



MATERIAL SAFETY DATA SHEET

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

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: < 1% METHYL BROMIDE, Balance Hydrogen
CHEMICAL NAME: Mixture of Methyl Bromide (< 1%), Hydrogen (Balance)
FORMULA: Methyl Bromide = CH₃Br; Hydrogen = H₂
SYNONYMS: Not Applicable

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DATE OF PREPARATION: December 9, 2002
MSDS NUMBER: 1160
PRODUCT USE: Lighting applications, research and development.

SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

COMPOSITION: Methyl Bromide (< 1%), Hydrogen (Balance)
CAS NUMBER: Methyl Bromide 74-83-9; Hydrogen = 1333-74-0
EINECS NUMBER: Methyl Bromide 200-813-2; Hydrogen = 215-605-7
EXPOSURE LIMITS: (10,000 ppm = 1%)

	OSHA PELs:	ACGIH TLVs:	NIOSH RELs:
Methyl Bromide:			
TWA = 5 ppm [skin] (vacated 1989 PEL)		TWA = 1 ppm (skin)	LFC, LOQ = 4.7 ppm
STEL = 20 (ceiling)			IDLH = 250 ppm, Ca
Hydrogen:			
There are no exposure limits for Hydrogen, Hydrogen is a simple asphyxiant.			

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This gas is a colorless, flammable, gas, shipped under pressure, with a chloroform-like odor. This gas mixture may cause significant, adverse health effects because of the Methyl Bromide content, which can reach exposure limits at the level present in the mixture. Due to presence of Methyl Bromide, releases of this product should be responded to with caution. The odor of Methyl Bromide exceeds its TLV; the odor is not a good warning of a release. This gas mixture poses a serious fire hazard when it is accidentally released. Flame or high temperature impinging on a localized area of the cylinder of this product can cause the cylinder to burst or rupture without activating the cylinder's relief devices. The gas is lighter than air, and may spread long distances or accumulate near ceiling. Distant ignition and flashback are possible. Provide adequate fire protection and respiratory protection during emergency response situations Persons responding to releases of this gas mixture 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 Methyl Bromide (a component of this gas mixture), they should be equipped with Self-Contained Breathing Apparatus (SCBA), and appropriate body protection for Methyl Bromide exposure. Acute overexposure to this gas mixture may cause the following health effects:

EYE CONTACT: Minor contact with this gas will cause tearing and irritation including swelling and redness, due to the presence of Methyl Bromide. Prolonged exposure to the eyes has the potential to cause burns, or possibly blindness, if contact is prolonged. Release of a high-pressure gas may result in airborne objects.

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

SECTION 3. HAZARD IDENTIFICATION (Continued)

ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE (continued):

INHALATION: This gas mixture can cause significant, adverse effects, due to the presence of Methyl Bromide, which is toxic and corrosive. Minor inhalation exposure of this gas mixture may cause irritation to the lungs, nose, throat and mucous membranes, resulting in coughing and breathing difficulty. Methyl Bromide is a central nervous system depressant. Prolonged inhalation of this gas mixture may cause headache, dizziness, abdominal pain, nausea, vomiting, chest pain, difficulty breathing, visual disturbances (blurred or double vision, transient blindness), muscular pain and numbness. In the event of prolonged inhalation overexposures, there is the potential for tissue damage. Symptoms of overexposure can be delayed for 1 to 48 hours. Severe overexposure by inhalation to this mixture may cause tremors, convulsions, permanent brain damage, liver and kidney damage, and pulmonary edema (an accumulation of fluid in the lungs), a potentially fatal condition.

High concentrations of this gas can cause an oxygen-deficient environment (it should be noted that before suffocation can occur, the lower flammability limit of Hydrogen will be reached). 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.

SKIN CONTACT: Depending on the concentration and duration of overexposure, skin contact may lead to severe burns or dermatitis (red, cracked, irritated skin). The Methyl Bromide component of this gas mixture can be absorbed via intact skin. Prolonged skin contact may cause symptoms described under "Inhalation".

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. There are animal data suggesting that the Methyl Bromide is a suspect mutagen.

