1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: ETHYLENE OXIDE 10 ppm-2.5% / NITROGEN (Balance) GAS MIXTURE

CHEMICAL FAMILY: Organic Hydrocarbon Mixture

PRODUCT USE: Calibration Mixture

MANUFACTURER
MATHESON TRI-GAS, INC.
959 ROUTE 46 EAST
PARSIPPANY, NJ 07054-0624
USA
Phone: 973/257-1100

EMERGENCY PHONE:
CHEMTREC (U.S. DOMESTIC): 1-800-424-9300
CHEMTREC INTERNATIONAL: 1-703-527-3887
CANUTEC (CANADA): 1-613-996-6666

2. COMPOSITION and INFORMATION ON INGREDIENTS

(10,000 ppm = 1%)

<table>
<thead>
<tr>
<th>CHEMICAL NAME</th>
<th>CAS #</th>
<th>mole %</th>
<th>EXPOSURE LIMITS IN AIR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACGIH-TLV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TWA ppm</td>
</tr>
<tr>
<td>Ethylene Oxide</td>
<td>75-21-8</td>
<td>10 ppm-2.5</td>
<td>1</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>7727-37-9</td>
<td>Balance</td>
<td>There are no specific exposure limits for Nitrogen. Oxygen levels should be maintained above 19.5%.</td>
</tr>
</tbody>
</table>

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1998 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR. See Section 16 for Definitions of Terms Used.
3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This gas mixture is a colorless, odorless gas. This gas mixture can cause significant, adverse health effects at relatively low concentrations, due to the presence of Ethylene Oxide. Low concentrations of the Ethylene Oxide component of this gas mixture can be irritating to eyes and upper respiratory system; inhalation of low levels of this gas may also cause nausea, vomiting, and numbing of the sense of smell. Ethylene Oxide is a central nervous system depressant; this effect is not expected from this gas mixture due to the low concentration of Ethylene Oxide. The Ethylene Oxide component can cause cancer, based on human information. Ethylene Oxide may harm reproductive capability, based on animal information and may cause inheritable genetic damage. 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 presents no hazard of flammability or reactivity. Flame or high temperature impinging on a localized area of the cylinder can cause cylinder to rupture violently or explosively.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this product is by inhalation. The components of this gas mixture that are not indicated to have specific health effects are either not known to have adverse health effects or there are no data regarding adverse effects.

INHALATION: One of the components of this gas mixture, Ethylene Oxide, is toxic and may cause adverse effects at the concentrations present in this gas mixture. Inhalation over-exposures may cause upper respiratory system irritation. Symptoms of such over-exposure may include coughing, sneezing, and nasal congestion. Additionally, prolonged inhalation of low concentrations of Ethylene Oxide can cause nausea, vomiting, and numbing of the sense of smell. The following are symptoms of exposure to Ethylene Oxide at varying levels and duration of exposure. This level of exposure is not expected from this gas mixture, but the information is provided for additional information on the effects of Ethylene Oxide.

<table>
<thead>
<tr>
<th>CONCENTRATION OF ETHYLENE OXIDE</th>
<th>OBSERVED EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 ppm (estimated) for 2-3 minutes</td>
<td>Nausea, stomach spasms, lightheadedness, temporary unconsciousness and seizures. Random twitching of the muscles, nausea and tiredness occurred over the next 24 hours. Full recovery occurred within 3 weeks.</td>
</tr>
<tr>
<td>&gt; 700 ppm (estimated) for up to 30 minutes</td>
<td>Headache and diarrhea, which disappeared in 70 hours. Additional symptoms included mouth dryness, dizziness and weakness. Symptoms persisted up to 21 days.</td>
</tr>
<tr>
<td>&gt; 700 ppm 4 hours/day for 4 days</td>
<td>Persistent non-allergic asthma (reactive airways syndrome), with symptoms of coughing, wheezing and shortness of breath. Impaired lung function has occurred in individuals exposed at this level, due to scarring of the lungs (pulmonary fibrosis).</td>
</tr>
<tr>
<td>&gt; 700 ppm intermittently 2-8 weeks</td>
<td>Peripheral neuropathy with headache, weakness in the extremities, incoordination and irregular gait.</td>
</tr>
</tbody>
</table>

