

MATERIAL SAFETY DATA SHEET

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

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NON-FLAMMABLE GAS MIXTURE
Containing the Following Component in Nitrogen Balance Gas:
Ethylene Oxide: 0.0005 - 0.02%

SYNONYMS: Not Applicable
CHEMICAL FAMILY NAME: Not Applicable
FORMULA: Not Applicable
Document Number: 50029

Note: The Material Safety Data Sheet is for this gas mixture supplied in cylinders with 33 cubic feet (935 liters) or less gas capacity (DOT - 39 cylinders). This MSDS has been developed for various gas mixtures with the composition of components within the ranges listed in Section 2 (Composition and Information on Ingredients). Refer to the product label for information on the actual composition of the product.

PRODUCT USE:	Calibration of Monitoring and Research Equipment
SUPPLIER/MANUFACTURER'S NAME:	AIR LIQUIDE AMERICA L.P.
ADDRESS:	821 Chesapeake Drive Cambridge, MD 21613
EMERGENCY PHONE:	CHEMTREC: 1-800-424-9300
BUSINESS PHONE:	1-410-228-6400
General MSDS Information 1-713/868-0440	
Fax on Demand: 1-800/231-1366	

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH-TLV		OSHA-PEL		NIOSH IDLH ppm	OTHER ppm
			TWA ppm	STEL ppm	TWA ppm	STEL ppm		
Ethylene Oxide	75-21-8	0.0005-0.02%	1	NE	1 See 29 CFR 1910.1047 (a)(2)	5 See 29 CFR 1910.104 7(a)(2)	800	NIOSH RELS: TWA = < 0.1 STEL = 5 (ceiling) 10 minute/day DFG MAK: Skin Carcinogen: IARC-1, MAK-2, NIOSH-Ca, NTP-K, OSHA-Ca, TLV-A2
Nitrogen	7727-37-9	Balance	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					

NE = Not Established. See Section 16 for Definitions of Terms Used.
NOTE (1): ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. This gas mixture has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This gas mixture is a colorless, odorless gas. The most significant, acute health hazard associated with releases of this gas mixture is the potential for development of oxygen-deficient atmospheres (especially in confined spaces or other poorly-ventilated environments); individuals in such atmospheres may be asphyxiated. 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.

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

INHALATION: Due to the small size of an individual cylinder of this gas mixture, no unusual health effects from over-exposure to the product are anticipated under routine circumstances of use. The most significant, acute effect associated with a release of this gas mixture would be for the potential development of oxygen-deficient atmospheres. If this gas mixture is released in a small, poorly-ventilated area (i.e. an enclosed or confined space), an oxygen-deficient environment may occur. 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 over-exposure, death may occur. The effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN

12-16% Oxygen:

10-14% Oxygen:

6-10% Oxygen:

Below 6%:

OBSERVED EFFECT

Breathing and pulse rate increased, muscular coordination slightly disturbed.
Emotional upset, abnormal fatigue, disturbed respiration.
Nausea, vomiting, collapse, or loss of consciousness.
Convulsive movements, possible respiratory collapse, and death.

Due to the presence of Ethylene Oxide in this gas mixture in concentrations of 5-200 ppm, 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.

CONCENTRATION OF ETHYLENE OXIDE

500 ppm (estimated) for 2-3 minutes

> 700 ppm (estimated) for up to 30 minutes

> 700 ppm 4 hours/day for 4 days

> 700 ppm intermittently 2-8 weeks

OBSERVED EFFECT

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.
Headache and diarrhea, which disappeared in 70 hours. Additional symptoms included mouth dryness, dizziness and weakness. Symptoms persisted up to 21 days.
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).
Peripheral neuropathy with headache, weakness in the extremities, incoordination and irregular gait.

SKIN and EYE CONTACT: Due to the presence of Ethylene Oxide in this gas mixture, over-exposures to the eyes may cause irritation (i.e. redness, stinging). The Ethylene Oxide component of this gas mixture can be absorbed via intact skin, causing effect described under "inhalation". Chronic skin contact may cause dermatitis (dry, red, cracked skin).

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM		
HEALTH HAZARD	(BLUE)	2
FLAMMABILITY HAZARD	(RED)	0
PHYSICAL HAZARD	(YELLOW)	0
PROTECTIVE EQUIPMENT		
EYES	RESPIRATORY	HANDS BODY
See Section 8		
For Routine Industrial Use and Handling Applications		

3. HAZARD IDENTIFICATION (Continued)

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to this gas mixture may cause the following health effects:

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.

