# 1. PRODUCT IDENTIFICATION

**CHEMICAL NAME; CLASS:** Silane/Hydrogen Gas Mixture  
**CHEMICAL FAMILY:** Organic Hydrocarbon Mixture  
**PRODUCT USE:** Research Gas  
**MANUFACTURER**  
MATHESON TRI-GAS, INC.  
959 ROUTE 46 EAST  
PARSIPPANY, NJ 07054-0624  
USA  
Phone: 973/257-1100  
**EMERGENCY PHONE:**  
CHEMTREC (U.S. DOMESTIC): 1-800-424-9300  
CHEMTREC INTERNATIONAL: 1-703-527-3887  
CANUTEC (CANADA): 1-613-996-6666

# 2. COMPOSITION and INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>CHEMICAL NAME</th>
<th>CAS #</th>
<th>mole %</th>
<th>EXPOSURE LIMITS IN AIR</th>
<th>OTHER ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACGIH-TLV TWA ppm</td>
<td>OSHA-STEEL TWA ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ppm</td>
</tr>
<tr>
<td>Silane</td>
<td>7803-62-5</td>
<td>5%</td>
<td>5</td>
<td>NE</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>1333-74-0</td>
<td>Balance</td>
<td>There are no specific exposure limits for Hydrogen. Hydrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.</td>
<td></td>
</tr>
</tbody>
</table>

Note: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1998 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

See Section 16 for Definitions of Terms Used.
3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This is a colorless, highly-flammable gas mixture with an unpleasant odor, due to the presence of Silane. This gas mixture can form flammable mixtures in air and presents an extreme fire hazard when accidentally released. Releases of this mixture which have not ignited must be considered extremely dangerous, and should not be approached. In addition, releases of this gas mixture may produce oxygen-deficient atmospheres; individuals in such atmospheres may be asphyxiated. Flame or high temperature impinging on a localized area of the cylinder of this gas mixture can cause the cylinder to rupture or burst without activating the cylinder’s relief devices. In addition, due to the presence of Silane, this gas mixture may react with water to form corrosive silicic acid. Provide adequate fire protection during emergency response situations.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this product is by inhalation.

INHALATION: Inhalation of high concentrations of this gas can result in headache, nausea, dizziness, and irritation of the upper respiratory tract. The Silane component reacts with water to form silicic acid, which can be irritating to the mucous membranes and the respiratory system. Decomposition of 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. In addition, high concentrations of this gas mixture can cause an oxygen-deficient environment. It should be noted that before suffocation could occur, the lower flammability limit of the components in air would be exceeded; possibly causing an oxygen-deficient and explosive atmosphere. 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. The effects associated with various levels of oxygen are as follows:

<table>
<thead>
<tr>
<th>CONCENTRATION OF OXYGEN</th>
<th>OBSERVED EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-16% Oxygen:</td>
<td>Breathing and pulse rate increase, muscular coordination slightly disturbed.</td>
</tr>
<tr>
<td>10-14% Oxygen:</td>
<td>Emotional upset, abnormal fatigue, disturbed respiration.</td>
</tr>
<tr>
<td>6-10% Oxygen:</td>
<td>Nausea, vomiting, collapse, or loss of consciousness.</td>
</tr>
<tr>
<td>Below 6%:</td>
<td>Convulsive movements, possible respiratory collapse, and death.</td>
</tr>
</tbody>
</table>

CONTACT WITH SKIN or EYES: In the presence of water, contact of this gas mixture with the skin can cause irritation, due to the formation of silicic acid. Brief contact with the eyes can cause irritation. Contact of longer duration and concentration may cause injury to the eyes, due to the formation of silicic acid. Decomposition of the Silane component will result in the production of amorphous silicon dioxide. Skin or eye contact with particulates of amorphous silicon dioxide may be irritating. Contact with rapidly expanding gases (which are released under high pressure) may cause frostbite.

SKIN ABSORPTION: No component of this gas mixture presents a hazard of skin absorption.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: Over-exposure to this gas mixture may cause the following health effects:

ACUTE: The most significant hazard associated with this gas mixture is inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency include ringing in ears, headaches, shortness of breath, wheezing, dizziness, indigestion, and nausea. At high concentrations, unconsciousness or death may occur. In addition, overexposure to this gas mixture in the presence of moisture can cause irritation of the skin, eyes and respiratory system.

CHRONIC: There are currently no known adverse health effects associated with chronic exposure to this gas mixture.

TARGET ORGANS: ACUTE: Respiratory system. CHRONIC: None.

HMIS RATING: HEALTH = 1 FLAMMABILITY = 4 REACTIVITY = 1 PPE LEVEL = B
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe  PPE LEVEL B = Goggles, gloves (leather for handling cylinders)
4. FIRST-AID MEASURES

GENERAL INFORMATION: Remove to fresh air, as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Seek medical attention immediately.