HMIS RATINGS: HEALTH HAZARD: = 2; FLAMMABILITY HAZARD: = 4; PHYSICAL HAZARD: = 0;
PPE: Level X (see Section 8, Exposure Controls/Personal protective Equipment)

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Inhalation, Skin Absorption

TARGET ORGANS: Respiratory System, Eyes, Skin, Central Nervous System, Brain, Liver, Kidneys

SYMPTOMS: Dermatitis, skin burns or lesions may result from repeated skin contact with this gas mixture. Repeated overexposures by inhalation may result in erosion of tooth enamel. Repeated over-exposure to a mixture that contains Methyl Bromide can result in emphysema. Chronic inhalation exposure to mixtures containing Methyl Bromide may cause injury to the central nervous system. Symptoms may include lethargy, muscular pains, visual, speech and sensory disturbances, and mental confusion. In the most serious cases, symptoms can also include tremors, hallucinations, fainting spells and seizures. Chronic inhalation exposure may also cause damage to kidneys, liver and permanent brain damage.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Pre-existing dermatitis, other skin conditions, respiratory disorders or disorders of the liver, brain and kidneys may be aggravated by over-exposure to this gas mixture.

CARCINOGENICITY: The Methyl Bromide component of this product is listed by agencies that track the carcinogenic potential of chemical compounds, as follows: EPA-D, IARC-3, MAK-3B, NIOSH-Ca, ACGIH TLV-A4. The remaining components of this gas mixture are not found on the IARC, FEDERAL OSHA Z LIST, NTP, CAL/OSHA, or Carcinogenicity lists and therefore are neither considered to be nor suspected to be cancer-causing agents by these agencies.

SECTION 4. FIRST AID MEASURES

THERMAL BURNS: In the event personnel are burned as a result of a release of this gas mixture, 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 this gas mixture 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.

SECTION 4. FIRST AID MEASURES (Continued)

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 that develop after exposure, victim must seek appropriate medical attention.

SKIN CONTACT: If this gas mixture 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

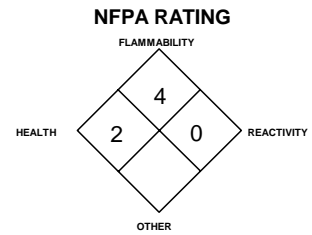
FLASH POINT: Flammable gas.

AUTOIGNITION: For Hydrogen: 565.5°C (1050°F)

FLAMMABLE RANGE: For Hydrogen: Lower (LEL): 4.0%; Upper (UEL): 75.0%

NFPA RATINGS:

HEALTH: = 2 FLAMMABILITY: = 4
REACTIVITY: = 0 SPECIAL: None



See Section 16 for Definition of Ratings

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

SPECIAL FIRE-FIGHTING PROCEDURES: The best fire-fighting technique may be simply to let the burning gas escape from the cylinder or pipeline. Stop the leak before extinguishing fire. If the fire is extinguished before the leak is sealed, the still-leaking gas could explosively re-ignite without warning and cause extensive damage, injury, or fatality. Consider increasing ventilation to prevent flammable or explosive mixture formation. An extreme explosion hazard exists in areas in which the gas has been released, but the material has not yet ignited.

UNUSUAL FIRE AND EXPLOSION HAZARDS: An extreme explosion hazard exists in areas in which the gas has been released, but the material has not yet ignited. **Hydrogen burns with an almost invisible blue flame.**

DANGER! Fires impinging (direct flame) on the outside surface of unprotected cylinders of Hydrogen 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 resulting fire and explosion 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. Due to low electrical conductivity, this substance can generate electrostatic charges during handling operations.

HAZARDOUS COMBUSTION PRODUCTS: The Hydrogen in this mixture will not decompose in fire to produce toxic compounds. Methyl Bromide will decompose into bromides and hydrogen bromide.

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 (ID #1048, Guide # 125) recommends 200 feet initial isolation from release for pure Methyl Bromide. All releases of this gas pose a very serious hazard of fire. If any possibility of fire is suspected, personnel entering the area of a release should be fire-response personnel who are trained and equipped appropriately in the response to fires of flammable gases. 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.

Only trained personnel should re-enter a contaminated area. Combustible gas concentration must be below 10% of the LEL (0.4%) prior to entry and the level of Methyl Bromide should be below the TLV. Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves and Self-Contained Breathing Apparatus.** Use only non-sparking tools and equipment. If it is not possible to close the source cylinder or otherwise stop the release, allow the gas to release in-place or remove it to a safe area, away from sources of ignition, and allow the gas to be released there. Allow the gas, which is lighter than air, to dissipate. Monitor the surrounding area for combustible gas levels. Although the hazard due to combustible gas level is the greatest hazard due to the great potential for fire, monitoring of oxygen level should also be considered to prevent an oxygen-deficient atmosphere.

