1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NITROGEN/CARBON DIOXIDE/ETHANE/METHANE/HYDROGEN/HYDROGEN SULFIDE GAS MIXTURE

CHEMICAL FAMILY: Inorganic/Hydrocarbon Flammable Gas Mixture  PRODUCT USE: Welding Gas

MANUFACTURER

MATHESON TRI-GAS, INC.
150 ALLEN ROAD, Ste 302
BASKING RIDGE, NJ 07920
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

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.

2. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Product Description: This is a colorless, odorless, highly-flammable gas mixture, with a distinct “rotten egg” odor, due to the presence of Hydrogen Sulfide. Health Hazards: This gas mixture can cause significant, adverse health effects at relatively low concentrations, due to the presence of Hydrogen Sulfide. Overexposure can cause dizziness, headache, nausea, respiratory arrest, coma, collapse or unconsciousness. Additionally, releases of this gas mixture may cause adverse effects on the central nervous system and/or produce oxygen-deficient atmospheres. Individuals in such atmospheres may be asphyxiated. This gas mixture may be irritating to contaminated skin and eyes. Moisture in the air could lead to the formation of carbonic acid which can be irritating to the eyes. Flammability Hazards: This gas mixture presents a serious fire hazard if accidentally released. Releases of this gas mixture will spread long distances; ignition or flash-back from a distance is possible. Flame or high temperature impinging on a localized area of the cylinder can cause cylinder to rupture violently or explosively. Reactivity Hazards: This gas mixture is not reactive. Environmental Hazards: Release of this gas mixture may cause hazard to plants and animals in the environment if accidentally released to due to the presence of Hydrogen Sulfide and the hazard of frostbite in event of rapid release from the cylinder. Emergency Response Considerations: Provide adequate fire protection during emergency response.

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

INHALATION: One of the components of this gas mixture, Hydrogen Sulfide, is toxic and can cause adverse effects at the concentrations present in this gas mixture. Inhalation of Hydrogen Sulfide can cause dizziness, headache, nausea, respiratory arrest, coma, or unconsciousness. Exposure to Hydrogen Sulfide for more than 30 minutes at concentrations of greater than 600 ppm have been fatal. Continuous inhalation of low concentrations may cause olfactory fatigue, so that the odor is no longer an effective warning of the presence of Hydrogen Sulfide. A summary of exposure concentrations and observed effects are as follows:

<table>
<thead>
<tr>
<th>HYDROGEN SULFIDE CONCENTRATION</th>
<th>EXPOSURE SYMPTOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3-30 ppm:</td>
<td>Odor is obvious and unpleasant.</td>
</tr>
<tr>
<td>50 ppm:</td>
<td>Eye irritation. Dryness and irritation of nose, throat.</td>
</tr>
<tr>
<td>Slightly higher than 50 ppm:</td>
<td>Irritation of the respiratory system.</td>
</tr>
<tr>
<td>100-150 ppm:</td>
<td>Temporary loss of smell.</td>
</tr>
</tbody>
</table>
2. HAZARD IDENTIFICATION (Continued)

INHALATION (continued):

**HYDROGEN SULFIDE (continued)**

<table>
<thead>
<tr>
<th>CONCENTRATION</th>
<th>EXPOSURE SYMPTOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>200-250 ppm:</td>
<td>Headache, vomiting, nausea. Prolonged exposure may lead to lung damage.</td>
</tr>
<tr>
<td>300-500 ppm:</td>
<td>Swifter onset of symptoms. Death occurs in 1-4 hours.</td>
</tr>
<tr>
<td>500 ppm:</td>
<td>Headache, excitement, staggering, stomach after brief exposure. Death occurs from 0.5 - 1 hour.</td>
</tr>
<tr>
<td>&gt; 600 ppm:</td>
<td>Rapid onset of unconsciousness, coma, death.</td>
</tr>
<tr>
<td>&gt; 1000 ppm:</td>
<td>Immediate respiratory arrest.</td>
</tr>
</tbody>
</table>

Severe exposures to Hydrogen Sulfide which do not result in death may cause long-term symptoms such as memory loss, paralysis of facial muscles, or nerve tissue damage.