In addition, high concentrations of this gas mixture can cause an oxygen-deficient environment, especially if 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>

ETHYLENE OXIDE(10 ppm-2.5%)/ NITROGEN (Balance) GAS MIXTURE MSDS EFFECTIVE DATE: JULY 22, 2003

MATHESON TRI-GAS
3. HAZARD IDENTIFICATION (Continued)

CONTACT WITH SKIN or EYES: Due to the presence of Ethylene Oxide in this gas mixture, over-exposures to the eyes may cause irritation (i.e. redness, stinging). Chronic skin contact may cause dermatitis (dry, red, cracked skin). In addition, contact with rapidly expanding gases (which are released under high pressure) may cause frostbite.

SKIN ABSORPTION: The Ethylene Oxide component of this gas mixture can be absorbed via intact skin, causing effect described under "inhalation".

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

ACUTE: The most significant hazard associated with this gas mixture is the potential for exposure to oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, ringing in ears, headaches, shortness of breath, wheezing, headache, dizziness, indigestion, nausea, unconsciousness, and death. The skin of a victim of over-exposure may have a blue color. Due to the presence of Ethylene Oxide (≤ 200 ppm) in this gas mixture, inhalation over-exposures may cause upper respiratory system and eye irritation. Additionally, inhalation over-exposures to low levels of Ethylene Oxide can cause nausea, vomiting, and numbing of the sense of smell.

CHRONIC: Some studies involving chronic exposure to low levels of Ethylene Oxide suggest that permanent damage to the peripheral nervous system may occur. There is conflicting evidence that Ethylene Oxide may cause skin and/or respiratory sensitization. Due to the presence of Ethylene Oxide, this gas mixture must be considered a potential carcinogen and reproductive hazard to humans. Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may affect the heart and nervous system. Refer to Section 11 (Toxicology Information) for more data.

TARGET ORGANS: ACUTE: Respiratory system, skin, eyes, central nervous system. CHRONIC: Reproductive system, skin, peripheral nervous system, heart, central nervous system.

HMIS RATING: HEALTH = 2 FLAMMABILITY = 0 REACTIVITY = 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

4. FIRST-AID MEASURES

GENERAL INFORMATION: RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS GAS MIXTURE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Fire-Retardant clothing must be worn. 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 15 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.

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

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms; eliminate exposure. Refer to the OSHA Ethylene Oxide Standard (29 CFR 1910.1047; Paragraph K and Appendix A) for specific information on Medical Surveillance requirements (i.e. for the general physical exam, medical history, serum specimens, specific tests, and re-examination protocol).

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable; non-flammable gas.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %): Not applicable.
5. FIRE-FIGHTING MEASURES (Continued)

FIRE EXTINGUISHING MATERIALS: Use fire-extinguishing material appropriate for surrounding materials. Use water spray to cool fire-exposed structures, cylinders and equipment.

UNUSUAL FIRE AND EXPLOSION HAZARD: None; this gas is non-flammable.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Evacuate all personnel from danger area. Immediately cool cylinders with water spray from maximum distance, to avoid danger of cylinder rupture. 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 North American Emergency Response Guidebook (Guide Number 126).

6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Evacuate immediate area. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment, 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 the level the level of Ethylene Oxide and Oxygen. The atmosphere must have at least 19.5 percent Oxygen before non-emergency personnel can be allowed in the area without Self-Contained Breathing Apparatus.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES

NOTE: Refer to the OSHA Ethylene Oxide Standard (29 CFR 1910.1047) for specific requirements associated with the use of this gas. The Action Level for Ethylene Oxide is 0.5 ppm. In workplaces where employees are exposed above the Action Level, the OSHA requirements for monitoring, established of regulated areas, methods of compliance, respiratory protection, emergency response protocol, medical surveillance, training, and record-keeping must be followed.

