

CGA P-12—2009

**SAFE HANDLING OF
CRYOGENIC LIQUIDS**

FIFTH EDITION



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**IN CASE OF A TRANSPORTATION EMERGENCY
INVOLVING A CRYOGENIC LIQUID**

In the UNITED STATES, ask for advice through CHEMTREC¹⁾, the Chemical Transportation Emergency Center at the American Chemistry Council in Arlington, VA.

48 contiguous states, Puerto Rico, Virgin Islands, Alaska, Hawaii,
and if transporting Canadian products in the United States (toll free) (800) 424-9300

For foreign locations (exclusive of Canada) call collect (202) 483-7616

In CANADA, ask for advice through CANUTEC, Transport Dangerous Goods Directorate, Transport Canada, Ottawa, Ontario.

In an emergency, from all points within Canada,
call collect 24 hours a day (613) 996-6666

For non-emergency information only, call (613) 992-4624

¹⁾ CHEMTREC only deals with transportation emergencies and is only available to registered suppliers. Some companies have developed alternative means for complying with emergency response regulations.

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1 Introduction

Large quantities of cryogenic liquids have been safely transported, handled, and stored for over half a century. Liquid oxygen was first shipped by tank truck in 1932. Today it is common to see portable liquid containers, cryogenic trailers, trucks, and railroad tank cars transporting large quantities of cryogenic liquids over land. Cryogenic tanker ships transport liquefied natural gas (LNG) overseas. Air transportation is used to transport some liquefied gases, especially liquid helium.

The cost of large-scale transportation and storage of cryogenic liquids is lower than the cost of transporting and storing compressed gases. Cryogens can be used in the liquid state, e.g., liquid nitrogen refrigeration systems, but the liquid is usually vaporized and used as a gas, e.g., vaporized liquid oxygen used in hospitals, welding, and steelmaking.

Safe handling practices for cryogens are based on understanding each cryogenic liquid's specific properties, using procedures that were developed based on those specific properties, and knowing each cryogenic liquid's material compatibility. The compressed gas industry has developed safe handling, delivery, and equipment design methods that are specific to each cryogen discussed in this publication by obtaining a thorough understanding of the risks and hazards associated with each cryogenic liquid. This individualized approach makes the handling and use of cryogenic products as risk free as possible. Anyone handling cryogenic products should strictly adhere to the safety practices.

For the purpose of this publication, the term cryogen means cryogenic liquid.

2 Scope

This publication provides general information about the properties, transportation, storage, safe handling, and safe use of the cryogenic liquids commonly used by industry and institutions. It is intended for cryogenic liquid users, shippers, carriers, distributors, equipment designers or installers, safety administrators, and anyone seeking an introduction to cryogenic liquids. If more detailed or specialized information is required, consult your cryogenic liquid supplier. The information in this standard is intended to complement federal, state, provincial/territorial, local, and insurance company safety requirements.

The most common industrial gases that are transported, handled, and stored as cryogenic liquids are oxygen, nitrogen, argon, hydrogen, and helium. Three rare atmospheric gases, neon, krypton, and xenon, are also transported, handled, and stored as cryogenic liquids. Although not usually classified as industrial gases, liquefied natural gas (LNG), liquid methane, ethylene, and carbon monoxide are also transported, handled, and stored as cryogenic liquids.

Some gases, including fluorine (boiling point $-306.8\text{ }^{\circ}\text{F}$ [$-188.2\text{ }^{\circ}\text{C}$]) and nitric oxide (boiling point $-241.2\text{ }^{\circ}\text{F}$ [$-151.8\text{ }^{\circ}\text{C}$]) can exist as cryogenic liquids due to their low boiling points. Both fluorine and nitric oxide are extremely reactive and hazardous to handle without extraordinary precautions; they are not normally handled as cryogenic liquids due to their reactive nature; it is more common for them to be handled as gases at ambient temperatures in compressed gases industry. They are not discussed in this publication, due to their specialized nature and hazards.

Carbon dioxide and nitrous oxide are not classified as a cryogenic liquids because their normal boiling point is greater than $-130\text{ }^{\circ}\text{F}$ ($-90\text{ }^{\circ}\text{C}$). Although carbon dioxide and nitrous oxide are transported and stored as refrigerated liquids, they are not discussed in this publication.

3 Standards and specifications

Many industry and government standards are available to guide the user in the proper selection of equipment for use in specific cryogenic operations, installations, and required maintenance practices. In some applications, additional requirements may be specified by federal, state, provincial, territorial, or local authorities. The user should check the requirements when preparing for specific operations.