One of the other possible health hazards associated with this gas mixture is the potential for overexposure to Carbon Dioxide. Carbon Dioxide is an asphyxiant and a powerful cerebral vasodilator. Inhalation of concentrations 2% (the level in this mixture) can cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. Carbon Dioxide initially stimulates respiration and then causes respiratory depression. Symptoms in humans at levels of concentration possible in this mixture are as follows:

<table>
<thead>
<tr>
<th>CARBON DIOXIDE CONCENTRATION</th>
<th>SYMPTOMS OF EXPOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%:</td>
<td>Slight increase in breathing rate.</td>
</tr>
<tr>
<td>2%:</td>
<td>Breathing rate increases to 50% above normal; headache; tiredness.</td>
</tr>
</tbody>
</table>

Releases of this gas mixture may also cause an oxygen-deficient environment released in a poorly-ventilated area (e.g., an enclosed or confined space). 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>

**WARNING:** Exposure to atmospheres containing 8-10% or less oxygen will bring about unconsciousness without warning and so quickly that individuals cannot help or protect themselves. Lack of sufficient oxygen may cause serious injury or death.

**CONTACT WITH SKIN or EYES:** Due to the presence of Hydrogen Sulfide, this gas mixture may be irritating to the skin. Inflammation and irritation of the eyes can occur at very low airborne concentrations (less than 10 ppm Hydrogen Sulfide). Exposure over several hours may result in “gas eyes” or “sore eyes” with symptoms of scratchiness, irritation, teary and burning. Above 50 ppm, there is an intense tearing, blurring of vision, and pain when looking at light. Exposed individuals may see rings around bright lights. Most symptoms disappear when exposure ceases; however, in serious cases, the eye can be permanently damaged. Moisture in the air could lead to the formation of carbonic acid, which can be irritating to the eyes. Contact with the eyes can cause damage to the retinal ganglion cells. 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:** Due to the presence of Hydrogen Sulfide, inhalation of relatively low concentrations of this gas mixture can cause dizziness, headache, and nausea. Exposure to higher concentrations of this gas mixture can result in respiratory arrest, coma, and may be fatal due to the toxicity of Hydrogen Sulfide and oxygen deficiency. Continuous inhalation of low concentrations may cause olfactory fatigue, so that the odor of Hydrogen Sulfide is no longer an effective warning of over-exposure to this gas mixture. Additionally this gas mixture may cause skin and eye irritation. Contact with rapidly expanding gases (which are released under high pressure) may cause frostbite.

**CHRONIC:** Severe exposures which do not result in death may cause long-term symptoms such as memory loss, paralysis of facial muscles, or nerve tissue damage. Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may affect the heart and nervous system.

**TARGET ORGANS:** ACUTE: Respiratory system, skin, eyes, central nervous system. CHRONIC: Central nervous system, cardiac system.

**HMIS RATING:** HEALTH HAZARD = 2 FLAMMABILITY HAZARD = 4 PHYSICAL HAZARD = 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe *Chronic Hazard
3. COMPOSITION and INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>CHEMICAL NAME</th>
<th>CAS #</th>
<th>mole %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>7727-37-9</td>
<td>1.0%</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>124-38-9</td>
<td>2.0%</td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td>7783-06-4</td>
<td>5.0%</td>
</tr>
<tr>
<td>Methane</td>
<td>74-82-8</td>
<td>5.0%</td>
</tr>
<tr>
<td>Ethane</td>
<td>74-84-0</td>
<td>12.0%</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>1333-74-0</td>
<td>Balance</td>
</tr>
</tbody>
</table>

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.

SKIN EXPOSURE: Rinse exposed skin for 20 minutes if any irritation adverse effects occur. If release of this gas mixture has resulted in frostbite, warm affected area slowly. Seek immediate medical attention.

EYE EXPOSURE: If release of this gas mixture has affected the eyes, seek immediate medical attention.

