminate the eyes, immediately begin decontamination with running water, open victim's eyes while under gently running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek medical attention. If mechanical injury occurs, 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.

SKIN CONTACT: If silicic acid (from the reaction of Deuterated Silane and water) contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. If amorphous silicon dioxide (from the reaction of Deuterated Silane with oxygen) contaminates the skin, flush area with copious amounts of water. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek medical attention if irritation persists, or if there are other adverse health effects.

NOTES TO PHYSICIANS: Administer oxygen, if necessary, and treat symptoms. Be observant for initial signs of pulmonary edema.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT: Not applicable. Pyrophoric gas.

AUTOIGNITION: Not applicable. Pyrophoric gas.

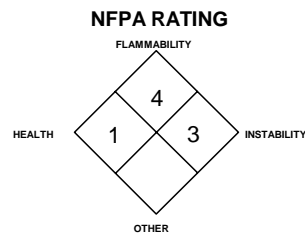
FLAMMABLE RANGE: Lower (LEL): 1.0%; Upper (UEL): 96.0-100.0%

NFPA RATINGS:

HEALTH: = 1 FLAMMABILITY: = 4

INSTABILITY: = 3 SPECIAL: None

EXTINGUISHING MEDIA: Extinguish Deuterated Silane fires by shutting-off the source of the gas. Use a fine water spray or fog to reduce combustion products formed in air. Do not use halocarbon-type fire extinguishing agents. Cool fire-exposed cylinders with water spray, from the maximum distance possible.



**See Section 16 for
Definition of Ratings**

SECTION 5. FIRE FIGHTING MEASURES (Continued)

SPECIAL FIRE-FIGHTING PROCEDURES: Deuterated Silane cylinders, whether actively involved in the fire or not, pose a significant explosion hazard. If cylinders are not leaking, and are not in the area of a fire, effort to remove them from the area should be attempted, if it does not endanger personnel. If this is not possible, keep cylinders cool with a water spray to ensure that they do not rupture. If the cylinder is leaking, or if involved in the fire, attempt to stop the flow of gas, if it can be done safely, cool with a fine water spray, and fight fire from the maximum distance possible. Do not attempt to remove cylinders unless it can be done quickly and safely. If cylinder cannot be removed, evacuate area.

UNUSUAL FIRE AND EXPLOSION HAZARDS: PYROPHORIC GAS! An extreme explosion hazard exists in areas in which the gas has been released, but the material has not yet ignited. This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide. The products of thermal decomposition of this material include amorphous silicon dioxide and hydrogen. Deuterated Silane can react with water to form corrosive silicic acid. The decomposition products of Deuterated Silane can be irritating to exposed tissue. **If Deuterated Silane is released at high pressure or high flow velocity, a delayed detonation may occur. Deuterated Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached.**

DANGER! Fires impinging (direct flame) on the outside surface of unprotected cylinders of Deuterated Silane can be very dangerous. Exposure to fire could cause a catastrophic failure of the cylinder releasing the contents into a fireball and explosion of released gas. The ensuing explosion (and possible fireball) and can result in severe equipment damage and personnel injury or death over a large area around the cylinder. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Static discharge may cause this gas to ignite explosively.

HAZARDOUS COMBUSTION PRODUCTS: Amorphous silicon dioxide is produced upon exposure to air. When amorphous silicon dioxide is heated to extreme temperatures as may be encountered in a fire, hazardous forms of crystalline silicon dioxide are formed.

SECTION 6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: In the event of a leak of this product, operator should close the gas source if possible to do so safely. Evacuate area in the event of a significant release. The North American Emergency Response Guidebook (Guide #115) recommends 0.5 miles.

Only trained incident-response personnel may re-enter a contaminated area. **Deuterated Silane is a pyrophoric gas.** Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves and Self-Contained Breathing Apparatus.** Locate and seal the source of the leaking gas, if competent fire-fighting authority determines that this can be done safely. If the flow of pyrophoric gas cannot be stopped, allow entire cylinder contents to burn.