THERMAL BURNS: In the event personnel are burned as a result of a Silane 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.

SKIN EXPOSURE: If silicic acid (from the reaction of 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 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.

EYE EXPOSURE: 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.

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

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable for a flammable gas.

AUTOIGNITION TEMPERATURE: Not determined for mixture.

For Hydrogen: 500-571°C (932-1059.8°F)
For Silane: Pyrophoric.

FLAMMABLE LIMITS (in air by volume, %): Not determined for mixture. The following are available for components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Lower (LEL)</th>
<th>Upper (UEL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silane</td>
<td>1.4%</td>
<td>96.0%</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>4.0%</td>
<td>75.0%</td>
</tr>
</tbody>
</table>

FIRE EXTINGUISHING MATERIALS: Extinguish fires of this gas mixture by shutting-off the source of gas. Use water spray to cool fire-exposed structures and equipment.

UNUSUAL FIRE AND EXPLOSION HAZARD: DANGER! This gas is extremely flammable and readily forms explosive mixtures with air over a very wide range. If released into a confined space, an extreme fire hazard exists.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

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

SPECIAL FIRE-FIGHTING PROCEDURES: Evacuate all personnel from danger area. Immediately cool cylinders with water spray from maximum distance, taking care to NOT extinguish flames if source of gas has not been stopped. Stop the leak and flow of gas before extinguishing fire. If release is still occurring, explosive re-ignition may occur. In event that fire is extinguished before the leak is stopped, attempt to increase ventilation to area to prevent formation of explosive air/gas mixtures. Incipient fire responders should wear eye protection. Structural fire fighters must wear Self-Contained Breathing Apparatus and full protective equipment. When cool, move cylinders from fire area if this can be done without risk to firefighters. Other information for pre-planning can be found in the American Petroleum Institute Publications 2510 and 1510A, and the North American Emergency Response Guidebook (Guide Number 115). Releases of this mixture which have not ignited must be considered extremely dangerous, and should not be approached.
6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Evacuate immediate area. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Eliminate any possible source of ignition and provide maximum explosion-proof ventilation. Proper protective equipment, including fire protection, should be used in the event of a significant release from a single cylinder. Use only non-sparking tools. Call CHEMTREC (1-800-424-9300) for emergency assistance. Or if in Canada, call CANUTEC (613-996-6666).

Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there. Protect personnel attempting to shut-off with water spray. Monitor the surrounding area for combustible gas levels and the level of Oxygen. The atmosphere must have not more than 10% of the LEL of each component gas (see Section 5, Fire-Fighting Measures) and at least 19.5 percent Oxygen before non-emergency personnel can be allowed in the area without Self-Contained Breathing Apparatus and fire protection.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES

Do not eat or drink while handling chemicals. Be aware of all potential exposure symptoms; exposures to a fatal oxygen-deficient atmosphere could occur without any significant warning symptoms.

All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release.

Workers who handle this gas mixture should wear protective clothing, as listed in Section 8 (Exposure Controls and Personal Protection).

If ventilation controls are not adequate to provide sufficient oxygen content, proper respiratory protection equipment should be provided and workers using such equipment should be carefully trained in its operation and limitations.

Precautions must always be taken to prevent suck-back of foreign materials into the cylinder by using a check-valve, or vacuum break, since suck-back may cause dangerous pressure changes within the cylinder.

STORAGE AND HANDLING PRACTICES:

WARNING: Extreme caution should be used with mixtures containing Silane which as been stored for extended periods. There is some evidence that long-term storage of Silane mixtures will increase the cylinder pressure over time, due to the auto-decomposition. Full containers of Silane mixtures stored for long periods of time should be approached and handled with extreme caution and appropriate personal protective equipment. Cylinder pressure and general cylinder condition should be monitored by trained personnel, if Silane is to be kept in long-term storage.

Cylinders should be stored upright and be firmly secured to prevent falling or being knocked-over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Cylinders should be stored in dry, well-ventilated areas away from sources of heat or ignition. Do not allow the area where cylinders are stored to exceed 52°C (125°F).

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). Storage areas must meet National Electrical Codes for Class 1 Hazardous Areas. Post “No Smoking or Open Flames” signs in storage or use areas. Consider leak detection and alarm for storage and use areas. Have appropriate extinguishing equipment in storage area (i.e. sprinkler system, portable fire extinguishers).
7. HANDLING and USE (Continued)

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Compressed gases can present significant safety hazards. The following rules are applicable to work situations in which cylinders are being used.

**Before Use:** Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap (where provided) in-place until cylinder is ready for use.