THERMAL BURNS: Administer oxygen and continue even after spontaneous breathing is established. If pulmonary edema ensues, treat accordingly. In severe poisonings, treat with amyl nitrite and sodium nitrite as for cyanide poisoning, but omit sodium thiosulfate injection. Use of antibiotics should be considered at the first sign of pulmonary infection. Atropine sulfate may contribute some symptomatic relief. In event of eye contamination, conjunctivitis may be relieved by instillation of 1 drop of olive oil and sometimes by 3 to 4 drops of epinephrine solution (1:1000) at frequent intervals (e.g. 5 minutes). Occasionally, local anesthetics and hot or cold compresses are necessary to control pain. In the event personnel are burned as a result of a 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.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing respiratory conditions may be aggravated by overexposure to this gas mixture.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable for a flammable gas.

AUTOIGNITION TEMPERATURE: Not determined for mixture.

For Ethane: 472°C (882°F) 
For Hydrogen: 500-571°C (932-1059.8°F)

For Methane: 537°C (999°F)

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

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>LOWER (LEL)</th>
<th>UPPER (UEL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYDROGEN</td>
<td>4.0%</td>
<td>75.0%</td>
</tr>
<tr>
<td>METHANE</td>
<td>5.0%</td>
<td>15.4%</td>
</tr>
<tr>
<td>ETHANE</td>
<td>3.0%</td>
<td>12.5%</td>
</tr>
<tr>
<td>HYDROGEN SULFIDE</td>
<td>4.0%</td>
<td>44.0%</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.

FIRE EXTINGUISHING MATERIALS NOT TO BE USED: Water may be ineffective to extinguish fires involving this gas mixture. Halons should not be used due to Hydrogen content.

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.
5. FIRE-FIGHTING MEASURES (Continued)

SPECIAL FIRE-FIGHTING PROCEDURES (continued): 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).

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 flammable 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:
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).

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 an 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 this section. 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.

EXPOSURE LIMITS:

<table>
<thead>
<tr>
<th>CHEMICAL NAME</th>
<th>CAS #</th>
<th>ACGIH-TLVs</th>
<th>OSHA-STELs</th>
<th>NIOSH-RELs</th>
<th>NIOSH OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TWA ppm</td>
<td>STEL ppm</td>
<td>TWA ppm</td>
<td>STEL ppm</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>124-38-9</td>
<td>5000</td>
<td>30,000</td>
<td>5000</td>
<td>30,000</td>
</tr>
<tr>
<td>Ethane</td>
<td>74-84-0</td>
<td>NE</td>
<td>NE</td>
<td>NE</td>
<td>NE</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>74-82-8</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>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td>7783-06-4</td>
<td>1</td>
<td>5</td>
<td>10 (Vacated 1989 PEL)</td>
<td>20 (ceiling); 50 min. peak, once per 8-hr shift</td>
</tr>
<tr>
<td>Methane</td>
<td>74-82-8</td>
<td>1000</td>
<td>NE</td>
<td>NE</td>
<td>NE</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>7727-37-9</td>
<td>There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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). The following NIOSH respiratory protection recommendations for Carbon Dioxide and Hydrogen Sulfide concentrations in air are provided for additional guidance in respirator selection:

CARBON DIOXIDE

CONCENTRATION

Up to 40,000 ppm:

Supplied Air Respirator (SAR); or full-facepiece Self-Contained Breathing Apparatus (SCBA).

Emergency or Planned Entry Into Unknown Concentrations or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.

Escape: Escape-type SCBA.

HYDROGEN SULFIDE

CONCENTRATION

Up to 100 ppm:

Any Powered, Air-Purifying Respirator (PAPR) with cartridge(s), or any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted canister, or any Supplied-Air Respirator (SAR), or any Self-Contained Breathing Apparatus (SCBA) with a full facepiece.

Emergency or Planned Entry Into Unknown Concentrations or IDLH Conditions: Any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or any 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 canister providing protection against the compound of concern, or any appropriate escape-type, SCBA.


HAND PROTECTION: Chemically resistant gloves should be worn when using this gas mixture. Wear mechanically-resistant gloves when handling cylinders containing this gas mixture. If necessary, refer to U.S. OSHA 29 CFR 1910.138, or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to the task. If necessary, refer to the OSHA Technical Manual (Section VII: Personal Protective Equipment) or appropriate Standards of Canada.
8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

body protection (continued): 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 and the Canadian CSA Standard Z195-02, Protective Footwear.

ENVIRONMENTAL EXPOSURE CONTROLS: Controls should be engineered to prevent release to the environment, including procedures to prevent spills, atmospheric release and release to waterways.