If this gas leaks without igniting, extreme caution must be used; flammable or explosive mixtures with air may be formed. Allow the gas, which is heavier than air, to dissipate.

Combustible gas concentration must be below 10% of the LEL (1.0%) prior to entry without fire risk. Deuterated Silane levels should be reduced below the exposure limits for standard working conditions (see Section 2, Composition and Information on Ingredients) before workers re-enter the area.

If leak is in user's gas handling equipment or system, close cylinder valve, and safely vent high pressure before attempting repairs. If leak is from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier.

SECTION 7. HANDLING AND STORAGE

STORAGE: Locations where Deuterated Silane is used or stored should be well-ventilated and located away from other work areas and populated buildings. Low level leaks of Silane may accumulate for some time before igniting without warning, possibly with explosive force. Storage areas should be designed and built to withstand possible emergencies. Areas in which Deuterated Silane is used or stored should be equipped with Deuterated Silane detectors. Detectors indicate whether a leak has occurred so that it can be brought under control immediately before dangerous levels can accumulate. Cylinders of Deuterated Silane should be equipped with flow-restricting orifices.

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).

SECTION 7. HANDLING AND STORAGE (Continued)

STORAGE (continued): Cylinders should be stored upright (with valve protection caps and 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.

Storage and use areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs. Have appropriate extinguishing equipment (i.e. sprinkler system, portable fire extinguishers). Use non-sparking ventilation systems, approved explosion-proof equipment, and appropriate electrical systems. Electrical equipment used in gas-handling operations, or located in storage areas, should be non-sparking or explosion proof.

Cylinders should be separated from oxygen cylinders, or other oxidizers, by a minimum distance of 20 ft., or by a barrier of non-combustible material at least 5 ft. high, having a fire-resistance rating of at least 0.5 hours. Isolate from other incompatible chemicals (refer to Section 10, Stability and Reactivity).

HANDLING: Releases of Deuterated Silane are extremely dangerous, as this gas is pyrophoric and can ignite spontaneously. Fire blanket should be stored in or very near the work area. Wearing contact lenses is not recommended when handling this gas.

When removing the valve plug, personnel should wear fire-resistant gloves. The cylinder valve should be securely closed. The plug should be oriented away from worker's body and removed slowly; if there is any Deuterated Silane trapped behind the plug, it may ignite as the plug is loosened.

All equipment used to handle Deuterated Silane must be free of any type of halogen or halogen-containing compounds. Deuterated Silane reacts violently with even trace amounts of these compounds (including certain types of degreasing agents). Stainless steel and iron are the recommended materials for regulators and piping. When working with Deuterated Silane, a pressure-reducing regulator, equipped with a metal diaphragm to lower pressure to a safe working level, should be used. Valves should be diaphragm packless with Teflon seats. Systems should be equipped with isolation valves and check valves to prevent hazardous backflow. Systems should be designed with minimal dead space so that purging can be done efficiently.

Before introducing Deuterated Silane, systems should be leak-checked (above working pressure) and thoroughly purged with an inert gas to remove air. Residual Deuterated Silane should be purged from the system after use and properly vented. Never purge Deuterated Silane through a vacuum pump.

Deuterated Silane is a pyrophoric gas, thus on contact with air it ignites. If systems are not thoroughly purged, there is a danger of explosion. Solid by-products of combustion can clog and contaminate cylinder orifices, piping, regulators and instrumentation.

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. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage or open the valve. Use an adjustable strap-wrench to remove over-tight or rusted caps. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never tamper with pressure relief devices in valves and cylinders. Close valve after each use and when empty.

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.

Only trained, experienced personnel should handle this gas.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Relieve pressure before attempting repairs. Follow all cautionary procedures described above during maintenance operations.