4. FIRST-AID MEASURES

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 must be worn.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Eye conditions and respiratory disorders may be aggravated by over-exposure to this gas mixture.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

NEPA RATING

NFPA RATING

A diamond-shaped diagram representing the NFPA rating system. The diamond is divided into four quadrants by two diagonal lines intersecting at the center. The top vertex is labeled 'FLAMMABILITY', the bottom vertex is labeled 'OTHER', the left vertex is labeled 'HEALTH', and the right vertex is labeled 'REACTIVITY'. The top-left quadrant contains the number '0', the top-right quadrant contains the number '0', and the bottom-left quadrant contains the number '3'. The bottom-right quadrant is empty.

FLAMMABILITY	HEALTH	OTHER	REACTIVITY
0	3		0

LEAK RESPONSE: Due to the small size and content of the cylinder, an accidental release of this gas mixture presents significantly less risk of overexposure to 5th long O₂ in a normal deficient environment, or other safety hazards than a similar release from a larger cylinder. However,

7. HANDLING and USE

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:

EFFECTIVE DATE: APRIL 1, 2004

7. HANDLING and USE (Continued)

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: WARNING! Compressed gases can present significant safety hazards. During cylinder use, use equipment designed for these specific cylinders. Ensure all lines and equipment are rated for proper service pressure.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: No special ventilation systems or engineering controls are needed under normal circumstances of use. As with all chemicals, use this gas mixture in well-ventilated areas. If this gas mixture is used in a poorly-ventilated area, install automatic monitoring equipment to detect the levels of oxygen.

RESPIRATORY PROTECTION: Maintain exposure levels of Ethylene Oxide below the levels listed in Section 2 (Composition and Information on Ingredients) and Oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if Ethylene Oxide levels exceed exposure limits and if Oxygen level is below 19.5% or during emergency response to a release of this gas mixture. If respiratory protection is required for emergency response to this gas mixture, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent State standards. The following are NIOSH recommendations for respiratory protection for concentration of Ethylene Oxide in air.

ETHYLENE OXIDE
CONCENTRATION

Up to 5 ppm:

RESPIRATORY PROTECTION

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.

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: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

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

BODY PROTECTION: No special protection is needed under normal circumstances of use. 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.

9. PHYSICAL and CHEMICAL PROPERTIES

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

GAS DENSITY @ 32°F (0°C) and 1 atm: .072 lbs/ ft ³ (1.153 kg/m ³)	BOILING POINT: -320.4°F (-195.8°C)
FREEZING/MELTING POINT @ 10 psig: -345.8°F (-210°C)	pH: Not applicable.
SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 0.906	MOLECULAR WEIGHT: 28.01
SOLUBILITY IN WATER vol/vol @ 32°F (0°C) and 1 atm: 0.023	EXPANSION RATIO: Not applicable.
EVAPORATION RATE (nBuAc = 1): Not applicable.	SPECIFIC VOLUME (ft³/lb): 13.8
VAPOR PRESSURE @ 70°F (21.1°C) (psig): Not applicable.	
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.	

The following information is for this gas mixture.

APPEARANCE, ODOR AND COLOR: This gas mixture is a colorless, odorless gas.

HOW TO DETECT THIS SUBSTANCE (warning properties): Fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Normally stable in gaseous state.

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: Titanium will burn in Nitrogen (the main component of this gas mixture). Lithium reacts slowly with Nitrogen at ambient temperatures.

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 following toxicology data are available for the components of this gas mixture:

ETHYLENE OXIDE:

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

Standard Draize Test (Eye-Rabbit) 18 mg/6 hours:

Moderate

TCLo (Inhalation-Human) 12,500 ppm/10 seconds:

Sense Organs 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): lacrimation; Gastrointestinal: nausea or vomiting, hypermotility, diarrhea

ETHYLENE OXIDE (continued):

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-Cat) 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

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)

ETHYLENE OXIDE (continued):

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

11. TOXICOLOGICAL INFORMATION (Continued)

TOXICITY DATA (continued):

ETHYLENE OXIDE (continued):

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) 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) 255 ppm/6 hours: male 10 day(s) pre-mating: Reproductive: Effects on Embryo or Fetus: fetal death

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

ETHYLENE OXIDE (continued):

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 (Intraperitoneal-Mouse) 750 mg/kg: male 25 day(s) pre-mating: Reproductive: Effects on Newborn: live birth index (measured after birth), delayed effects

TDLo (Intraperitoneal-Mouse) 125 mg/kg: female 1 day(s) after conception: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants), litter size (e.g. # fetuses per litter; measured before birth); Specific Developmental Abnormalities: eye/ear