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.
7. HANDLING and USE (Continued)

STORAGE AND HANDLING PRACTICES:
Entrances to regulated areas (as defined by the OSHA Ethylene Oxide Standard, 29 CFR 1910.1047) must be posted with legible signs which read as follows:

**DANGER**
**ETHYLENE OXIDE**
**CANCER HAZARD AND REPRODUCTIVE HAZARD**
**AUTHORIZED PERSONNEL ONLY**
**RESPIRATORS AND PROTECTIVE CLOTHING MAY BE REQUIRED TO BE WORN IN THIS AREA**

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).

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

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

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

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

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

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

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

**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).
8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

RESPIRATORY PROTECTION (continued): The following are NIOSH respiratory protection guidelines for the Ethylene Oxide component of this gas mixture. These are presented as this component presents a risk of toxicity in this mixture.

**ETHYLENE OXIDE CONCENTRATION**

<table>
<thead>
<tr>
<th>RESPIRATORY PROTECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 ppm: Any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against Ethylene Oxide (end of service life indicator (ESLI) required), or any Self-Contained Breathing Apparatus (SCBA) with a full facepiece, or any Supplied-Air Respirator (SAR) with a full facepiece.</td>
</tr>
</tbody>
</table>

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: 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 SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Escape: Any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister, or any appropriate escape-type, SCBA.

**NOTE:** Follow the specific respiratory selection guidelines of the OSHA Ethylene Oxide Standard in regulated areas (as defined by 29 CFR 1910.1047).

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

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 a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee’s feet may be exposed to electrical hazards, foot protection should be used, as described in U.S. OSHA 29 CFR 1910.136.

9. PHYSICAL and CHEMICAL PROPERTIES

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

- **VAPOR DENSITY:** 1.145 kg/m³ (0.0715 lb/ft³)
- **EVAPORATION RATE (nBuAc = 1):** Not applicable.
- **SPECIFIC GRAVITY (air = 1):** 0.967
- **FREEZING POINT:** -210°C (-345.8°F)
- **SOLUBILITY IN WATER:** 1.49% (v/v)
- **BOILING POINT (at 1 atmos.):** -195.8°C (-320.4°F)
- **EXPANSION RATIO:** Not applicable.
- **SPECIFIC VOLUME (ft³/lb):** 13.8
- **ODOR THRESHOLD:** Not applicable.
- **VAPOR PRESSURE (psia):** Not applicable.
- **COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.

The following information is pertinent to this product:

- **APPEARANCE, ODOR AND COLOR:** This gas mixture is colorless and odorless.

- **HOW TO DETECT THIS SUBSTANCE (warning properties):** There are no good warning properties for this gas mixture in event of a release. 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: The thermal decomposition products of Ethylene Oxide include carbon oxides. Nitrogen does not decompose, per se, but can react with other compounds in the heat of a fire.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Ethylene Oxide is incompatible with bases, alcohols, air, m-nitroaniline, trimethyl amine, copper, iron chlorides, iron oxides, magnesium perchlorate, mercaptans, potassium, alkane thiols and bromomethane. Ethylene Oxide reacts explosively with glycerol above 200°F (93.3°C). Rapid compression of the vapor of Ethylene Oxide with air can cause an explosion. The Nitrogen component is inert.

HAZARDOUS POLYMERIZATION: Will not occur. Ethylene Oxide can undergo violent polymerization in the presence of an initiating agent (i.e. acids, alcohols, bases, and metals); however, due to this component’s low concentration in the gas mixture, this is not anticipated to be a significant safety hazard.

CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The Nitrogen component is a simple asphyxiant (SA), which acts to displace oxygen in the environment. No toxicity data are applicable. The following are toxicity data for the Ethylene Oxide component of this gas mixture:

**ETHYLENE OXIDE:**

**Standard Draize Test (Skin-Human) 1%/7 seconds**

**Standard Draize Test (Eye-Rabbit) 18 µg/m³/6 hours:** Moderate

**TCLo (Inhalation-Human) 12,500 ppm/10 seconds:** Sensory Organ and Special Senses (Olfaction): effect, not otherwise specified

**TCLo (Inhalation-Woman) 500 ppm/2 minutes:** Behavioral: convulsions or effect on seizure threshold; Gastrointestinal: nausea or vomiting; Lungs, Thorax, or Respiration: other changes

**LD₅₀ (Oral-Rat) 72 mg/kg**

**LD₅₀ (Oral-Guinea Pig) 270 mg/kg**

**LD₅₀ (Subcutaneous-Rat) 187 mg/kg**

**LD₅₀ (Intraperitoneal-Mouse) 175 mg/kg**

**LD₅₀ (Intravenous-Mouse) 290 mg/kg**

**LD₅₀ (Intravenous-Dog) 330 mg/kg:** Sense Organs and Special Senses (Eye): effect, not otherwise specified; Behavioral: convulsions or effect on seizure threshold; Gastrointestinal: nausea or vomiting

**LC₅₀ (Inhalation-Rat) 800 ppm/4 hours:** Lungs, Thorax, or Respiration: other changes; Liver: other changes; Kidney, Ureter, Bladder: other changes

**LC₅₀ (Inhalation-Mouse) 836 ppm/4 hours**

**LC₅₀ (Inhalation-Dog) 960 ppm/4 hours:** Sense Organs and Special Senses (Eye): effect, not otherwise specified; Behavioral: convulsions or effect on seizure threshold; Gastrointestinal: nausea or vomiting, hypermotility, diarrhea

**LC₅₀ (Inhalation-Guinea Pig) 1500 mg/m³/4 hours**

**LDLo (Unreported-Rat) 200 mg/kg:** Lungs, Thorax, or Respiration: other changes; Liver: other changes; Kidney, Ureter, Bladder: other changes

**LDLo (Subcutaneous-Rat) 100 mg/kg**

**LDLo (Intravenous-Rabbit) 175 mg/kg:** Sense Organs and Special Senses (Eye): effect, not otherwise specified; Behavioral: muscle weakness, rigidity (including catalepsy)

**TCLo (Inhalation-Rat) 406 ppm/6 hours/6 weeks-intermittent:** Nutritional and Gross Metabolic: weight loss or decreased weight gain; Related to Chronic Data: death

**TCLo (Inhalation-Rat) 300 µg/m³/24H/83 days-continuous:** Behavioral: muscle contraction or spasticity; Blood: other changes; Nutritional and Gross Metabolic: changes in chlorine

**ETHYLENE OXIDE (continued):**

**TCLo (Inhalation-Rat) 33 ppm/6 hours/2 years-intermittent:** Tumorigenic: Carcinogenic by RTECS criteria; Brain and Coverings: tumors; Blood: leukemia

**TCLo (Inhalation-Rat) 100 ppm/6 hours:** female 6-15 day(s) after conception: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus)

**TCLo (Inhalation-Rat) 100 ppm/6 hours:** male 12 week(s) pre-mating female 9 week(s) pre-mating; 3 week(s) after conception: Reproductive: Effects on Newborn: live birth index (measured after birth)

**TCLo (Inhalation-Rat) 3600 µg/m³/24 hours:** male 60 day(s) pre-mating: Reproductive: Paternal Effects: testes, epididymis, sperm duct; Fertility: pre-implantation mortality (e.g. reduction in number of implants per female; total number of implants per corpora lutea)

**TCLo (Inhalation-Rat) 100 ppm/6 hours:** female 12 week(s) pre-mating: 21 day(s) after conception: Reproductive: Fertility, pre-implantation mortality (e.g. reduction in number of implants per female; total number of implants per corpora lutea); Effects on Newborn: live birth index (measured after birth)

**TCLo (Inhalation-Rat) 150 ppm/7 hours:** female 7-16 day(s) after conception: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus); Specific Developmental Abnormalities: craniofacial (including nose and tongue), musculoskeletal system

**TCLo (Inhalation-Mouse) 50 ppm/6 hours/2 years:** Tumorigenic: Carcinogenic by RTECS criteria; Lungs, Thorax, or Respiration: tumors

**TCLo (Inhalation-Mouse) 400 ppm/6 hours/13 weeks-intermittent:** Kidney, Ureter, Bladder; changes in bladder weight; Blood: normocytic anemia; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: hepatic microsomal mixed oxidase (dealkylation, hydroxylation, etc.)