SPECIAL PRECAUTIONS: All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. 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: Deuterated Silane detectors should be installed in or near areas where this product is being used or stored. If appropriate, install automatic monitoring equipment to detect the level of oxygen and the presence of potentially explosive air-gas mixtures. Use with adequate ventilation. Forced explosion-proof ventilation systems for the general work area should be provided to ensure Deuterated Silane does not approach its lower flammability limit of 1% or 5 ppm of Deuterated Silane (the TWA of Deuterated Silane). Deuterated Silane should not be vented into hoods or large volume venting systems, where the danger of explosion is high. Use small diameter vent piping ending in a shallow water seal to prevent back diffusion to air. Pure Deuterated Silane should be vented to an area designed for Deuterated Silane disposal (flare stack, pilot flame, etc.). Contact manufacturer for specific details. Do not vent pure Deuterated Silane to the outdoors. All ventilation equipment must be non-sparking and electrically grounded.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if oxygen level is below 19.5% or 5 ppm of Deuterated Silane (the TWA of Deuterated Silane), 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 EN166, and EC member states.

EYE PROTECTION: Use approved safety goggles or safety glasses, as described in OSHA 29 CFR 1910.133 or by the European Standard EN166. Eyewash stations should be available in areas where Deuterated Silane is used.

SKIN PROTECTION: Work (such as leather) gloves are recommended when handling cylinders of this gas. Wear gloves appropriate to the specific operation for which Deuterated Silane is used. Use triple gloves for spill response. Safety showers should be in areas where Deuterated Silane is used.

OTHER PROTECTIVE EQUIPMENT: Use body protection appropriate for task. Cotton or Nomex clothing is recommended to prevent static build-up. Safety shoes are recommended when handling cylinders. Transfer of large quantities under pressure may require fire-retardant clothing.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

MOLECULAR WEIGHT: 36.15

GAS DENSITY 0°C (32°F): 0.0899 lb/ft³ (1.44 kg/m³)

BOILING POINT @ 1 atm: -112°C (-169°F)

FREEZING/MELTING POINT @ 1 atm: -184.7°C (-300.5°F)

SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F): 1.2

SOLUBILITY IN WATER vol/vol at 20°C (68°F) and 1 atm: Negligible.

SPECIFIC VOLUME @ 21.1°C (70°F): 12.0 lb/ft³ (0.749 m³/kg)

CRITICAL PRESSURE: 703 psia (4842 kPa abs)

VAPOR PRESSURE @ -122°C (-187.6°F): 7.73 psig

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

ODOR THRESHOLD: Not determined.

APPEARANCE, ODOR AND STATE: Colorless, with a choking effect.

WARNING PROPERTIES FOR THIS GAS: This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide.

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Pyrophoric. Ignites spontaneously on exposure to air.

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

MATERIALS WITH WHICH GAS IS INCOMPATIBLE: Deuterated Silane will react violently with heavy-metal halides and free halogens (i.e. bromine, chlorine, carbonyl chloride, antimony pentachloride, tin[IV] chloride). Deuterated Silane ignites in oxygen and can react with other oxidizers. Deuterated Silane is also incompatible with bases.

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Amorphous silicon dioxide and hydrogen.

B) HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following are toxicology data for Silane.

Inhalation-Rat LC₅₀: 9600 ppm/4 hours

Inhalation-Mouse LCLo: 9600 ppm/4 hours

Mutation in microorganisms-Salmonella typhimurium: 1 pph

CARCINOGENICITY: Deuterated Silane has not been found to be carcinogenic.

SECTION 11. TOXICOLOGICAL INFORMATION (Continued)

IRRITANCY OF PRODUCT: The decomposition products of Deuterated Silane are irritating to the eyes, skin, and tissues of the respiratory system.

SENSITIZATION OF PRODUCT: Deuterated Silane is not a sensitizer.

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

Mutagenicity: Deuterated Silane has not been found to cause mutagenic effects in humans. Mutation data are available on microorganisms exposed to high levels of Silane.

Embryotoxicity: Deuterated Silane has not been found to cause embryotoxic effects in humans.