**During Use:** Use designated CGA fittings and other support equipment. Do not use adapters. Do not use oils or grease on gas-handling fittings or equipment. Immediately contact the supplier if there are any difficulties associated with operating the cylinder valve. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage the valve, causing a leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Never strike an arc, on a compressed gas cylinder or make a cylinder part of and electric circuit.

**After Use:** Close main cylinder valve. Replace valve protection cap. Close valve after each use and when empty. Mark empty cylinders "EMPTY".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Refer to current CGA Guidelines for information on protective practices during maintenance of contaminated equipment.

---

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate, explosion-proof ventilation to ensure compliance with exposure limits described in Section 2 (Composition and Information on Ingredients). Local exhaust ventilation is preferred, because it prevents dispersion of this gas mixture into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the level of Oxygen and the presence of potentially explosive air-gas mixtures.

RESPIRATORY PROTECTION: Maintain the Oxygen level above 19.5% in the workplace. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards and Canadian CSA Standard Z94.4-93. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998).

EYE PROTECTION: Splash goggles or safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133, or appropriate Canadian Standards.


BODY PROTECTION: Use body protection appropriate for task. Cotton clothing is recommended for use to prevent static electric build-up. Transfer of large quantities under pressure may require protective equipment appropriate to the task. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee’s feet may be exposed to electrical hazards, foot protection should be used, as described in U.S. OSHA 29 CFR 1910.136. Transfer of large quantities under pressure may require use of fire retardant clothing.

---

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for Hydrogen, the main component of this gas mixture:

- **GAS DENSITY:** 0.00521 lb/cu ft (0.08342 kg/m³)
- **SPECIFIC GRAVITY (air = 1):** 0.06860
- **SOLUBILITY IN WATER:** 0.019
- **EXPANSION RATIO:** Not applicable.
- **ODOR THRESHOLD:** Not applicable.
- **VAPOUR PRESSURE (psia):** Not applicable.
- **COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.
- **EVAPORATION RATE (nBuAc = 1):** Not applicable.
- **FREEZING POINT:** -259.2°C (-434.5°F)
- **BOILING POINT(@ 1 atmos.):** -252.8°C (-423.9°F)
- **SPECIFIC VOLUME (ft³/lb):** 192.0
- **MOLECULAR WEIGHT:** 2.016
9. PHYSICAL and CHEMICAL PROPERTIES

The following information is pertinent to this product:

**APPEARANCE, ODOR AND COLOR:** This gas mixture is colorless, with an unpleasant odor.

**HOW TO DETECT THIS SUBSTANCE (warning properties):** There are no distinct warning properties of this gas mixture. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

**STABILITY:** Stable at standard temperatures and pressures. The Silane component may also slowly decompose (releasing hydrogen) while stored in cylinders.

**DECOMPOSITION PRODUCTS:** When ignited in presence of oxygen, this gas mixture will burn, producing carbon monoxide, carbon dioxide and amorphous silicon dioxide. In contact with water the Silane component will produce silicic acid.

**MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE:** The Silane present in this mixture will react violently with heavy-metal halides and free halogens (i.e. bromine, chlorine, carbonyl chloride, antimony pentachloride, tin [IV] chloride). Silane ignites in oxygen and can react with other oxidizers. Silane is also incompatible with bases. The Hydrogen component is incompatible with strong oxidizers, halogen compounds (e.g. bromine, chlorine, fluorine), lithium, nitrogen trifluoride, oxygen difluoride. Finely divided platinum and some other metals will cause hydrogen to react explosively with oxygen in air.

**HAZARDOUS POLYMERIZATION:** Will not occur.

**CONDITIONS TO AVOID:** Due to the high hazard of Silane reaction with air, this mixture should be protected from exposure to air. Contact with incompatible material, heat, spark or flame. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

**TOXICITY DATA:** Hydrogen is a simple asphyxiant (SA), which acts to displace oxygen in the environment. No toxicity data are applicable. Currently the following toxicity data are toxicological data available for Silane.

- Inhalation-Rat LC50: 9600 ppm/4 hours
- Inhalation-Mouse LCLo: 9600 ppm/4 hours
- Mutation in microorganisms-Salmonella typhimurium: 1 pph

**SUSPECTED CANCER AGENT:** The components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, IARC, NTP, CAL/OSHA, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

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

**SENSITIZATION TO THE PRODUCT:** The components of this product are not known to be skin or respiratory sensitizers.

**REPRODUCTIVE TOXICITY INFORMATION:** Listed below is information concerning the effects of the components of this gas mixture on the human reproductive system.