SECTION 6. ACCIDENTAL RELEASE MEASURES (Continued)

TRAINED RESPONSE TEAM: Personal Protective Equipment should include appropriate body protection for Methyl Bromide exposure, gloves, and Self-Contained Breathing Apparatus (SCBA). 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. Allow the gas, which is lighter than air, to dissipate. Any supplemental ventilation should be explosion-proof equipment.

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. Do not flush contaminated water down the sewer systems. 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.

THIS IS AN EXTREMELY FLAMMABLE AND A POTENTIALLY HARMFUL, CORROSIVE GAS. Protection of all personnel and the area must be maintained. All responders must be adequately protected from exposure. Detection systems should be available to monitor for combustible gas levels and for the level of Methyl Bromide.

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. Storage and use areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs. Consider installation of leak detection and alarm for storage and use areas. 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). **NOTE:** This gas is lighter than air and must not be allowed to accumulate in elevated locations. 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. Store away from incompatible materials, such as aluminum, dimethyl sulfoxide, mineral acids, strong oxidizing agents (e.g. organic peroxides), caustics, nitrides, alkali or alkaline earth metals (e.g. magnesium), strong reducing agents (e.g. hydrazines), azo and diazo compounds, amines and metals. Contact with these materials can result in violent reactions.

HANDLING: This mixture can be dangerous and should only be handled by trained personnel. Wearing contact lenses is not recommended when handling this gas mixture. Spectra Gases, Inc., strongly recommends that this gas mixture only be handled in areas with extensive venting capabilities, preferably a gas handling cabinet. Eye wash stations/safety showers should be considered for 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 mixture is used. Detection of Methyl Bromide 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. 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. Consideration should be made on the use of a flash arrestor on cylinders containing this gas mix due to its extreme flammability. 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 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. (continued on following page)

SECTION 7. HANDLING AND STORAGE (Continued)

HANDLING (continued): 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 explosion-proof ventilation systems for the general work area should be provided to ensure Hydrogen does not reach its lower flammability limit of 4.0%. If appropriate, install automatic monitoring equipment to detect the level of flammable gas. Spectra Gases, Inc. recommends that cylinders in use be secured within a ventilated enclosure such as a gas cabinet. 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 Methyl Bromide below the levels listed in Section 2 (Composition / Information on Ingredients). Use supplied air respiratory protection if Methyl Bromide 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. The following guidelines, based NIOSH respiratory protection recommendations, are for Methyl Bromide.

CONCENTRATION RESPIRATORY EQUIPMENT of METHYL BROMIDE

At Concentrations Above the NIOSH REL, Or Where There is no REL, At Any Detectable Concentration:
Any Self-Contained Breathing Apparatus (SCBA) that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or any Supplied-Air Respirator (SAR) that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA 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 organic vapor canister, or any appropriate escape-type, SCBA.
The IDLH concentration for Methyl Bromide is 250 ppm.

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 gloves (such as leather) are recommended when handling cylinders of this gas. Wear Neoprene Rubber gloves for industrial use. Do NOT use very thin natural rubber, neoprene, nitrile and PVC gloves (0.3 mm or less). Polyethylene, polyvinyl chloride gloves are not recommended due to the presence of Methyl Bromide and the potential for breakthrough. Methyl Bromide is a recognized skin absorption hazard (ACGIH or OSHA). Use appropriate gloves for spill response. If necessary, refer to U.S. OSHA 29 CFR 1910.138, and appropriate Standards of the EC and Canada for further information.

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. Steel-toe safety shoes are recommended when handling cylinders. 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, use foot protection, as described in U.S. OSHA 29 CFR 1910.136.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

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

MOLECULAR WEIGHT: 4.032

GAS DENSITY @ 21.1°C (70°F): 0.00521 lb/ft³ (0.08342 kg/m³)

BOILING POINT @ 1 atm: -253.0°C (-423.0°F)

FREEZING/MELTING POINT @ 1 atm: -259°C (-434.6°F)

SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F): 0.069

SOLUBILITY IN WATER vol/vol at 20°C (68°F) and 1 atm: 0.019

SPECIFIC VOLUME @ 21.1°C (70°F): 190.8 lb/ft³ (11.99 m³/kg)

CRITICAL PRESSURE: 190.8 psia (1315 kPa abs)

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

ODOR THRESHOLD: Hydrogen is odorless.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES (Continued)

The following information is for Methyl Bromide, the toxic, corrosive component of this mixture:

- MOLECULAR WEIGHT:** 99.944
- GAS DENSITY @ 25°C (77°F) and 1 atm:** 0.248 lb/ft³ (3.974 kg/m³)
- BOILING POINT @ 1 atm:** 3.56°C (38.4°F)
- FREEZING/MELTING POINT @ 1 atm:** -94°C (-137.2°F)
- SPECIFIC GRAVITY (air = 1) @ 25°C (77°F):** 3.355
- SOLUBILITY IN WATER:** 1.75/100 lb
- SPECIFIC VOLUME @ 25°C (77°F):** 4.031 lb/ft³ (0.252 m³/kg)
- CRITICAL PRESSURE:** 757.1 psia (5220 kPa abs)
- VAPOR PRESSURE @ 70°C (21.1°F):** 27.5 psig (189.6 kPa)
- ODOR THRESHOLD:** 17-2000 ppm
- COEFFICIENT WATER/OIL DISTRIBUTION:** 1.19

Information for gas mixture:

- APPEARANCE, ODOR AND STATE:** Colorless, gas with a chloroform-like odor.
- WARNING PROPERTIES FOR THIS GAS MIXTURE:** The odor of this gas mixture is not a reliable warning property in event of a release as the odor threshold of the Methyl Bromide component is above the TLV for this gas.

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Hydrogen is a simple asphyxiant and stable. Methyl Bromide is stable under normal conditions of temperature and pressure.

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

MATERIALS WITH WHICH GAS MIXTURE IS INCOMPATIBLE: Hydrogen is incompatible with strong oxidizer such as chlorine, bromine, pentafluoride, oxygen, oxygen difluoride and nitrogen trifluoride. Hydrogen/Oxygen mixtures can explode on contact with a catalyst such as platinum. Due to the presence of Methyl Bromide, do not use with incompatible materials, such as aluminum, dimethyl sulfoxide, mineral acids, strong oxidizing agents (e.g. organic peroxides), caustics, nitrides, alkali or alkaline earth metals (e.g. magnesium), strong reducing agents (e.g. hydrazines), azo and diazo compounds, amines and metals. All these can favor violent reactions. The Methyl Bromide component is incompatible with dimethyl sulfoxide.

REACTIVITY:

- A) HAZARDOUS DECOMPOSITION PRODUCTS:** The Methyl Bromide component can thermally decompose to form bromides and hydrogen bromide.
- B) HAZARDOUS POLYMERIZATION:** Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: There are no toxicology data for Hydrogen. Hydrogen is an asphyxiant because it can displace oxygen in the environment needed for breathing. The following toxicological data are available for Methyl Bromide.

METHYL BROMIDE:

- DOT LC₅₀ (inhalation) 1007
- LCLo (Inhalation-Man) 60,000 ppm/2 hours: Behavioral: convulsions or effect on seizure threshold; Lungs, Thorax, or Respiration: respiratory stimulation; Gastrointestinal: nausea or vomiting
- LCLo (Inhalation-Child) 1 gm/m³/2 hours: Blood: change in clotting factors
- TCLo (Inhalation-Human) 35 ppm: Behavioral: anorexia (human); Gastrointestinal: nausea or vomiting; Skin and Appendages: corrosive (after topical exposure)
- TDLo (Skin-Human) 35 gm/m³/40 minutes-Intermittent: Skin and Appendages: dermatitis, irritative (after systemic exposure)
- LD₅₀ (Oral-Rat) 214 mg/kg
- LD₅₀ (Subcutaneous-Rat) 135 mg/kg
- LC₅₀ (Inhalation-Rat) 302 ppm/8 hours: Behavioral: changes in motor activity (specific assay); Nutritional and Gross Metabolic: weight loss or decreased weight gain, body temperature decrease

METHYL BROMIDE (continued):

- LC₅₀ (Inhalation-Mouse) 1540 mg/m³/2 hours
- LC₅₀ (Inhalation-Rabbit) 28,900 mg/m³/30 minutes
- LDLo (Oral-Dog) 500 mg/kg: Cardiac: pulse rate increase, without fall in BP; Gastrointestinal: nausea or vomiting; Nutritional and Gross Metabolic: body temperature decrease
- LCLo (Inhalation-Guinea Pig) 300 ppm/9 hours: Behavioral: muscle weakness; Lungs, Thorax, or Respiration: fibrosis, focal (pneumoconiosis); Skin and Appendages: hair
- TCLo (Inhalation-Rat) 120 ppm/6 hours/13 weeks-intermittent: Blood: pigmented or nucleated red blood cells; Blood: changes in erythrocyte (RBC) count; Nutritional and Gross Metabolic: weight loss or decreased weight gain
- TCLo (Inhalation-Rat) 150 ppm/6 hours/5 days-intermittent: Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other transferases; Metabolism (Intermediary): amino acids (including renal excretion)