**TCLo (Inhalation-Mouse) 600 ppm/6 hours/14 weeks-intermittent:** Sense Organs and Special Senses (Olfaction): effect, not otherwise specified; Endocrine: other changes; Related to Chronic Data: death

**TCLo (Inhalation-Mouse) 255 ppm/6 hours:** male 10 day(s) pre-mating: Reproductive: Effects on Embryo or Fetus: fetal death
TOXICITY DATA (continued):

ETHYLENE OXIDE (continued):
TCLo (Inhalation-Mouse) 450 mg/m³/6 hours/10 weeks-intermittent: Liver; changes in liver weight; Endocrine: changes in spleen weight; Related to Chronic Data: changes in testicular weight
TCLo (Inhalation-Mouse) 1200 ppm/90 minutes: female 1 day(s) after conception: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants); Effects on Embryo or Fetus: fetal death; Specific Developmental Abnormalities: homeostasis
TCLo (Inhalation-Mouse) 1200 ppm/90 minutes: female 1 day(s) pre-mating: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants); Effects on Embryo or Fetus: fetal death, other effects to embryo
TCLo (Inhalation-Mouse) 2700 ppm/6 hours: female 7 day(s) after conception: Reproductive: Effects on Embryo or Fetus: other effects to embryo
TCLo (Inhalation-Dog) 290 ppm/6 hours/6 weeks-intermittent: Blood: pigmented or nucleated red blood cells, changes in erythrocyte (RBC) count
TCLo (Inhalation-Dog) 102 ppm/26 weeks-intermittent: Blood: pigmented or nucleated red blood cells, changes in erythrocyte (RBC) count
TCLo (Inhalation-Monkey) 100 ppm/7 hours/2 years-intermittent: Sense Organs and Special Senses (Eye): effect, not otherwise specified
TCLo (Inhalation-Monkey) 50 ppm/7 hours: male 96 week(s) pre-mating: Reproductive: Paternal Effects: spermatogenesis (incl. genetic material, sperm morphology, motility, and count)
TCLo (Inhalation-Monkey) 50 ppm/7 hours: male 2 year(s) pre-mating: Reproductive: Paternal Effects: spermatogenesis (incl. genetic material, sperm morphology, motility, and count)
TDLo (Oral-Rat) 1186 mg/kg/2 years-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Gastrointestinal: tumors; Liver: tumors
TDLo (Subcutaneous-Mouse) 292 mg/kg/95 weeks-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Blood: lymphoma, including Hodgkin’s disease; Tumorigenic: tumors at site of application
TDLo (Intravenous-Mouse) 225 mg/kg: female 10-12 day(s) after conception: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants)
TDLo (Intravenous-Mouse) 450 mg/kg: female 8-10 day(s) after conception: Reproductive: Specific Developmental Abnormalities: musculoskeletal system
TDLo (Intravenous-Mouse) 450 mg/kg: female 10-12 day(s) after conception: Reproductive: Fertility: litter size (e.g. # fetuses per litter; measured before birth); Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus)
TDLo (Intraperitoneal-Mouse) 150 mg/kg: male 1 day(s) pre-mating: Reproductive: Effects on Embryo or Fetus: fetal death
TDLo (Intravenous-Rabbit) 324 mg/kg: female 6-14 day(s) after conception: Reproductive: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants)
TD (Subcutaneous-Mouse) 1090 mg/kg/91 weeks-intermittent: Tumorigenic: neoplastic by RTECS criteria; Blood: lymphoma, including Hodgkin’s disease; Tumorigenic: tumors at site of application
TD (Subcutaneous-Mouse) 908 mg/kg/95 weeks-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Blood: lymphoma, including Hodgkin’s disease; Tumorigenic: tumors at site of application
TD (Subcutaneous-Mouse) 2576 mg/kg/95 weeks-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Blood: lymphoma, including Hodgkin’s disease; Tumorigenic: tumors at site of application
TD (Oral-Rat) 5112 mg/kg/2 years-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Gastrointestinal: tumors; Liver: tumors
TC (Inhalation-Rat) 50 ppm/7 hours/2 years-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Blood: tumors
TC (Inhalation-Rat) 33 ppm/6 hours/2 years-intermittent: Tumorigenic: equivocal tumorigenic agent by RTECS criteria; Brain and Coverings: tumors
TC (Inhalation-Rat) 33 ppm/6 hours/2 years-intermittent: Tumorigenic: Carcinogenic by RTECS criteria; Brain and Coverings: tumors
Mutation in Microorganisms (Salmonella typhimurium) 40 µmol/plate
Mutation in Microorganisms (Salmonella typhimurium) 20 ppm Mutation in Microorganisms (Escherichia coli) 3500 µmol/10 hours
Specific Locus Test (Parenteral-Drosophila melanogaster) 114 mmol/L