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/m^3)
- **Specific Gravity (air = 1)**: 0.06860
- **Solubility in Water**: 0.019
- **Expansion Ratio**: Not applicable.
- **Odor Threshold**: Not applicable.
- **Vapor Pressure (psia)**: Not applicable.
- **Coefficient Water/Oil Distribution**: Not applicable.

**Appearance, Odor and Color**: This is a colorless, odorless, highly-flammable gas mixture, with a distinct “rotten egg” odor, due to the presence of Hydrogen Sulfide.

**How to Detect this Substance (Warning Properties)**: The smell of this gas mixture cannot be relied upon as an adequate warning of a release as the Hydrogen Sulfide component causes olfactory fatigue after continuous exposure to low concentration. 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.

**Decomposition Products**: Combustion: When ignited in presence of oxygen, this gas mixture will burn, producing carbon oxides and sulfur oxides. Hydrolysis: Carbonic acid.

**Materials with which Substance is Incompatible**: 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 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. The Hydrogen Sulfide component of this gas mixture, is a strong reducing agent and may also react with alkaline materials, metals (e.g., copper, lead, silver), and metal oxides, even in relatively low concentrations. The Methane and Ethane components of this gas mixture will decompose into carbon dioxide and carbon monoxide at extremely high temperatures.

**Hazardous Polymerization**: Will not occur.

**Conditions to Avoid**: 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**: Ethane, Methane, Nitrogen and Hydrogen are simple asphyxiants (SA), which act to displace oxygen in the environment. No toxicity data are available. The following data are available for the Carbon Dioxide and Hydrogen Sulfide components of this gas mixture.

**Carbon Dioxide**:
- TCLo (Inhalation, Man): 80 ppm/5 minutes
- TCLo (Inhalation, Rat): 800 ppm/5 minutes
- TCLo (Inhalation, Human): 800 ppm/5 minutes
- LC50 (Inhalation, Man): 5700 µg/kg: Behavioral: coma; Lungs, Thorax, or Respiration: chronic pulmonary edema
- LC50 (Inhalation, Rat): 1200 mg/m3/2 hours/5 days-intermittent: Brain and Coverings: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase

**Hydrogen Sulfide**:
- TCLo (Inhalation, Rat): 1200 mg/m3/2 hours:其它 degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase
- TCLo (Inhalation, Rat): 100 ppm/8 hours:其它 degenerative changes; Lungs, Thorax, or Respiration: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: enzyme inhibition, induction, or change in blood or tissue levels: cytochrome oxidases (including oxidative phosphorylation)
- TCLo (Inhalation, Rat): 80 ppm/6 hours/90 days:其它 degenerative changes; Lungs, Thorax, or Respiration: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: cytochrome oxidases (including oxidative phosphorylation)
- TCLo (Inhalation, Rat): 80 ppm/6 hours/90 days:其它 degenerative changes; Lungs, Thorax, or Respiration: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase
- TCLo (Inhalation, Rat): 20 ppm: female 6-22 day(s): other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase
- TCLo (Inhalation, Rabbit): 40 mg/m3/15 minutes/30 days:其它 degenerative changes; Lungs, Thorax, or Respiration: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase

**Carbon Dioxide (continued)**:
- TCLo (Inhalation, Rat): 1200 mg/m3/2 hours/5 days-intermittent: Brain and Coverings: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase
- TCLo (Inhalation, Rat): 100 ppm/8 hours/5 weeks-intermittent: Brain and Coverings: other degenerative changes; Lungs, Thorax, or Respiration: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: cytochrome oxidases (including oxidative phosphorylation)
- TCLo (Inhalation, Rat): 80 ppm/6 hours/90 days-intermittent: Brain and Coverings: changes in brain weight: Nutritional and Gross Metabolic: weight loss or decreased weight gain
- TCLo (Inhalation, Rabbit): 20 ppm: female 6-22 day(s): other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase
- TCLo (Inhalation, Rabbit): 40 mg/m3/15 minutes/30 days-intermittent: Sense Organs and Special Senses (Eye): conjunctive irritation