TDLo (Intraperitoneal-Mouse) 125 mg/kg: female 1 day(s) after conception: Reproductive: Specific Developmental Abnormalities: musculoskeletal system, other developmental abnormalities

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)

ETHYLENE OXIDE (continued):

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: Fertility: 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

ETHYLENE OXIDE (continued):

Mutation in Microorganisms (*Salmonella typhimurium*) 20 ppm

Mutation in Microorganisms (*Escherichia coli*) 3500 µmol/10 hours

Mutation in Microorganisms (Microorganism-not otherwise specified) 540 mg/L

Specific Locus Test (Parenteral-*Drosophila melanogaster*) 114 mmol/L

NITROGEN: There are no specific toxicology data for Nitrogen. Nitrogen is a simple asphyxiant, which acts to displace oxygen in the environment.

SUSPECTED CANCER AGENT: The components of this gas mixture are 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.

Nitrogen is not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, and IARC; therefore, it is not considered to be, nor suspected to be, a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: This gas mixture may be irritating to contaminated eyes and the upper respiratory system.

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 this gas mixture and its components 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: No embryotoxic effects have been described for the components of this gas mixture.

Teratogenicity: 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.

A *mutagen* is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An *embryotoxin* is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A *teratogen* is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A *reproductive toxin* is any substance which interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) have not been determined for the components of this gas mixture.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The gas will be dissipated rapidly in well-ventilated areas. The following environmental data are applicable to the components of this gas mixture.

NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C. 1.6 volumes Nitrogen/100 volumes water at 20°C.

ETHYLENE OXIDE:

Terrestrial Fate: When released on land, Ethylene Oxide would tend to volatilize rapidly. Ethylene Oxide is miscible in water and poorly adsorbed to soil so leaching is likely to occur. Although experimental data are lacking, hydrolysis in soil is probable.

Aquatic Fate: When released into water Ethylene Oxide will primarily be lost by three processes: volatilization, hydrolysis and biodegradation in that order of importance. Volatilization will depend on wind and mixing conditions and would be expected to occur in hours to days. The volatilization half-lives of Ethylene Oxide in a model river and lake are 5.9 hr and 3.8 days, respectively. The half-life for hydrolysis is 9-14 days leading to biodegradable products. Because of the limited data, it is difficult to estimate the rate of biodegradation; the available data would suggest that the biodegradation rate is slower than the volatilization and hydrolysis rates. Ethylene Oxide would not tend to adsorb to sediment. In groundwater, ethylene oxide will degrade due to hydrolysis.

Atmospheric Fate: Ethylene oxide will degrade in the atmosphere primarily by reaction with photochemically produced hydroxyl radicals. Assuming a hydroxyl radical concentration of 5X10⁵ radicals/cu cm, the half-life of Ethylene Oxide in the atmosphere will be 211 days. Data suggests that neither rain out nor adsorption into aqueous aerosols in the air should remove much of this compound.

Bioconcentration: Although no studies of bioconcentration for Ethylene Oxide were found in the literature, one would not expect it to bioconcentrate due to its low octanol/water partition coefficient (log Kow= -0.3).

12. ECOLOGICAL INFORMATION (Continued)

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on the effects of this gas mixture on plant and animal life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this gas mixture's effects on aquatic life. The following aquatic toxicity data are available for the Ethylene Oxide component of this gas mixture:

ETHYLENE OXIDE:	ETHYLENE OXIDE (continued):
LC ₅₀ (Goldfish) 24 hours = 90 mg/L (ASTM D 1345)	LC ₅₀ (<i>Artemia salina</i>) 24 hours = 350-570 mg/l)
LC ₅₀ (<i>Daphnia magna</i>) 24 hours = 260-300 mg/L	LC ₅₀ (<i>Artemia salina</i>) 48 hours = 490-1,000 mg/L
LC ₅₀ (<i>Daphnia magna</i>) 48 hours = 137-300 mg/L	LC ₅₀ (<i>Pimephales promelas</i>) 96 hours = 84 mg/L

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL **PREPARING WASTES FOR DISPOSAL:** Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Cylinders with undesired residual product may be safely vented outdoors with the proper regulator. For further information, refer to Section 16 (Other Information).

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.

DOT LABEL(S) REQUIRED: Non-Flammable Gas

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MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as 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 can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

Note: DOT 39 Cylinders ship in a strong outer carton (overpack). Pertinent shipping information goes on the outside of the overpack. DOT 39 Cylinders do not have transportation information on the cylinder itself.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas 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): 121

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: 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:

CHEMICAL NAME	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Ethylene Oxide	YES	YES	YES

U.S. SARA THRESHOLD PLANNING QUANTITY: Ethylene Oxide = 1,000 pounds.