SUSPECTED CANCER AGENT: The Ethylene Oxide component is listed by agencies tracking the carcinogenic potential of chemical compounds, as follows:

ETHYLENE OXIDE: ACGIH TLV-A2 (Suspected Human Carcinogen); IARC-1 (Carcinogenic to Humans); MAK-2 (Substances That are Considered to Be Carcinogenic for Man Because Sufficient Data from Long-Term Animal Studies or Limited Evidence from Animal Studies Substantiated by Evidence from Epidemiological Studies Indicate That They Can Make a Significant Contribution to Cancer Risk); NIOSH-Ca (Potential Occupational Carcinogen with No Further Categorization); NTP-K (Known to Be a Human Carcinogen); OSHA-Ca (Carcinogen Defined with No Further Categorization). Ethylene Oxide has been associated with malignancies of the lymphatic and hematopoietic system in both human and experimental animals.

The Nitrogen component of this gas mixture is not found on the following lists: FEDERAL OSHA Z LIST, IARC, NTP, CAL/OSHA, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
11. TOXICOLOGICAL INFORMATION (Continued)

IRRITANCY OF PRODUCT: This gas mixture may be irritating to contaminated tissue, due to the presence of Ethylene Oxide.

SENSITIZATION TO THE PRODUCT: There is conflicting evidence that Ethylene Oxide may cause skin and/or respiratory sensitization.

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

Mutagenicity: Human mutation data are available for the Ethylene Oxide component of this gas mixture. Extensive testing has shown that Ethylene Oxide is a powerful mutagen. Positive results, including somatic cell mutations and gene mutations and heritable translocations in rodent germ cells, have been obtained in numerous studies. Ethylene Oxide is often used as a positive control in mutagenicity tests. It is regarded as a direct mutagen, which means that metabolic activation is not required.

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

Teratogenicity: The components of this gas mixture are not reported to cause teratogenic effects in humans. There is substantial evidence which demonstrates that the Ethylene Oxide component of this gas mixture is an experimental teratogen in animals.

Reproductive Toxicity: Exposure to the Ethylene Oxide component of this gas mixture has been demonstrated to cause reproductive toxicity in both humans and animals.