- **Mutagenicity:** This gas mixture is not expected to cause mutagenic effects in humans.
- **Embryotoxicity:** This gas mixture is not expected to cause embryotoxic effects in humans.
- **Teratogenicity:** This gas mixture is not expected to cause teratogenic effects in humans.
- **Reproductive Toxicity:** This gas mixture is not expected to cause adverse reproductive effects in humans.

**BIOLOGICAL EXPOSURE INDICES (BEIs):** Currently, there are no Biological Exposure Indices (BEIs) determined for the components of this gas mixture.
12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas mixture will be dissipated rapidly in well-ventilated areas.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen deficient environments.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No adverse effect from this gas mixture on aquatic life is expected.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to Matheson Tri-Gas. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS GAS MIXTURE IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Compressed gases, flammable, n.o.s. (Hydrogen, Silane)

HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1954
PACKING GROUP: Not applicable.
D.O.T HAZARD LABEL: Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 115
MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as a Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles present serious safety hazards and should be discouraged.

NOTE: Shipment of compressed gas cylinders which have not been filled with the owner’s consent is a violation of Federal law (49 CFR, Part 173.301 (b).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas mixture is considered as dangerous goods, per regulations of Transport Canada.

PROPER SHIPPING NAME: Compressed gases, flammable, n.o.s. (Hydrogen, Silane)

HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1954
PACKING GROUP: Not applicable.
HAZARD LABEL: Flammable Gas
SPECIAL PROVISIONS: 102
BULK TRANSPORTATION: Revoked [SOR/95-547]
LIMITED QUANTITY: Prohibited
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 115
NOTE: Shipment of compressed gas cylinders via Public Passenger Road Vehicle is a violation of Canadian law (Transport Canada Transportation of Dangerous Goods Act, 1992).
15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: No component of this product is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for the components of this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lbs (4,540 kg) therefore applies, per 40 CFR 370.20.

U.S. SARA HAZARD CATEGORIES (SECTION 311/312, 40 CFR 370-21): ACUTE: Yes; CHRONIC: No; FIRE: Yes; REACTIVE: No; SUDDEN RELEASE: Yes

U.S. TSCA INVENTORY STATUS: Components of this product are listed on the TSCA Inventory.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

OTHER U.S. FEDERAL REGULATIONS: Silane and Hydrogen are subject to the reporting requirements of Section 112(r) of the Clean Air Act. The threshold quantity for each of these gases is 10,000 lbs (4,540 kg). Both Hydrogen and Silane are listed as Regulated Substances in quantities of 10,000 lbs (4,540 kg) or greater, per 40 CFR, Part 68 of the Risk Management for Chemical Accidental Release. Any process that involves a flammable gas on-site, in one location, in quantities of 10,000 lbs (4,540 kg) or greater has requirements under the Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119), unless the gas is used as a fuel.

U.S. STATE REGULATORY INFORMATION: Components of this product are covered under some specific State regulations, as denoted below (other State regulatory lists may exist; individual States should be contacted regarding full compliance).

California - Permissible Exposure Limits for Chemical Contaminants: Silane, Hydrogen.
New Jersey - Right to Know Hazardous Substance List: Silane, Hydrogen.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this product is on the California Proposition 65 lists.

LABELING: Cylinders of this gas mixture should be labeled for precautionary information per the guidelines of the CGA. Refer to the CGA for further information.

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: The components of this product are listed on the DSL Inventory.

OTHER CANADIAN REGULATIONS: Not applicable.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: The components of this product are not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS SYMBOLS: This gas mixture would be categorized as a Controlled Product, Hazard Classes: A (compressed gas) and F (flammable). The following symbol is required for WHMIS compliance for this gas mixture.
16. OTHER INFORMATION

CREATION DATE: August 31, 2001
REVISION DATE: April 11, 2002
REVISION HISTORY: Up-date of manufacturer address and phone.

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you use the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information 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.

“Safe Handling of Compressed Gases in Containers” (P-1, 1999)
“Safe Handling and Storage of Compressed Gases” (AV-1, 1999)
“Handbook of Compressed Gases” (1992)

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA  91944-3519
800/441-3365

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, 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. 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: 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. 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). PPE Rating B: Hand and eye protection is required for routine chemical use.

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”.

SILANE, HYDROGEN GAS MIXTURE MSDS
PAGE 9 OF 10
EFFECTIVE DATE: APRIL 11, 2002
MATH0039
DEFINITIONS OF TERMS

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 select 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, LDₒ, and LCₒ, or TC, TCo, LCo, 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.

TOXICOLOGICAL INFORMATION (continued):
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: EC is the effect concentration in water. BCF = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. TLₐₘ = median threshold limit; Coefficient of Oil/Water Distribution is represented by log Kₒₜ or log Kₒₐ and is used to assess a substance’s behavior in the environment.

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/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.