METHYL BROMIDE (continued):

- TCLo (Inhalation-Rat) 160 ppm/6 hours/6 weeks-intermittent: Brain and Coverings: other degenerative changes; Sense Organs and Special Senses (Olfaction): effect, not otherwise specified; Cardiac: other changes
- TCLo (Inhalation-Rat) 300 ppm/4 hours/3 weeks-intermittent: Behavioral: somnolence (general depressed activity), ataxia; Related to Chronic Data: death
- TCLo (Inhalation-Rat) 30 ppm/6 hours/2.5 years-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Sense Organs and Special Senses (Olfaction): tumors
- TCLo (Inhalation-Mouse) 200 ppm/6 hours/14 days-intermittent: Related to Chronic Data: death
- TCLo (Inhalation-Mouse) 120 ppm/6 hours/13 weeks-intermittent: Behavioral: muscle contraction or spasticity; Nutritional and Gross Metabolic: weight loss or decreased weight gain; Related to Chronic Data: death
- TCLo (Inhalation-Mouse) 160 ppm/6 hours/6 weeks-intermittent: Kidney, Ureter, Bladder: changes in tubules (including acute renal failure, acute tubular necrosis); Endocrine: other changes; Blood: changes in spleen

SECTION 11. TOXICOLOGICAL INFORMATION (Continued)

TOXICITY DATA (continued):

METHYL BROMIDE (continued):

TCLo (Inhalation-Monkey) 250 mg/m³/8 hours/26 weeks-intermittent: Peripheral Nerve and Sensation: spastic paralysis with or without sensory change; Behavioral: convulsions or effect on seizure threshold

TCLo (Inhalation-Rabbit) 130 mg/m³/8 hours/26 weeks-intermittent: Peripheral Nerve and Sensation: spastic paralysis with or without sensory change; Lungs, Thorax, or Respiration: fibrosis, focal (pneumoconiosis); Related to Chronic Data: death

TCLo (Inhalation-Guinea Pig) 850 mg/m³/8 hours/26 weeks-intermittent: Peripheral Nerve and Sensation: spastic paralysis with or without sensory change; Lungs, Thorax, or Respiration: chronic pulmonary edema, dyspnea

TDLo (Oral-Rat) 21,840 mg/kg/2 years-continuous: Kidney, Ureter, Bladder: other changes in urine composition; Skin and Appendages: hair; Nutritional and Gross Metabolic: weight loss or decreased weight gain

METHYL BROMIDE (continued):

TDLo (Oral-Rat) 3250 mg/kg/13 weeks-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Gastrointestinal: peritonitis, tumors

TDLo (Oral-Rat) 300 mg/kg: female 6-15 day(s) after conception: Reproductive: Maternal Effects: other effects

TDLo (Oral-Rabbit) 130 mg/kg: female 6-18 day(s) after conception: Reproductive: Maternal Effects: other effects

Mutation in Microorganisms (Bacteria-*Salmonella typhimurium*) 400 ppm

Mutation in Microorganisms (Bacteria-*Salmonella typhimurium*) 5 mg/L

Mutation Test Systems-not otherwise specified (Bacteria-*Salmonella typhimurium*) 3 pph

METHYL BROMIDE (continued):

Mutation in Microorganisms (Bacteria-*Klebsiella pneumoniae*) 4750 mg/m³

Specific Locus Test (Inhalation-*Drosophila melanogaster*) 8 mg/L/1 hour-continuous

Sex Chromosome Loss and Nondisjunction (Inhalation-*Drosophila melanogaster*) 150 mg/m³/6 hours

Cytogenetic Analysis (Human-Lymphocyte) 95 mg/L

Sister Chromatid Exchange (Human-Lymphocyte) 43,000 ppm

Sister Chromatid Exchange (Human-Lymphocyte) 5 mg/L

Micronucleus Test (Inhalation-Rat) 338 ppm/6 hours/14 days-intermittent

Micronucleus Test (Inhalation-Mouse) 100 ppm/6 hours/14 days-intermittent

Sister Chromatid Exchange (Inhalation-Mouse) 200 ppm/6 hours/14 days-intermittent