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

12. ECOLOGICAL INFORMATION

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

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

EFFECT OF CHEMICAL ON AQUATIC LIFE: There are no data on possible adverse effects from this gas mixture on aquatic life. The following are aquatic toxicity data for the Ethylene Oxide component:

<table>
<thead>
<tr>
<th>Test Organism</th>
<th>Concentration (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50 (Goldfish) 24 hours</td>
<td>90 mg/L (ASTM D 1345)</td>
</tr>
<tr>
<td>LC50 (Daphnia magna) 24 hours</td>
<td>260-300 mg/L</td>
</tr>
<tr>
<td>LC50 (Daphnia magna) 48 hours</td>
<td>137-300 mg/L</td>
</tr>
</tbody>
</table>

ETHYLENE OXIDE (continued):

<table>
<thead>
<tr>
<th>Test Organism</th>
<th>Concentration (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50 (Artemia salina) 24 hours</td>
<td>350-570 mg/L</td>
</tr>
<tr>
<td>LC50 (Artemia salina) 48 hours</td>
<td>490-1,000 mg/L</td>
</tr>
<tr>
<td>LC50 (Pimephales promelas) 96 hours</td>
<td>84 mg/L</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 of locally.

14. TRANSPORTATION INFORMATION

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

PROPER SHIPPING NAME: Compressed gases, n.o.s. (Ethylene Oxide, Nitrogen)

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1956

PACKING GROUP: Not applicable.

D.O.T HAZARD LABEL: Non-Flammable Gas

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126

MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).
U.S. DEPARTMENT OF TRANSPORTATION (continued).

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

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

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

PROPER SHIPPING NAME: Compressed gases, n.o.s. (Ethylene Oxide, Nitrogen)
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
PACKING GROUP: Not Applicable
HAZARD LABEL: Class 2.2 (Non-Flammable Gas)
SPECIAL PROVISIONS: None
EXPLOSIVE LIMIT AND LIMITED QUANTITY INDEX: 0.12
ERAP INDEX: None
PASSENGER CARRYING SHIP INDEX: None
PASSENGER CARRYING ROAD VEHICLE OR PASSENGER CARRYING RAILWAY VEHICLE INDEX: 75

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126
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).

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)).

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: The Ethylene Oxide 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>Ethylene Oxide</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

U.S. SARA SECTION 302 EXTREMELY HAZARDOUS THRESHOLD PLANNING QUANTITY (TPQ): Ethylene Oxide = 1000 lb (454 kg)

U.S. SARA SECTION 304 EXTREMELY HAZARDOUS REPORTABLE QUANTITY (RQ): Ethylene Oxide = 10 lb (4.54 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. TSCA INVENTORY STATUS: Components of this product are listed on the TSCA Inventory.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Ethylene Oxide = 10 lb (4.54 kg)

OTHER U.S. FEDERAL REGULATIONS: Due to the presence of Ethylene Oxide in this gas mixture, requirements of the Ethylene Oxide Standard, 29 CFR 1910.1047 must be met. Ethylene Oxide is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The threshold quantity for this gas is 10,000 lbs (4,540 kg). Ethylene Oxide is listed in Table 1, as a Regulated Substance (Toxic Substance) in quantities of 10,000 lb (4,554 kg) or greater.
ADDITIONAL U.S. REGULATIONS (continued):

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

<table>
<thead>
<tr>
<th>California</th>
<th>New Jersey</th>
<th>Pennsylvania</th>
</tr>
</thead>
</table>

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65):
Ethylene Oxide is on the Proposition 65 lists. WARNING: Contains a chemical known to the State of California to cause cancer, birth defects, and other reproductive harm.

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

ADDITIONAL CANADIAN REGULATIONS:

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

OTHER CANADIAN REGULATIONS: Not applicable.

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

CANADIAN WHMIS SYMBOLS: This gas mixture would be categorized as a Controlled Product, Hazard Classes: A (compressed gas), and D2B (Materials Causing Other Toxic Effects - Acute and Chronic Toxic Effects). The following symbol is required for WHMIS compliance for this gas mixture.

16. OTHER INFORMATION

CREATION DATE: June 11, 2003
REVISION DATE: New

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

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

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

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA 91944-3519
800/441-3365
A large number of abbreviations and acronyms appear on a MSDS.