**Hydrogen Sulfide (continued)**: 
- TCLo (Inhalation, Rat): 1200 mg/m3/2 hours/5 days-intermittent: Brain and Coverings: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase
- TCLo (Inhalation, Rat): 100 ppm/8 hours/5 weeks-intermittent: Brain and Coverings: other degenerative changes; Lungs, Thorax, or Respiration: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: cytochrome oxidases (including oxidative phosphorylation)
- TCLo (Inhalation, Rat): 80 ppm/6 hours/90 days-intermittent: Brain and Coverings: changes in brain weight: Nutritional and Gross Metabolic: weight loss or decreased weight gain
- TCLo (Inhalation, Rabbit): 20 ppm: female 6-22 day(s): other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other degenerative changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase
- TCLo (Inhalation, Rabbit): 40 mg/m3/15 minutes/30 days-intermittent: Sense Organs and Special Senses (Eye): conjunctive irritation
11. TOXICOLOGICAL INFORMATION (Continued)

CARCINOGENIC POTENTIAL OF COMPONENTS: The Hydrogen Sulfide component is listed by agencies tracking the carcinogenic potential of chemical compounds, as follows:

**HYDROGEN SULFIDE:** EPA-I (Data are Inadequate for an Assessment of Human Carcinogenic Potential)

The remaining components of this product are not found on the following lists: U.S. EPA, U.S. NTP, U.S. OSHA, U.S. NIOSH, GERMAN MAK, IARC, or ACGIH, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Due the presence of Hydrogen Sulfide and the formation of carbonic acid, this gas mixture may be irritating to contaminated eyes.

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:** The components of this gas mixture have not been reported to cause mutagenic effects in humans. Animal mutagenic data are available for the Carbon Dioxide component of this gas mixture; these data were obtained during clinical studies on specific animal tissues exposed to relatively high doses of this gas.

**Embryotoxicity:** The components of this gas mixture have not been reported to cause embryotoxic effects in humans.

**Teratogenicity:** The components of this gas mixture have not been reported to cause teratogenic effects in humans.

**Reproductive Toxicity:** The components of this gas mixture have not been reported to cause adverse reproductive effects in humans. Studies involving test animals exposed to high concentrations of Carbon Dioxide show effects (e.g., changes in testes). Animal reproductive data are available for the Hydrogen Sulfide component of this gas mixture at high doses.

BIOLICAL 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: There are no data on possible adverse effects from this gas mixture on aquatic life. The following are aquatic toxicity data for the Hydrogen Sulfide component:

<table>
<thead>
<tr>
<th>Species/Type</th>
<th>Time (hr)</th>
<th>Concentration (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asellussp</td>
<td>96</td>
<td>0.111</td>
</tr>
<tr>
<td>Cranfgonyx sp</td>
<td>96</td>
<td>1.07</td>
</tr>
<tr>
<td>Gammarrus</td>
<td>96</td>
<td>0.84</td>
</tr>
<tr>
<td>Lepomis macrochirus, bluegill sunfish</td>
<td>96</td>
<td>0.0478 @ 21-22°C</td>
</tr>
<tr>
<td>Lepomis macrochirus, bluegill sunfish</td>
<td>96</td>
<td>0.0448 @ 21-22°C</td>
</tr>
<tr>
<td>L. promelas</td>
<td>96</td>
<td>0.0071-0.55</td>
</tr>
<tr>
<td>Pimephales promelas, fathead minnow</td>
<td>96</td>
<td>0.0216-0.038 mg/L @ 8-12.5°C</td>
</tr>
<tr>
<td>Salvenilis foninalis, brook trout</td>
<td>96</td>
<td>0.0216-0.038 mg/L @ 8-12.5°C</td>
</tr>
</tbody>
</table>

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 locally.