Teratogenicity: Deuterated Silane has not been found to cause teratogenic effects in humans.

Reproductive Toxicity: Deuterated Silane has not been found 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) are not applicable for Deuterated Silane.

SECTION 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Deuterated Silane ignites spontaneously upon contact with air, generating amorphous silicon dioxide and hydrogen. Deuterated Silane, upon contact with water or moisture, will generate silicic acid. All work practices must be directed at eliminating environmental contamination.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: The primary health hazard associated with Deuterated Silane is the potential for severe thermal burns to plants and animals from contact with flames which result from the spontaneous ignition of this gas. Depending on the severity of the burns, such exposures can be fatal.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Deuterated Silane, upon contact with water or moisture, will generate silicic acid. Silicic acid can lower the pH of water; subsequently, releases of Deuterated Silane can have an adverse effect on aquatic life in contaminated bodies of water.

MOBILITY: Deuterated Silane does not present a hazard of mobility.

PERSISTENCE AND BIODEGRADABILITY: Persistence: Deuterated Silane presents no hazard of persistence. Biodegradation: Deuterated Silane is fully biodegradable.

POTENTIAL TO BIOACCUMULATE: Deuterated Silane will not bioaccumulate.

OZONE-DEPLETION POTENTIAL: Deuterated Silane 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 residual product. Return residual 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: Residual product in user's system may be incinerated. This 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: Silane (Deuterated Silane)

HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)

UN IDENTIFICATION NUMBER: UN 2203

U.S. DOT SHIPPING LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)

PLACARD (When required): Flammable

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).

NAERG (NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK) #: 116

SECTION 14. TRANSPORT INFORMATION (Continued)

CANADIAN SHIPPING INFORMATION:

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as Dangerous Goods, per regulations of Transport Canada. The use of the above U.S. DOT information from the U.S. 49 CFR regulations is allowed for shipments that originate in the U.S. For shipments via ground vehicle or rail that originate in Canada, the following information is applicable.

U.S. DOT PROPER SHIPPING NAME: Silane (Deuterated Silane)
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 2203
PACKING GROUP: Not Applicable
HAZARD SHIPPING LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)
SPECIAL PROVISIONS: 38
EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX: 0.125
ERAP INDEX: 25
PASSENGER CARRYING SHIP INDEX: Forbidden
PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX: Forbidden

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: Silane (Deuterated Silane)
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 2203
HAZARD LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)

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		Forbidden	

NOTE A2: Under IATA regulations, Compressed Silane can only be shipped on passenger aircraft with the prior approval of appropriate authorities of the State of origin under the written conditions established by that authority. A copy of the document of approval, showing the quantity limitations and packing requirements, must accompany the consignment. The commodity may be carried on cargo aircraft in accordance with other provisions of IATA for the compound.

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):

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

PROPER SHIPPING NAME: Silane, compressed (Deuterated Silane)
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 2203
HAZARD LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)
SPECIAL PROVISIONS: None
LIMITED QUANTITIES: None
EmS: F-D, S-U

STOWAGE CATEGORY: Category E - Clear of living quarters. "Separated from" bromine and chlorine.

MARINE POLLUTANT: Silane 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:

UN NUMBER: 2203
NAME and DESCRIPTION: Silane (deuterated silane)
CLASS: 2
CLASSIFICATION CODE: 2F
PACKING GROUP: Not Applicable
LABELS: 2.1
SPECIAL PROVISIONS: 632
LIMITED QUANTITIES: LQ0
PACKING INSTRUCTIONS: P200
MIXED PACKING INSTRUCTIONS: MP9

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: Silane 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: No

PRESSURE: Yes

DELAYED HEALTH: No

REACTIVITY: No

FIRE: Yes

SECTION 15. REGULATORY INFORMATION (Continued)

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

Releases of Silane do not require reporting under Section 313.

