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SAFE HANDLING OF LIQUID CARBON MONOXIDE

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FOR AN EMERGENCY INVOLVING CRYOGENIC LIQUIDS:

In the UNITED STATES, ask for advice through CHEMTREC, the Chemical Transportation Emergency Center at the Chemical Manufacturers Association in Washington, D.C.

48 contiguous states (toll free)	800-424-9300
Alaska and Hawaii	202-483-7616
District of Columbia	202-483-7616

In CANADA, ask for advice through CANUTEC, Centre Canadien d'Urgence Transport or Canadian Transport Emergency Centre of the Transport Dangerous Goods Directorate, Transport Canada, in Ottawa, Ontario, Canada.

Canada	(613) 996-6666

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A catalog listing all publications, audio visual programs, safety bulletins and safety posters is available upon request at no charge from the Compressed Gas Association, Inc., 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202, (703) 979-4341.

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1. INTRODUCTION

1.1 General This publication is one of a series compiled by the Compressed Gas Association, Inc. to satisfy the demand for information relative to the production, transportation, handling and storage of compressed and liquefied gases. The purpose of this publication is to provide general information, specific regulations and recommended guidelines for the safe handling of liquid carbon monoxide which requires particular care because of its multiple hazards—a cryogenic liquid which vaporizes to a toxic, flammable, colorless and odorless gas. Liquid carbon monoxide is a cryogenic liquid which exists at a temperature of –313°F (–192°C) and atmospheric pressure. In addition to being a very cold liquid, it becomes a flammable vapor upon addition of heat and has an OSHA threshold limit value (TLV) of 35 ppm for eight-hour breathing exposure.[1]* This pamphlet was developed because of the particular care and special technology necessary for handling this product.

1.2 Scope This pamphlet offers guidance in the safe handling of liquid carbon monoxide from the production plant to the end use of the product. Certain special requirements are pointed out based on practices developed over a number of years of safe operations in commercial transportation and industrial use. This pamphlet may not include every acceptable safety precaution. Each person handling liquid carbon monoxide must receive adequate training in the handling of cryogenic liquids and the use of respiratory protection equipment to ensure safe handling of this product.

1.3 Definitions and Abbreviations

1.3.1 Cryogenic Liquid. A cryogenic liquid is a refrigerated liquefied gas having a normal boiling point below - 238°F (150°C) at atmospheric pressure as defined in National Bureau of Standards Handbook 44.[2]

1.3.2 Atmospheric Pressure. The pressure exerted due to the weight of atmospheric gases above a particular area. The standard value of 14.7 psia (760 mm Hg) is used.

** **1.3.3 Threshold Limit Value.** (TLV) The time-weighted average concentration for a normal 8-hour workday or a 40 hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

1.3.4 SCF. Standard cubic feet at 70°F (21.1°C) and 14.7 psia (760 mm Hg).

1.3.5 Btu. British thermal unit, the amount of heat required to raise the temperature of one pound of water one degree F (1 Btu = 778.26 ft.lb).

1.4 Physical Constants [3]

Boiling point of liquid at one atmosphere	–312.7°F	–191.5°C
Density of liquid at normal boiling point (nbp)	49.37 lb/cu.ft.	790.8 kg/m³
Density of saturated vapor (nbp)	0.276 lb/cu.ft.	4.42 kg/m³
SCF of gas per gallon of liquid at liquid nbp	90.88 cu.ft./gal	0.680 m³/L
Latent heat of vaporization (nbp)	92.79 Btu/lb	215.8 kJ/kg
Sensible heat to 77°F (25°C) from nbp	99.31 Btu/lb	230.8 kJ/kg
Total heat to 77°F (25°C) from liquid at nbp	192.10 Btu/lb	446.6 kJ/kg

Additional physical constants and information can be found in the *Handbook of Compressed Gases*.[3]

2. TOXICITY

2.1 General Carbon monoxide (CO) is toxic to humans and animals because it combines 300 times more readily with the hemoglobin or red corpuscles in the blood than oxygen. It can exclude oxygen from the blood and thus deprive the brain and other organs from their normal supply of oxygen. The first symptom is headache, which upon greater exposure can develop into loss of consciousness. Heavy exposure, even for short periods, is fatal. National Bureau of Standards Technologic Paper No. 212[4] gives information as to relative effects on human beings for various lengths of time at two exposure levels as follows on the next page.

The effects are also related to the physique and general physical condition of the individual, so times can be approximate only. Since carbon monoxide is odorless, colorless, and tasteless, persons exposed for several hours at a time should be protected by spot checks of the atmosphere. A healthy person can stand 8 hours of exposure to 50 ppm without ill effect. Cigarette smoking increases the

*NOTE: References in this document are shown by bracketed numbers and are listed in the order of appearance in Section 9, *References*.

**NOTE: As an aid to the user in identifying changes other than editorial from the previous edition, a vertical line appears in the left margin opposite the change.

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