14. TRANSPORTATION INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION REGULATIONS: This product is classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

**PROPER SHIPPING NAME:** Compressed gases, flammable, n.o.s. (Hydrogen, Ethane, Methane)

**HAZARD CLASS NUMBER and DESCRIPTION:** 2.1 (Flammable Gas)

**UN IDENTIFICATION NUMBER:** UN 1954

**PACKING GROUP:** Not Applicable

**D.O.T HAZARD LABEL:** Class 2.1 (Flammable Gas)

**NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004):** 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)).
14. TRANSPORTATION INFORMATION (Continued)

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

PROPER SHIPPING NAME: Compressed gases, flammable, n.o.s. (Hydrogen, Ethane, Methane)
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1954
PACKING GROUP: Not Applicable
HAZARD LABEL: Class 2.1 (Flammable Gas)
SPECIAL PROVISIONS: 16
EXPLOSIVE LIMIT AND LIMITED QUANTITY INDEX: 0.125
ERAP INDEX: 3000
PASSENGER CARRYING SHIP INDEX: Forbidden
PASSENGER CARRYING ROAD VEHICLE OR PASSENGER CARRYING RAILWAY VEHICLE INDEX: Forbidden
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): 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: The Hydrogen Sulfide component of this gas mixture is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

<table>
<thead>
<tr>
<th>CHEMICAL NAME</th>
<th>SARA 302 (40 CFR 355, Appendix A)</th>
<th>SARA 304 (40 CFR Table 302.4)</th>
<th>SARA 313 (40 CFR 372.65)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen Sulfide</td>
<td>Yes</td>
<td>Yes</td>
<td>Hydrogen Sulfide has been 'stayed' from reporting</td>
</tr>
</tbody>
</table>

U.S. SARA SECTION 302 EXTREMELY HAZARDOUS THRESHOLD PLANNING QUANTITY (TPQ): Hydrogen Sulfide = 500 lb (270 kg)
U.S. SARA SECTION 304 EXTREMELY HAZARDOUS REPORTABLE QUANTITY (RQ): Hydrogen Sulfide = 100 lb (45.4 kg)
U.S. SARA HAZARD CATEGORIES (SECTION 311/312, 40 CFR 370-21): ACUTE: Yes; CHRONIC: Yes; FIRE: No; REACTIVE: No; SUDDEN RELEASE: Yes
U.S. CERCLA REPORTABLE QUANTITY (RQ): Hydrogen Sulfide = 100 lb (45.4 kg)
U.S. TSCA INVENTORY STATUS: Components of this product are listed on the TSCA Inventory.
OTHER U.S. FEDERAL REGULATIONS: Hydrogen, Hydrogen Sulfide, Ethane and Methane are subject to the reporting requirements of Section 112(r) of the Clean Air Act. The threshold quantity for these gases is 10,000 lbs (4,540 kg). Hydrogen and Methane 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. Hydrogen Sulfide is listed in Table 1, as a Regulated Substance (Toxic Substance) in quantities of 10,000 lb (4,540 kg) or greater.
CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this gas mixture is on the California Proposition 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 CLASSIFICATION AND SYMBOLS: This gas mixture would be categorized as a Controlled Product, Hazard Classes: A (compressed gas), Class D2B: (Other Toxic Effects), and F (flammable). The following symbol is required for WHMIS compliance for this gas mixture.
CREATION DATE: January 17, 2001
REVISION DATE: September 8, 2008

REVISION HISTORY: Up-date MSDS to current ANSI Standard format.

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), 421 Walton Road, 5th Floor, Chantilly, VA 20151. Telephone: (703) 788-2700, Fax: (703) 825-1851.

"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
800/441-3366 / 619/670-0800

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 workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or NIOSH RELs:

NIOSH RELs: 1993 Air Contaminants Rule (Federal Register
1993, No. 194)

NIOSH CEILING:

TLV-Threshold Limit Value:

The concentration that shall not be exceeded during any part of the workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or NIOSH RELs.

TLV-TWA: 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.

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.

0: (Minimal Hazard): No significant health risk, irritation of skin or eyes not anticipated. Skin Irritation: Essentially non-irritating. Eye Irritation: Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. pure water].

1: (Slight Hazard): Mild irritation of skin or eyes may occur. Skin Irritation: Slightly irritating; reversible. Eye Irritation: Slightly irritating.

2: (Moderate Hazard): Temporary or transient irritation may occur. Skin Irritation: Moderately irritating; reversible. Eye Irritation: Moderately irritating.

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 > 0, < 25. Oral Toxicity LD50 Rat > 50-500 mg/kg. Dermal Toxicity LD50 Cat or Rabbit: > 200-1000 mg/kg. Inhalation Toxicity LC50 4-hrs Rat or Rabbit > 0.05-0.5 mg/L.