Mutation in Mammalian Somatic Cells (Mouse-Lymphocyte) 300 µg/L

CARCINOGENICITY: The Methyl Bromide component of this product is listed by agencies that track the carcinogenic potential of chemical compounds, as follows: EPA-D (Not Classifiable as to Human Carcinogenicity), IARC-3 (Unclassifiable as to Carcinogenicity in Humans), MAK-3B (Substances for Which *in vitro* tests or Animal Studies have yielded evidence of carcinogenic effects that is not sufficient for classification of the substance in one of the other categories. Further studies are required before a final classification can be made), NIOSH-Ca (Potential Occupational Carcinogen with No Further Categorization), ACGIH TLV-A4 (Not Classifiable as a Human Carcinogen). Hydrogen is not carcinogenic.

IRRITANCY OF PRODUCT: This gas mixture may be mildly to severely irritating to contaminated tissue, depending on the duration and concentration of contact.

SENSITIZATION OF PRODUCT: The components of this gas mixture are not 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. The Methyl Bromide component is considered mutagenic based on positive results obtained in tests using live animals. There is no human information available. Positive results have been obtained in tests using cultured human white blood cells.

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. Methyl Bromide has been reported to cause teratogenic effects in research animals at very high doses, but not 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 the components of this gas mixture.

SECTION 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Hydrogen occurs naturally in the atmosphere. Hydrogen will be dissipated rapidly in well-ventilated areas. Methyl Bromide hydrolyzes to form methanol and hydrogen halides.

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

SECTION 12. ECOLOGICAL INFORMATION (Continued)

EFFECT OF CHEMICAL ON AQUATIC LIFE: Methyl Bromide can be hydrolyzed slowly in neutral waters forming methanol and hydrogen halides. The primary fate of Methyl Bromide in water is expected to be volatilization. Hydrolysis of Methyl Bromide to methanol and bromide ion will also occur with half-lives of 20-26.7 days as calculated from hydrolysis rate constants of 4.09×10^{-7} 1/second, and 3×10^{-7} 1/second. Bioconcentration is not expected to be significant. If a release this product occurs near a river or other body of water, the release has the potential to kill fish and other aquatic life. The following are aquatic toxicity data for the Methyl Bromide component:

METHYL BROMIDE:

LC₅₀ (*Lepomis macrochirus* bluegill) 96 hours = 11 ppm (static bioassay in fresh water at 23°C, mild aeration applied after 24 hours)

LC₅₀ (*Menidia beryllina* tidewater silverside) 96 hours = 12 ppm (static bioassay in synthetic seawater at 23°C, mild aeration applied after 24 hours)

LD₅₀ (*Coleoptera*) 24 hours = 4.505 mg/L

MOBILITY: Hydrogen does not present a hazard of mobility. The primary fate of Methyl Bromide in soil is expected to be volatilization. Due to its weak adsorption to soil, Methyl Bromide is expected to leach.

PERSISTENCE AND BIODEGRADABILITY: Persistence and Biodegradability: Hydrogen presents no hazard of persistence and is fully bio-degradable. Methyl Bromide reacts with soil or organic material to form bromide ion. The rate of bromide production is influenced by soil type: it is greatest in peaty manure, intermediate in loam (clay soil), and least in sand. Bromide ion in soil can be absorbed and concentrated by plants and may be ingested subsequently by humans & animals.

POTENTIAL TO BIOACCUMULATE: Using an measured log octanol/water partition coefficient of 1.19, a bioconcentration factor (BCF) of 4.7 was estimated for Methyl Bromide. A BCF of this magnitude suggests that bioconcentration will not be significant in fish.

OZONE-DEPLETION POTENTIAL: The Methyl Bromide component of this gas mixture is a Class I 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 this gas mixture may be disposed of by bubbling it through a 15% solution of sodium hydroxide. A trap should be used to prevent hazardous backflow. The use of a flashback arrestor during this process should be considered. Neutralization should only be done by appropriately trained and experienced personnel under conditions of adequate ventilation. 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, flammable, n.o.s., (Hydrogen, Methyl Bromide)

HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1954

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

PLACARD (When required): Flammable Gas

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position. It is not recommended that cylinder are transported in a 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) #: 115

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.

