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MATERIAL SAFETY DATA SHEET

No. 17

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| PRODUCT NAME Carbon Monoxide | CAS # 630-08-0 |
| TRADE NAME AND SYNONYMS Carbon Monoxide | DOT I.D. No.: UN 1016 |
| CHEMICAL NAME AND SYNONYMS Carbon Monoxide | DOT Hazard Class: Division 2.3 |
| ISSUE DATES AND REVISIONS Revised January 1995 | Formula CO |
| | Chemical Family: Nonmetal Oxide |

HEALTH HAZARD DATA

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| <p>TIME WEIGHTED AVERAGE EXPOSURE LIMIT TWA = 25 Molar PPM (ACGIH 1994-1995). OSHA 1993 PEL (8 Hr. TWA) = 50 Molar PPM.</p> |
| <p>SYMPTOMS OF EXPOSURE Depending on levels and duration of exposure, symptoms may include headache, dizziness, heart palpitations, weakness, confusion and nausea to convulsions, eventual unconsciousness and death.</p> <p>Because it is a colorless and odorless poisonous gas, there is no warning of its presence other than the above symptoms. Analytical monitors with alarms should be employed where the possibility of the release of toxic quantities exists.</p> |
| <p>TOXICOLOGICAL PROPERTIES</p> <p>The oxygen transport function of the hemoglobin of the blood is reduced since it reacts with inhaled carbon monoxide to form carboxy hemoglobin instead of its normal reaction with the oxygen in the lungs to form oxyhemoglobin. The affinity of hemoglobin for carbon monoxide is 200-300 times greater than its affinity for oxygen.</p> <p>All the disorders are due to the markedly reduced cellular respiration and may include central nervous system impairment, cardiovascular collapse, renal insufficiency, coma, etc.</p> <p style="text-align: right;">(Continued on Page 4)</p> |
| <p>RECOMMENDED FIRST AID TREATMENT</p> <p>PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO CARBON MONOXIDE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND BE COGNIZANT OF EXTREME FIRE AND EXPLOSION HAZARD.</p> <p><u>Inhalation:</u> Conscious persons should be assisted to an uncontaminated area and be treated with supplemental oxygen. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area and be given assisted respiration and oxygen at the same time. The administering of the oxygen at an elevated pressure (up to 2-2.5 atmospheres) has shown to be beneficial as has treatment in a hyperbaric chamber. The physician should be informed that the patient has inhaled toxic quantities of carbon monoxide.</p> |

Information contained in this material safety data sheet is offered without charge for use by technically qualified personnel at their discretion and risk. All statements, technical information and recommendations contained herein are based on tests and data which we believe to be reliable, but the accuracy or completeness thereof is not guaranteed and no warranty of any kind is made with respect thereto. This information is not intended as a license to operate under or a recommendation to practice or infringe any patent of this Company or others covering any process, composition of matter or use. Since the Company shall have no control of the use of the product described herein, the Company assumes no liability for loss or damage incurred from the proper or improper use of such product.

Carbon Monoxide

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

Carbon Monoxide is flammable in air over a very wide range. It reacts violently with oxygen difluoride and barium peroxide.

PHYSICAL DATA

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| BOILING POINT -312.7°F (-191.5°C) | LIQUID DENSITY AT BOILING POINT 49.5 lb/ft ³ (793 kg/m ³) |
| VAPOR PRESSURE 70°F (21.1°C): Above the critical temp. of -220.4°F (-140.2°C) | GAS DENSITY AT 70°F, 1 atm .072 lb/ft ³ (1.15 kg/m ³) |
| SOLUBILITY IN WATER Very slightly | FREEZING POINT -337.1°F (-205.1°C) |
| EVAPORATION RATE N/A (Gas) | SPECIFIC GRAVITY (AIR=1) @ 70°F (21.1°C) = 0.96 |
| APPEARANCE AND ODOR Colorless, odorless gas | |

FIRE AND EXPLOSION HAZARD DATA

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| FLASH POINT (Method used) N/A (Gas) | AUTO IGNITION TEMPERATURE 1166°F (630°C) | FLAMMABLE LIMITS % BY VOLUME (See Page 4) LE 12.5 UEL 74.0 |
| EXTINGUISHING MEDIA Water, dry chemical, carbon dioxide | | ELECTRICAL CLASSIFICATION Class 1, Group C |
| SPECIAL FIRE FIGHTING PROCEDURES If possible, stop the flow of carbon monoxide. Use water spray to cool surrounding containers. | | |
| UNUSUAL FIRE AND EXPLOSION HAZARDS Carbon Monoxide has almost the same density as air. It will not diffuse by rising as with some lighter flammables such as hydrogen or natural gas (methane). | | |