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

**DEFINITIONS OF TERMS**

Some of these which are commonly used include the following:

**HAZARDOUS MATERIALS IDENTIFICATION SYSTEM**

**HAZARD RATINGS (continued):**

1. **HEALTH HAZARD (continued):**
   - **2 (continued):** Dermal Toxicity LD_{50} Rat or Rabbit: > 200-1000 mg/kg. Inhalation Toxicity LC_{50} 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 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 LD_{50} Rat: > 1-50 mg/kg. Dermal Toxicity LD_{50} Rat or Rabbit: > 20-200 mg/kg. Inhalation Toxicity LC_{50} 4-hrs Rat: > 0.05-0.5 mg/L; 4 (Severe Hazard: Life-threatening; major or permanent damage may result from single or repeated exposure. **Skin Irritation:** Not appropriate. Do not rate as a “4”, based on skin irritation alone. **Eye Irritation:** Not appropriate. Do not rate as a “4”, based on eye irritation alone. Oral Toxicity LD_{50} Rat: 1 mg/kg. Dermal Toxicity LD_{50} Rat or Rabbit: 20 mg/kg. Inhalation Toxicity LC_{50} 4-hrs Rat: 0.05 mg/L.)

2. **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; Solids and semisolids having a flash point of 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 coarse dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials and solids 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;
HAZARDOUS MATERIALS IDENTIFICATION SYSTEM
HAZARD RATINGS (continued):

FLAMMABILITY HAZARD (continued):

4 (continued): Any liquid or gaseous material that is liquid while under pressure has a flash point below 22.8°C [73°F] and a boiling point below 37.8°C [100°F] [e.g. OSHA Class IA]; Material that ignites spontaneously when exposed to air at a temperature of 54.4°C [130°F] or below [e.g. pyrophoric].

PHYSICAL HAZARD:

0 (Water Reactivity: Materials that do not react with water. Organic Peroxides: Materials that are normally stable, even under fire conditions and will not react with water. Explosives: Substances that are Non-Explosive. Unstable Compressed Gases: No Rating. Pyrophorics: No Rating. Oxidizers: No “0” rating allowed. Unstable Reactives: Substances that will not polymerize, decompose, condense or self-react.; 1 (Water Reactivity: Materials that change or decompose upon exposure to moisture. Organic Peroxides: Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy. Explosives: Division 1.5 & 1.6 substances that are very insensitive explosives or that do not have a mass explosion hazard. Compressed Gases: Pressure below OSHA definition. Pyrophorics: No Rating. Oxidizers: Packaging Group III; Solids: any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3.7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. Liquids: any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%)/cellulose mixture and the criteria for Packing Group I and II are not met. Unstable Reactives: Substances that may decompose, condense or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosive hazard. Substances that readily undergo hazardous polymerization or undergo severe 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 time of a 1:1 aqueous sodium chloride 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); 2 (Water Reactivity: Materials that react explosively with water. Organic Peroxides: Materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); 3 (Water Reactivity: Materials that, under very short exposure could cause serious temporary or residual injury); 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 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 on very short exposure could cause death or major residual injury).

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

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

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

DEFINITIONS OF TERMS (Continued):  
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  TDL₀, the lowest dose to cause a symptom and  TCL₀ the lowest concentration to cause a symptom;  TDo, LDLo, and LDo, or  TC, TCo, LCoLo, 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.  

TOXICOLOGICAL INFORMATION (continued):  
RTECS - the Registry of Toxic Effects of Chemical Substances,  OSHA and CAL/OSHA.  IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4.  Subrankings (2A, 2B, etc.) are also used.  Other Information:  BEI - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.  

ECOLOGICAL INFORMATION:  
BCF = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter;  EC₅₀ is the Effect Concentration in water;  EC₉₀ is the Effect Concentration for 50% of the organisms exposed;  NOEC is the No Observed Effect Concentration;  MATC is the Maximum Acceptable Toxicant Concentration;  NOLC is the No Observed Lethal Concentration;  TL₅₀ = median threshold limit;  Coefficient of Oil/Water Distribution is represented by log Kow or log Kow and is used to assess a substance’s behavior in the environment.  

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