PROPER SHIPPING NAME: Compressed gas, flammable, n.o.s., (Hydrogen, Methyl Bromide)

HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1954

HAZARD SHIPPING LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)

PLACARD (When required): Non-Flammable Gas

SPECIAL PROVISIONS: 16

EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX: 0.12

ERAP INDEX: 3000

PASSENGER CARRYING SHIP INDEX: Forbidden

PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX: Forbidden

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA):

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

PROPER SHIPPING NAME: Compressed gas, flammable, n.o.s., (Hydrogen, Methyl Bromide)

HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1954

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				
//////	//////				

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):

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

PROPER SHIPPING NAME: Compressed gas, flammable, n.o.s., (Hydrogen, Methyl Bromide)

HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1954

HAZARD LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)

STOWAGE CATEGORY: Category D – Clear of Living Quarters.

EmS: 2-01

MARINE POLLUTANT: The components of this gas mixture are not designated by the IMO to be Marine Pollutants.

EUROPEAN SHIPPING INFORMATION:

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS

BY ROAD (ADR): This gas mixture is considered by the Economic Commission for Europe to be dangerous goods. Additional information is as follows:

UN NO.: 1954

NAME & DESCRIPTION: Compressed gas, flammable, n.o.s., (Hydrogen, Methyl Bromide)

CLASS: 2

CLASSIFICATION CODE: 1F

PACKING GROUP: None

LABELS: 2.1

SPECIAL PROVISIONS: 274

LIMITED QUANTITIES: LQ0

PACKING INSTRUCTIONS: P200

HAZARDOUS IDENTIFICATION NUMBER: 23

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): Methyl Bromide = 1000 lb (454 kg)

SARA TITLE III: Superfund Amendment and Reauthorization Act

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

Extremely Hazardous Substances: The Methyl Bromide component of this gas mixture has a Threshold Planning Quantity (TPQ) of 1000 lb = 454 kg).

Reportable Quantity (RQ): 1000 lb (454 kg)

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

IMMEDIATE HEALTH: Yes PRESSURE: Yes

DELAYED HEALTH: Yes REACTIVITY: No

FIRE: Yes

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

The Methyl Bromide component of this gas mixture has reporting requirements under Section 313.

CLEAN AIR ACT:

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

Threshold Planning Quantity (TPQ): Methyl Bromide = 10,000 lb (4540 kg)

TSCA: Toxic Substances Control Act

All components of this gas mixture are 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): Methyl Bromide = 1000 lb. (454 kg)

U.S. STATE REGULATORY INFORMATION:

CALIFORNIA PROPOSITION 65: No component of this gas mixture is a listed substance which the State of California requires warning under this statute.

The components of this gas mixture are covered under the following specific State regulations (more specific regulations exist in some States):

Alaska - Designated Toxic and Hazardous Substances: Hydrogen, Methyl Bromide.

California - Permissible Exposure Limits for Chemical Contaminants: Hydrogen, Methyl Bromide.

Florida - Substance List: Hydrogen, Methyl Bromide.

Illinois - Toxic Substance List: Hydrogen, Methyl Bromide.

Kansas - Section 302/313 List: Methyl Bromide.

Massachusetts - Substance List: Hydrogen, Methyl Bromide.

Michigan - Critical Materials Register: Methyl Bromide.

Minnesota - List of Hazardous Substances: Hydrogen, Methyl Bromide.

Missouri - Employer Information/Toxic Substance List: Hydrogen, Methyl Bromide.

New Jersey - Right to Know Hazardous Substance List: Hydrogen, Methyl Bromide.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: Methyl Bromide.

Pennsylvania - Hazardous Substance List: Hydrogen, Methyl Bromide.

Rhode Island - Hazardous Substance List: Hydrogen, Methyl Bromide.

Texas - Hazardous Substance List: Methyl Bromide.

West Virginia - Hazardous Substance List: Methyl Bromide.

Wisconsin - Toxic and Hazardous Substances: Methyl Bromide.

CANADIAN FEDERAL REGULATIONS:

CANADIAN DSL INVENTORY STATUS: All components of this gas mixture are listed on the Canadian DSL Inventory.

OTHER CANADIAN REGULATIONS: This gas mixture would be categorized as a Controlled Product, Hazard Classes A, B1 and D2, as per the Controlled Product Regulations. The components of this gas mixture are not on the CEPA Priorities Substances Lists.