U.S. TSCA INVENTORY STATUS: The components of this gas mixture are listed on the TSCA Inventory.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Ethylene Oxide = 10 pounds.

OTHER U.S. FEDERAL REGULATIONS:

- Ethylene Oxide is subject to the requirements of CFR 29 1910.1000. This component is listed in Table Z.1. Ethylene Oxide is also regulated under 29 CFR 1910.1047. Due to the presence of Ethylene Oxide in this gas mixture, requirements of the Ethylene Oxide Standard, 29 CFR 1910.1047 must be met.
- Depending on specific operations involving the use of Ethylene Oxide, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Ethylene Oxide is listed in Appendix A of this regulation. The threshold quantity for Ethylene Oxide under this regulation is 5000 pounds. Due to the small size of the cylinder for this mixture, this regulation should not apply.
- Ethylene Oxide is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for Ethylene Oxide is 10,000 pounds. Due to the small size of the cylinder for this mixture, this regulation should not apply.
- This gas mixture does not contain any Class I or Class II ozone depleting chemicals (40 CFR part 82).
- Nitrogen is not listed as a Regulated Substance, per 40 CFR, Part 68, of the Risk Management for Chemical Releases. Ethylene Oxide is listed under this regulation in Table 3 as a Regulated Substance (Toxic Substance), in quantities of 10,000 lbs (4,553 kg) or greater. Due to the small size of the cylinder for this mixture, this regulation should not apply.

U.S. STATE REGULATORY INFORMATION: The components of this gas mixture are covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: Ethylene Oxide.	Massachusetts - Substance List: Ethylene Oxide.	Pennsylvania - Hazardous Substance List: Nitrogen, Ethylene Oxide.
California - Permissible Exposure Limits for Chemical Contaminants: Nitrogen, Ethylene Oxide.	Minnesota - List of Hazardous Substances: Ethylene Oxide.	Rhode Island - Hazardous Substance List: Nitrogen, Ethylene Oxide.
Florida - Substance List: Ethylene Oxide.	Missouri - Employer Information/Toxic Substance List: Ethylene Oxide.	Texas - Hazardous Substance List: Ethylene Oxide.
Illinois - Toxic Substance List: Ethylene Oxide.	New Jersey - Right to Know Hazardous Substance List: Nitrogen, Ethylene Oxide.	West Virginia - Hazardous Substance List: Ethylene Oxide.
Kansas - Section 302/313 List: Ethylene Oxide.	North Dakota - List of Hazardous Chemicals, Reportable Quantities: Ethylene Oxide.	Wisconsin - Toxic and Hazardous Substances: Ethylene Oxide.

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.

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDL INVENTORY STATUS: The components of this gas mixture are listed on the DSL Inventory.

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

CANADIAN WHMIS CLASSIFICATION: This gas mixture is categorized as a Controlled Product, Hazard Classes A and D2A, as per the Controlled Product Regulations.

16. OTHER INFORMATION

INFORMATION ABOUT DOT-39 NRC (Non-Refillable Cylinder) PRODUCTS

DOT 39 cylinders ship as hazardous materials when full. Once the cylinders are relieved of pressure (empty) they are not considered hazardous material or waste. Residual gas in this type of cylinder is not an issue because toxic gas mixtures are prohibited. Calibration gas mixtures typically packaged in these cylinders are Nonflammable n.o.s., UN 1956. A small percentage of calibration gases packaged in DOT 39 cylinders are flammable or oxidizing gas mixtures.

For disposal of used DOT-39 cylinders, it is acceptable to place them in a landfill if local laws permit. Their disposal is no different than that employed with other DOT containers such as spray paint cans, household aerosols, or disposable cylinders of propane (for camping, torch etc.). When feasible, we recommended recycling for scrap metal content. Air Liquide America will do this for any customer that wishes to return cylinders to us prepaid. All that is required is a phone call to make arrangements so we may anticipate arrival. Scrapping cylinders involves some preparation before the metal dealer may accept them. We perform this operation as a service to valued customers who want to participate.

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

<i>P-1</i>	<i>"Safe Handling of Compressed Gases in Containers"</i>
<i>AV-1</i>	<i>"Safe Handling and Storage of Compressed Gases"</i>
	<i>"Handbook of Compressed Gases"</i>

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This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this gas mixture. To the best of Air Liquide America Corporation's knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this gas mixture is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.