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

Threshold Planning Quantity (TPQ): 10,000 lbs (4,553 kg)

TSCA: Toxic Substances Control Act

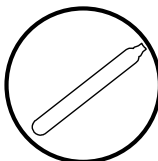
Silane is listed on the TSCA Inventory.

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:**29 CFR Part 1910.119:** Process Safety Management of Highly Hazardous Chemicals.

Threshold Planning Quantity (TPQ): 10,000 lbs (4,553 kg) [for all flammable gases, unless it is used as fuel]

U.S. STATE REGULATORY INFORMATION:**CALIFORNIA PROPOSITION 65:** Deuterated Silane is not a listed substance which the State of California requires warning under this statute.

Silane is listed by the following State regulations (more specific regulations exist in some States):

Alaska - Designated Toxic and Hazardous Substances: Silane.**California - Permissible Exposure Limits for Chemical Contaminants:** Silane.**Florida - Substance List:** Silane.**Illinois - Toxic Substance List:** Silane.**Kansas - Section 302/313 List:** No.**Massachusetts - Substance List:** Silane.**Michigan - Critical Materials Register:** No.**Minnesota - List of Hazardous Substances:** Silane.**Missouri - Employer Information/Toxic Substance List:** Silane.**New Jersey - Right to Know Hazardous Substance List:** Silane.**North Dakota - List of Hazardous Chemicals, Reportable Quantities:** No.**Pennsylvania - Hazardous Substance List:** Silane.**Rhode Island - Hazardous Substance List:** No.**Texas - Hazardous Substance List:** Silane.**West Virginia - Hazardous Substance List:** No.**Wisconsin - Toxic and Hazardous Substances:** No.**CANADIAN FEDERAL REGULATIONS:****CANADIAN DSL INVENTORY STATUS:** Silane is listed on the Canadian DSL Inventory.**OTHER CANADIAN REGULATIONS:** Deuterated Silane is categorized as a Controlled Product, Hazard Classes A, and B1 as per the Controlled Product Regulations. Deuterated Silane is not on the CEPA Priorities Substances Lists.**CANADIAN WHMIS SYMBOLS:****Class A:** Compressed Gas**Class B1:** Flammable Gas**EUROPEAN ECONOMIC COMMUNITY REGULATIONS:****EC LABELING AND CLASSIFICATION:** Silane meets the following definition of any hazard class, per the European Community Council Directive 67/548/EEC.**EC EINECS/ELINCS NUMBER:** 215-605-7.**EC CLASSIFICATION:** F+; (Extremely Flammable) Xi (Irritant)**EC RISK PHRASES:** Extremely flammable. [R:12] Irritating to eyes, respiratory system and skin. [36,37,38]**EC SAFETY PHRASES:** Keep container in well-ventilated place. Keep away from sources of ignition - No smoking. Take precautionary measures against static discharges. [S:9; S: 16; S: 33]**EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOL:** F+ (Extremely Flammable)

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), 4221 Wainey Road, 5th Floor, Chantilly, VA 20151-2923 Telephone: (703) 788-2700.

P-1 "Safe Handling of Compressed Gases in Containers"
 AV-1 "Safe Handling and Storage of Compressed Gases"
 G-5 "Silane"
 "Handbook of Compressed Gases"

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
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 619/670-0609

4/1/04 Revision: corrected UN# within IMO information, Sec. 14

4/12/04 Revision: updated emergency phone

DEFINITIONS OF TERMS

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

CAS #: This is the Chemical Abstract Service Number that uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

CEILING LEVEL: The concentration that shall not be exceeded during any part of the working exposure.

LOQ: Limit of Quantitation.

MAK: Federal Republic of Germany Maximum Concentration Values in the workplace.

NE: Not Established. When no exposure guidelines are established, an entry of NE is made for reference.

NIC: Notice of Intended Change.

NIOSH CEILING: The exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assumed as a 15-minute TWA exposure (unless otherwise specified) that shall not be exceeded at any time during a workday.

