

CGA P-25—2007

**GUIDE FOR FLAT-BOTTOMED
LOX/LIN/LAR STORAGE
TANK SYSTEMS**

SECOND EDITION



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1 Introduction

This publication was written to satisfy the demand for information related to the storage of liquid oxygen (LOX), liquid nitrogen (LIN), and liquid argon (LAR).

The purpose of this publication is to provide general information regarding safety in the design, installation, operation, and maintenance of LOX, LIN, and LAR flat-bottomed storage tank systems. The intent of this guide is to ensure that a minimum, uniform level of safety is provided throughout the industrial gas industry for the protection of the public and industry employees. The information presented does not supplant, but is intended to complement national, state, provincial, municipal, local, and insurance company safety requirements.

This guide presents recommendations to reduce the possibility of large releases of stored cryogenic fluids from a storage tank system through installation of protective equipment and instrumentation, equipment inspection and testing, and storage system design criteria. It is the intent of this guide to emphasize prevention of releases rather than the mitigation of consequences following a release.

2 Scope

The information in this publication is intended for use by flat-bottomed cryogenic storage tank system designers, owners, operators, fabricators, and others involved in LOX, LIN, or LAR flat-bottomed storage tank design, installation, or operation.

This publication is intended to cover flat-bottomed storage tank systems designed after the publication date of this guide and used for the storage of cryogenic LOX, LIN, or LAR in the United States.

This publication is not intended to cover LOX, LIN, and LAR flat-bottomed storage tank systems designed, built, or operated before the publication date of this guide. Application of this guide to existing installations is an individual company or storage system owner's decision.

A diagram for a typical flat-bottomed LOX, LIN, or LAR storage tank system is included as Appendix A. This diagram provides an illustration to define the intended scope of this publication.

This guide covers the storage system including the inner and outer tanks, the storage tank foundation and supports, the insulation systems, the process inlet piping to the inner tank from and including the check valve or emergency valve provided in the inlet line, the process outlet piping up to and including the emergency valve in the outlet line, other piping systems that connect to the inner tank, the pressure/vacuum control and relief systems for the inner and outer tanks, the inner tank level monitoring and control system, and the discharge piping associated with the pressure control and relief device vent systems.

3 Definitions

Unless otherwise specified, the latest edition shall apply.

3.1 Cryogenic liquid

Liquid with a normal boiling point below -130°F (-90°C).

3.2 Oxygen-enriched atmosphere

Air in which the oxygen concentration by volume exceeds 23.5% at sea level or whose partial pressure of oxygen exceeds 175 torr (mm Hg). See CGA P-39, *Oxygen-Rich Atmospheres* [1].¹

3.3 Oxygen-deficient atmosphere

Air in which the oxygen concentration by volume is less than 19.5% at sea level or whose partial pressure is less than 148 torr (mm Hg). See CGA SB-2, *Oxygen-Deficient Atmospheres* [2].

¹ References are shown by bracketed numbers and are listed in order of appearance in the reference section.

3.4 Qualified technical personnel

Persons who, by virtue of education, training, or experience, know how to apply physical and chemical principles involved in the reactions between oxygen and other materials.

4 Hazards

4.1 Enhanced flammability

Oxygen is a clear, colorless, odorless, and tasteless gas comprising approximately 21% by volume of the atmosphere of the earth. Oxygen by itself is not flammable; however, the presence of oxygen or other oxidizer is necessary to support combustion. An oxygen-enriched atmosphere can promote very rapid combustion and can cause combustion of some materials normally considered as being nonflammable.

4.2 Asphyxiation

Nitrogen and argon are colorless, odorless, inert gases that are classified as simple asphyxiants. The presence of oxygen in the earth's atmosphere is necessary to support life. When the oxygen content in the atmosphere is reduced (displaced or diluted by a release of stored nitrogen or argon), the ability of that atmosphere to support life is compromised.

4.3 Low temperature

4.3.1 Personnel exposures

Physical contact with vapors, liquids, or equipment at cryogenic temperatures can produce severe burns, frostbite, and damaged tissues.

4.3.2 Material embrittlement

Materials such as carbon steel and plastics become brittle at very low temperatures and are subject to failure at such conditions and could jeopardize the integrity of the storage system resulting in release of the stored cryogenic fluid.

4.3.3 Creation of fog (low visibility)

A release of LOX, LIN, or LAR to the atmosphere can create vapor fog clouds capable of limiting visibility on roads or inside plant boundaries. The vapor fog is composed of atmospheric water condensed by the cooling effect of the liquid being vaporized.

5 General storage tank system design considerations

The tank configuration for the storage of LOX, LIN, and LAR in flat-bottomed tanks is a double-walled, insulated storage tank. The annular space between the walls is purged/pressurized with a dry, nonflammable gas. Inner and outer tanks should be of all-welded construction. The design, fabrication, and testing of the storage tank should conform to applicable federal, state, and local regulations and should be guided by the requirements of API 620, *Design and Construction of Large, Welded, Low-Pressure Storage Tanks*, including Appendix Q. Although the scope of Appendix Q is limited to a design temperature of -270°F (-167.8°C) flat-bottomed storage tank systems can be designed for operating temperatures as low as -320°F (-195.6°C) by following the practices and procedures stated in API 620 including Appendix Q [3].

Seismic loads and method of analysis for the storage tank system should be in accordance with API 620 including Appendix L [3].

5.1 Inner tank

The inner tank should be fabricated of materials capable of withstanding the cryogenic temperature and internal pressure of the stored fluid and compatible with oxygen when in LOX service.