4: (Severe Hazard): Life-threatening; major or permanent damage may result from single or repeated exposure. Skin Irritation: Not appropriate. Do not rate as a “4” based on skin irritation alone. Eye Irritation: Not appropriate. Do not rate as a “4” based on eye irritation alone. Oral Toxicity LD50 Rat, Cat or Rabbit > 1 mg/kg. Dermal Toxicity LD50 Cat or Rabbit: > 200-1000 mg/kg. Inhalation Toxicity LC50 4-hrs Rat or Rabbit > 0.05-0.5 mg/L.

FLAMMABILITY HAZARD:

Flammable-Materials that will burn in air at a temperature of 615.5°C [1423°F] for a period of 5 minutes or longer. 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; Materials that will burn in air when exposed to a temperature of 615°C [1423°F] for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 21°C [70°F] and having a boiling point at or above 38°C [100°F]. 2: (Moderate Hazard-Materials that must be pre-heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree will 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 or at 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; and semisolids that readily give off flammable vapors); 3: (Serious Hazard-Materials that will ignite under almost all ambient temperature conditions; Materials in this degree, form hazardous atmospheres with air under all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions, including: Liquids having a flash point below 22°C [72°F] and having a boiling point at or above 38°C [100°F] and below 37.8°C [100°F] (e.g., OSHA Class 1B and IIC). 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 combustion [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 rapidly, including: Flammable gases; Flammable cryogenic materials;
HAZARDOUS MATERIALS IDENTIFICATION SYSTEM
Hazard Ratings (continued):

Flammability Hazard (continued):
4 (continued): 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 (e.g. pyrophoric).

Physical Hazard:
8 Water-reactive 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. 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 0.7 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 Reagents: 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 explosion hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors. (50%)/cellulose mixture. 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 - Explosives: Materials 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 a hazardous explosion of sufficient magnitude to cause significant heat generation or explosion hazard.

Compressed Gases: Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1°C (70°F) [500 psig]. Pyrophorics: No Rating. Oxidizers: Packaging Group II: solids - any material that, in either concentration tested, exhibits a mean burning time 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 time of a 1.1 aqueous sodium chloride solution (40%)/cellulose mixture and the criteria for Packing Group I are not met. Unstable Reagents: 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 form explosive reactions with water. Organic Peroxides: Materials that are capable of detonation or explosive reaction even if not exposed to strong initiating sources. These materials must be heated under conditions, including intrinsically noncombustible materials such as concrete, stone, and sand. Materials: that will not burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in accordance with Annex D. 1 Materials that must be preheated before ignition can occur. This degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. These materials will burn in air under conditions of exposure to a temperature of 816°C (1500°F) for a period of 5 minutes in accordance with Annex D. Liquids, solids and semisolids having a flash point between -66.5°C (-30°C) and -55°C (-5°F) that cause severe or irreversible tissue damage. Materials that are respiratory irritants. Cryogenic gases that cause frostbite and irreversible tissue damage. Materials that are skin irritants and sensitizers. Materials that, under emergency conditions, can cause serious or permanent injury. Gases and vapors whose LC50 for acute inhalation toxicity is greater than 1,000 ppm but less than or equal to 200 mg/L. Materials whose LD50 for acute oral toxicity is greater than 10 mg/kg but less than or equal to 50 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is greater than 200 mg/L. Materials whose LC50 for acute dermal toxicity is greater than 100 mg/kg but less than or equal to 2000 mg/kg. Materials whose LC50 for acute inhalation toxicity is greater than 10 mg/L but less than or equal to 200 mg/L. Materials whose LD50 for acute dermal toxicity is greater than 1000 mg/kg but less than or equal to 2000 mg/kg. Materials whose LC50 for acute oral toxicity is greater than 50 mg/kg but less than or equal to 500 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is greater than 500 ppm and that does not meet the criteria for either degree of hazard 3 or degree of hazard 4. Compressed liquefied gases with boiling points between -30°C (-22°F) and -55°C (-65.5°F) that cause severe frostbite.
National Fire Protection Association Hazard Ratings (continued):
Health Hazard (continued): 1 (materials that, under emergency conditions, can cause significant irritation). Gases and vapors whose LC50 for acute inhalation toxicity is greater than 10,000 ppm but less than or equal to 5000 ppm. Dusts and mists whose LC50 for acute inhalation toxicity is greater than 5000 ppm but less than or equal to 20,000 ppm. Materials whose LD50 for acute oral toxicity is greater than 2000 mg/kg but less than or equal to 5000 mg/kg. Materials whose LD50 for acute dermal toxicity is greater than 100 mg/kg but less than or equal to 5000 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is greater than 5000 ppm and that does not meet the criteria for either degree of hazard 3 or degree of hazard 4. Compressed liquefied gases with boiling points between -7° C (-17°F) and -10°C (-14°F) that cause severe frostbite.

NATURAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):
Health Hazard (continued): 1 (materials that, under emergency conditions, can cause significant irritation). Gases and vapors whose LC50 for acute inhalation toxicity is greater than 10,000 ppm but less than or equal to 5000 ppm. Dusts and mists whose LC50 for acute inhalation toxicity is greater than 5000 ppm but less than or equal to 20,000 ppm. Materials whose LD50 for acute oral toxicity is greater than 2000 mg/kg but less than or equal to 5000 mg/kg. Materials whose LD50 for acute dermal toxicity is greater than 100 mg/kg but less than or equal to 5000 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is greater than 5000 ppm and that does not meet the criteria for either degree of hazard 3 or degree of hazard 4. Compressed liquefied gases with boiling points between -7° C (-17°F) and -10°C (-14°F) that cause severe frostbite.
NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):
FLAMMABILITY HAZARD (continued): 2 (continued): Solid materials in fibrous or shredded form that burn rapidly and create flash fire hazards, such as cotton, sisal and hemp. Solids and semisolids that readily give off flammable vapors. Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. 3 Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions: Liquids having a flash point below 22.8°C (73°F) and having a boiling point at or above 37.8°C (100°F) and those liquids having a flash point at or above 22.8°C (73°F) and below 37.8°C (73°F) and below 37.8°C (100°F) (i.e. Class IB and IC liquids). Materials that, on account of their physical form or environmental conditions, can form explosive mixtures with air and are readily dispersed in air. Flammable or combustible dusts with a representative diameter less than 420 microns (40 mesh). Materials that burn with extreme rapidity, usually by reason of self-contained oxygen (e.g. dry nitrocellulose and many organic peroxides). Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. 4 Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily: Flammable gases. Flammable organic materials. Any liquid or gaseous materials 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) (i.e. Class IA liquids). Materials that ignite when exposed to air. Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. 5 Flammable liquids and solids. Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) below 0.01 W/mL. Materials that do not exhibit an exotherm at temperatures less than or equal to 500°C (932°F) when tested by differential scanning calorimetry. 1 Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures. Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 0.01 W/mL and below 10 W/mL. 2 Materials that readily undergo violent chemical change at elevated temperatures and pressures: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 10 W/mL and below 100 W/mL. 3 Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 100 W/mL and below 1000 W/mL. Materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures. 4 Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) of 1000 W/mL or greater. Materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures.
FLAMMABILITY LIMITS IN AIR:
Much of the information related to fire and explosion is derived from the National Fire Protection Association (NFPA). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - The lowest percent of vapor in air, by volume, that will ignite or burn 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 TDL₅₀, the lowest dose to cause a symptom and TDL₉₀ the lowest concentration to cause a symptom; TDo, LDLo, and LDo, or TC, TCo, LC₀, and LC₀, 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: BIEI - 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:

ECOLOGICAL INFORMATION:

Regulatory Information:
U.S. and Canada: ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. This section explains the impact of various laws and regulations on the material. EPA is the U.S. Environmental Protection Agency. NIOSH is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (OSHA). WHMIS is the Canadian Workplace Hazardous Materials Information System. DOT and TC are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (SARA); the Canadian Domestic/Non-Domestic Substances List (DSL/NDSL); the U.S. Toxic Substance Control Act (TSCA); Marine Pollutant status according to the DOT, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label. OSHA - U.S. Occupational Safety and Health Administration.