NIOSH RELs: NIOSH's Recommended Exposure Limits.

PEL-Permissible Exposure Limit: OSHA's Permissible Exposure Limits. 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 that was vacated by Court Order.

SKIN: Used when there is a danger of cutaneous absorption.

STEL-Short Term Exposure Limit: Short Term Exposure Limit, usually a 15-minute time-weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or REL-TWA.

TLV-Threshold Limit Value: An airborne concentration of a substance that 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.

TWA-Time Weighted Average: Time Weighted Average exposure concentration for a conventional 8-hr (TLV, PEL) or up to a 10-hr (REL) workday and a 40-hr workweek.

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.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

HAZARD RATINGS: This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):**HEALTH HAZARD:**

0 (Minimal Hazard): No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation:* Essentially non-irritating. PII or Draize = "0". *Eye Irritation:* Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. mechanical irritation]. Draize = "0". *Oral Toxicity LD₅₀ Rat* < 5000 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit* < 2000 mg/kg. *Inhalation Toxicity 4-hrs LC₅₀ Rat* < 20 mg/L.; **1 (Slight Hazard):** Minor reversible injury may occur; slightly or mildly irritating. *Skin Irritation:* Slightly or mildly irritating. *Eye Irritation:* Slightly or mildly irritating. *Oral Toxicity LD₅₀ Rat* > 500-5000 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit* > 1000-2000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat* > 2-20 mg/L.; **2 (Moderate Hazard):** Temporary or transitory injury may occur. *Skin Irritation:* Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation:* Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD₅₀ Rat* > 50-500 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit* > 200-1000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat* > 0.5-2 mg/L.; **3 (Serious Hazard):** Major injury likely unless prompt action is taken and medical treatment is given; high level of toxicity; corrosive. *Skin Irritation:* Severely irritating and/or corrosive; may destroy dermal tissue, cause skin burns, dermal necrosis. PII or Draize > 5-8 with destruction of tissue. *Eye Irritation:* Corrosive, irreversible destruction of ocular tissue; corneal involvement or irritation persisting for more than 21 days. Draize > 80 with effects irreversible in 21 days. *Oral Toxicity LD₅₀ Rat* > 1-50 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit* > 20-200 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat* > 0.05-0.5 mg/L.; **4 (Severe Hazard):** Life-threatening; major or permanent damage may result from single or repeated exposure. *Skin Irritation:* Not appropriate. Do not rate as a "4", based on skin irritation alone. *Eye Irritation:* Not appropriate. Do not rate as a "4", based on eye irritation alone. *Oral Toxicity LD₅₀ Rat* ≤ 1 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit* ≤ 20 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat* ≤ 0.05 mg/L).

FLAMMABILITY HAZARD:

0 (Minimal Hazard-Materials) that will not burn in air when exposure to a temperature of 815.5°C [1500°F] for a period of 5 minutes.; **1 (Slight Hazard-Materials)** that must be pre-heated before ignition can occur. Material require considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur, Including: Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3°C [200°F] (e.g. OSHA Class IIIB, or; Most ordinary combustible materials [e.g. wood, paper, etc.];

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

HAZARD RATINGS (continued):

FLAMMABILITY HAZARD (continued):

2 (Moderate Hazard-Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres in air, including: Liquids having a flash-point at or above 37.8°C [100°F]; Solid materials in the form of course dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp; Solids and semisolids that readily give off flammable vapors.); **3** (Serious Hazard- Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions, including: Liquids having a flash point below 22.8°C [73°F] and having a boiling point at or above 38°C [100°F] and below 37.8°C [100°F] [e.g. OSHA Class IB and IC]; Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air [e.g., dusts of combustible solids, mists or droplets of flammable liquids]; Materials that burn extremely rapidly, usually by reason of self-contained oxygen [e.g. dry nitrocellulose and many organic peroxides]); **4** (Severe Hazard-Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily, including: Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C [73°F] and a boiling point below 37.8°C [100°F] [e.g. OSHA Class IA; Material that ignites spontaneously when exposed to air at a temperature of 54.4°C [130°F] or below [e.g. pyrophoric]).