REACTIVITY DATA

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| STABILITY Unstable | | CONDITIONS TO AVOID None |
| Stable | X | |
| INCOMPATIBILITY (Materials to avoid) Oxidizers | | |
| HAZARDOUS DECOMPOSITION PRODUCTS None | | |
| HAZARDOUS POLYMERIZATION May Occur | | CONDITIONS TO AVOID |
| Will Not Occur | X | None |

SPILL OR LEAK PROCEDURES

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| STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Evacuate all personnel from a affected area. Use appropriate protective equipment. If leak is in use r's equipment, be certain to purge piping with an inert gas prior to attemptin g repairs. If leak is in container or container valve, contact your closest supplier location o r call the emergency telephone number listed herein. |
| WASTE DISPOSAL METHOD Do not attempt to dispose of waste or unused quantities. Return in the shipping container <u>properly labeled, with any valve outlet plugs or caps secured and valve protection cap in place</u> to your supplie r. For emergency disposal assistance, contact your closest supplier location or call the emergency telephone number listed herein. |

SPECIAL PROTECTION INFORMATION

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| RESPIRATORY PROTECTION (Specify type) | | Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use. | |
| VENTILATION Hood with forced ventilation | LOCAL EXHAUST To prevent accumulation above the TWA | SPECIAL | N/A |
| | MECHANICAL (Gen.) In accordance with electrical codes | OTHER | N/A |
| PROTECTIVE GLOVES Any material | | | |
| EYE PROTECTION Safety goggles or glasses | | | |
| OTHER PROTECTIVE EQUIPMENT safety shoes, safety showers | | | |

SPECIAL PRECAUTIONS*

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| SPECIAL LABELING INFORMATION | | | |
| DOT Shipping Name: | Carbon Monoxide | DOT Hazard Class: | Division 2.3 |
| DOT Shipping Labels: | Poison Gas, Flammable Gas | I.D. No.: | UN 1016 |
| SPECIAL HANDLING RECOMMENDATIONS | | | |
| <p>Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<2,000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.</p> <p>For additional handling recommendations, consult Compressed Gas Association's Pamphlet P-1.</p> | | | |
| SPECIAL STORAGE RECOMMENDATIONS | | | |
| <p>Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of noncombustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 125°F (52°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in - first out" inventory system to prevent full cylinders being stored for excessive periods of time. Post "No Smoking or Open Flames" signs in the storage or use area. There should be no sources of ignition in the storage or use area.</p> <p>For additional handling recommendations, consult Compressed Gas Association's Pamphlet P-1.</p> | | | |
| SPECIAL PACKAGING RECOMMENDATIONS | | | |
| <p>Carbon monoxide can be handled in all commonly used metals up to approximately 500 psig (3450 kPa). Above that pressure it forms toxic and corrosive carbonyl compounds with some metals. Carbon steels, aluminum alloys, copper and copper alloys, low carbon stainless steels and nickel-based alloys such as Hastelloy® A, B and C are recommended for higher pressure applications.</p> | | | |
| OTHER RECOMMENDATIONS OR PRECAUTIONS | | | |
| <p>Earth-ground and bond all lines and equipment associated with the carbon monoxide system. Electrical equipment should be non-sparking or explosion proof. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR).</p> | | | |
| (Continued on Page 4) | | | |

*Various Government Agencies (i.e. Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which will not be reflected in this data sheet. The customer should review these regulations to ensure that he is in full compliance.

Carbon Monoxide

HEALTH HAZARD DATA

TOXICOLOGICAL PROPERTIES: (Continued)

Carbon monoxide is not listed in IARC, NTP or by OSHA as a carcinogen or potential carcinogen.

Persons in ill health where such illness would be aggravated by exposure to carbon monoxide should not be allowed to work with or handle this product.

The State of California has listed carbon monoxide as a compound which is known to cause developmental reproductive toxicity.

SPECIAL PRECAUTIONS

OTHER RECOMMENDATIONS OR PRECAUTIONS: (Continued)

Always secure cylinders in an upright position before transporting them. NEVER transport cylinders in trunks of vehicles, enclosed vans, truck cabs or in passenger compartments. Transport cylinders secured in open flatbed or in open pick-up type vehicles.

Reporting under SARA, Title III, Section 313 not required.

NFPA 704 No. for gaseous carbon monoxide = 3 4 0 None