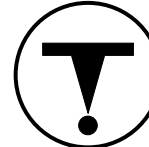
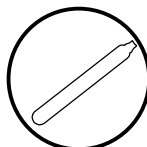
CANADIAN FEDERAL REGULATIONS (continued):

CANADIAN WHMIS SYMBOLS:

Class A: Compressed Gas

Class B1: Flammable Gas

Class D2: Toxic Material/Materials Causing Other Toxic Effects



SECTION 15. REGULATORY INFORMATION (Continued)

EUROPEAN ECONOMIC COMMUNITY REGULATIONS:

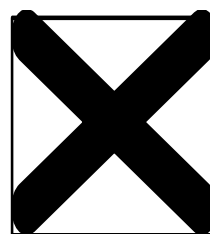
EC LABELING AND CLASSIFICATION: This product meets the following definition, per the European Community Council Directive 67/548/EEC.

EC CLASSIFICATION: [F+]; (Extremely Flammable); [Xn] Harmful:

EC RISK PHRASES: [R:12]: Extremely flammable. [R: 20/21]: Harmful by inhalation or in contact with skin. [R: 36, 37, 38] Irritating to the eyes, respiratory system, skin. [R: 40]: Possible risks of irreversible effects. [R: 48/20]: Harmful: danger of serious damage to health by prolonged exposure through inhalation.

EC SAFETY PHRASES: [S: 2½-]: Keep locked-up and out of reach of children. (*This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.*) [S: 27]: Take off immediately all contaminated clothing. [S: 9]: Keep container in well-ventilated place. [S: 16]: Keep away from sources of ignition - No smoking. [S: 33]: Take precautionary measures against static discharges. [S: 36/39]: Wear suitable protective clothing and eye/face protection. [S: 38]: In case of insufficient ventilation, wear suitable respiratory equipment. [S: 45]: In case of accident or if you feel unwell, seek medical advice immediately (show label where possible. [S: 59]: Refer to manufacturer/supplier for information on recovery/recycling. [S: 61]: Avoid release to the environment. Refer to special instructions/Safety data sheets.

EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOLS:



EUROPEAN COMMUNITY INFORMATION FOR COMPONENTS:

HYDROGEN:

EC EINECS/ELINCS NUMBER: 215-605-7

EC CLASSIFICATION: F+; (Extremely Flammable)

EC RISK PHRASES: Extremely flammable. [R:12]

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]

METHYL BROMIDE:

EC EINECS/ELINCS NUMBER: 200-813-2

EC LABELING AND CLASSIFICATION: Methyl Bromide is been classified as follows, per the European Community Council Directive 67/548/EEC.

EC CLASSIFICATION: [T]: Toxic. [Xn]: Harmful. [N]: Dangerous for the Environment. Mutagenic Substance, Category 3.

EC RISK PHRASES: [R: 23/25]: Toxic by inhalation. [R: 36/37/38]: Irritating to eyes, respiratory system and eyes. [R: 40]: Possible risks of irreversible effects. [R: 48/20]: Harmful: danger of serious damage to health by prolonged exposure through inhalation. [R: 50]: Very toxic to aquatic organisms. [R: 59]: Danger for the ozone layer.

EC SAFETY PHRASES: [S: 2½-]: Keep locked-up and out of reach of children. (*This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.*) [S: 27]: Keep away from heat. [S: 27]: Take off immediately all contaminated clothing. [S: 36/39]: Wear suitable protective clothing and eye/face protection. [S: 38]: In case of insufficient ventilation, wear suitable respiratory equipment. [S: 45]: In case of accident or if you feel unwell, seek medical advice immediately (show label where possible. [S: 59]: Refer to manufacturer/supplier for information on recovery/recycling. [S: 61]: Avoid release to the environment. Refer to special instructions/Safety data sheets.

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
 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 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.

LFC: Lowest Feasible Concentration.

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.

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.);

HEALTH HAZARD (continued): **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.]; **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 ignite 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.);

(continued on following page)

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

PHYSICAL HAZARD (continued):

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. 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 ≥ 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.). PPE Rating B: Hand and eye protection is required for routine chemical use. PPE Rating C: Hand, eye, and body protection may be required for routine chemical use.

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 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:

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:

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. TLm = median threshold limit; Coefficient of Oil/Water Distribution is represented by log Kow or log Koc 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/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. OSHA - U.S. Occupational Safety and Health Administration.

EUROPEAN and INTERNATIONAL:

The DFG: This is the Federal Republic of Germany's Occupation Health Agency, similar to the U.S. OSHA. 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. AICS is the Australian Inventory of Chemical Substances. MITI is the Japanese Minister of International Trade and Industry