PHYSICAL HAZARD:

0 (*Water Reactivity*: Materials that do not react with water. *Organic Peroxides*: Materials that are normally stable, even under fire conditions and will not react with water. *Explosives*: Substances that are Non-Explosive. *Unstable Compressed Gases*: No Rating. *Pyrophorics*: No Rating. *Oxidizers*: No "0" rating allowed. *Unstable Reactives*: Substances that will not polymerize, decompose, condense or self-react.); **1** (*Water Reactivity*: Materials that change or decompose upon exposure to moisture. *Organic Peroxides*: Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy. *Explosives*: Division 1.5 & 1.6 substances that are very insensitive explosives or that do not have a mass explosion hazard. *Compressed Gases*: Pressure below OSHA definition. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group III; *Solids*: any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. *Liquids*: any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%)/cellulose mixture and the criteria for Packing Group I and II are not met. *Unstable Reactives*: Substances that may decompose, condense or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosive hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors.); **2** (*Water Reactivity*: Materials that may react violently with water. *Organic Peroxides*: Materials that, in themselves, are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water. *Explosives*: Division 1.4 – Explosive substances where the explosive effect are largely confined to the package and no projection of fragments of appreciable size or range are expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package. *Compressed Gases*: Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

HAZARD RATINGS (continued):

PHYSICAL HAZARD (continued):

2 (continued): *Oxidizers*: Packing Group II *Solids*: any material that, either in concentration tested, exhibits a mean burning time of less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met. *Liquids*: any material that exhibits a mean pressure rise time less than or equal to the pressure rise of a 1:1 aqueous sodium chlorate solution (40%)/cellulose mixture and the criteria for Packing Group I are not met. *Unstable Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure, but have a low potential for significant heat generation or explosion. Substances that readily form peroxides upon exposure to air or oxygen at room temperature); **3** (*Water Reactivity*: Materials that may form explosive reactions with water. *Organic Peroxides*: Materials that are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before initiation; or materials that react explosively with water. *Explosives*: Division 1.2 – Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. *Compressed Gases*: Pressure \geq 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packing Group I *Solids*: any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3.:2 potassium bromate/cellulose mixture. *Liquids*: Any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%)/cellulose mixture. *Unstable Reactives*: Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a moderate potential to cause significant heat generation or explosion.); **4** (*Water Reactivity*: Materials that react explosively with water without requiring heat or confinement. *Organic Peroxides*: Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. *Explosives*: Division 1.1 & 1.2-explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. *Compressed Gases*: No Rating. *Pyrophorics*: Add to the definition of Flammability "4". *Oxidizers*: No "4" rating. *Unstable Reactives*: Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a high potential to cause significant heat generation or explosion.)

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS:

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: 0 Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand. **1** Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air. **3** Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. **4** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily.

DEFINITIONS OF TERMS (Continued)

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):

INSTABILITY HAZARD: 0 Materials that in themselves are normally stable, even under fire conditions. **1** Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures. **2** Materials that readily undergo violent chemical change at elevated temperatures and pressures. **3** Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. **4** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures.

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:

Human and Animal Toxicology: 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. 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. **Cancer Information:** 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 Information:** **BEI** - ACGIH 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:

BCF = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter; **EC** is the Effect Concentration in water; **EC₅₀** is the Effect Concentration for 50% of the organisms exposed; **NOEC** is the No Observed Effect Concentration; **MATC** is the Maximum Acceptable Toxicant Concentration; **NOLC** is the No Observed Lethal Concentration; **TL_m** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:**U.S. and CANADA:**

ACGIH: American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **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)**. **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/NDSL**); 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. **OSHA** - U.S. Occupational Safety and Health Administration.

EUROPEAN: **EC** is the European Community (formerly known as the **EEC**, European Economic Community). **EINECS:** This 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.