

CGA G-4—2015
REAFFIRMED 2020

OXYGEN

ELEVENTH EDITION

CGA
Compressed Gas Association

The Standard For Safety Since 1913

PLEASE NOTE:

The information contained in this document was obtained from sources believed to be reliable and is based on technical information and experience currently available from members of the Compressed Gas Association, Inc. and others. However, the Association or its members, jointly or severally, make no guarantee of the results and assume no liability or responsibility in connection with the information or suggestions herein contained. Moreover, it should not be assumed that every acceptable commodity grade, test or safety procedure or method, precaution, equipment or device is contained within, or that abnormal or unusual circumstances may not warrant or suggest further requirements or additional procedure.

This document is subject to periodic review, and users are cautioned to obtain the latest edition. The Association invites comments and suggestions for consideration. In connection with such review, any such comments or suggestions will be fully reviewed by the Association after giving the party, upon request, a reasonable opportunity to be heard. Proposed changes may be submitted via the Internet at our website, www.cganet.com.

This document should not be confused with federal, state, provincial, or municipal specifications or regulations; insurance requirements; or national safety codes. While the Association recommends reference to or use of this document by government agencies and others, this document is purely voluntary and not binding unless adopted by reference in regulations.

A listing of all publications, audiovisual programs, safety and technical bulletins, and safety posters is available via the Internet at our website at www.cganet.com. For more information contact CGA. Phone: 703-788-2700, ext. 799. E-mail: customerservice@cganet.com.

Work Item 19-052
Atmospheric Gases and Equipment Committee

NOTE—Technical changes from the previous edition are underlined

NOTE—No technical information has been changed from the 2015 edition. This reaffirmed edition may include minor editorial changes.

REAFFIRMED: 2020
ELEVENTH EDITION: 2015
TENTH EDITION: 2008
REAFFIRMED: 2002
NINTH EDITION: 1996

© 2015 The Compressed Gas Association, Inc. All rights reserved.

All materials contained in this work are protected by United States and international copyright laws. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical including photocopying, recording, or any information storage and retrieval system without permission in writing from The Compressed Gas Association, Inc. All requests for permission to reproduce material from this work should be directed to The Compressed Gas Association, Inc., 14501 George Carter Way, Suite 103, Chantilly VA 20151. You may not alter or remove any trademark, copyright or other notice from this work.

Contents	Page
1 Introduction.....	1
2 Scope	1
3 What is oxygen?.....	1
3.1 Physical and chemical properties.....	1
3.2 Manufacture.....	1
3.3 Commercial uses.....	2
4 Oxygen containers	3
4.1 Federal regulations applying to containers.....	3
4.2 Cylinders and containers.....	3
4.3 Tank cars.....	6
4.4 Highway vehicles.....	6
5 High pressure oxygen cylinders	7
5.1 General.....	7
5.2 Guidelines for safe storage.....	7
5.3 Guidelines for safe handling.....	8
5.4 Guidelines for safe use.....	9
5.5 Procedure for withdrawing oxygen from cylinders.....	9
5.6 Disposition of empty cylinders.....	10
6 Estimating amount of oxygen in a cylinder or container.....	10
7 Liquid oxygen	11
7.1 Guidelines for safe storage, handling, and use.....	11
7.2 Handling liquid oxygen in transfer systems or in open containers.....	12
8 Storing, handling, and using liquid oxygen cylinders.....	13
8.1 General.....	13
8.2 Filling.....	13
8.3 Moving cylinders or containers.....	13
8.4 Storage and use of cylinders or containers.....	13
8.5 Disposition of empty cylinders or containers.....	15
9 Oxygen piping and manifold systems.....	15
10 Bulk oxygen systems.....	16
11 References	16
 Table	
Table 1—Physical constants of oxygen	2

This page is intentionally blank.

Currently in preview, click buy full version

1 Introduction

This publication is one of a series of publications compiled by the Compressed Gas Association, Inc. (CGA) to satisfy the demand for information concerning the transportation, handling, and storage of compressed gases.

2 Scope

This publication provides information regarding the characteristics and safe handling of oxygen. Requests for specialized technical information should be directed to any one of the manufacturers of this gas. This publication is intended primarily for users of oxygen and some of the requirements do not apply to manufacturers or distributors of this gas.

3 What is oxygen?

3.1 Physical and chemical properties

Oxygen (O_2) is a molecule that exists at atmospheric temperatures and pressures as a colorless, odorless, tasteless gas. About one-fifth of the atmosphere is oxygen (20.95% by volume).

The outstanding property of oxygen is its ability to sustain life and to support combustion. Although oxygen is nonflammable, materials that normally do not burn in air can burn in an oxygen-enriched atmosphere. Materials that burn in air will burn more vigorously and at a higher temperature in an oxygen-enriched atmosphere. Some combustibles such as oil burn in oxygen with near explosive violence if ignited by flame, impact, or some other energy source. As a result of these properties, caution shall be exercised and precautions taken when entering areas or confined spaces where an oxygen-enriched atmosphere can exist. See CGA P-45, *Fire Hazards of Oxygen and Oxygen-Enriched Atmospheres* and National Fire Protection Association (NFPA) 53, *Recommended Practice on Materials, Equipment and Systems Used in Oxygen-Enriched Atmospheres* for more information regarding the hazards of oxygen-enriched atmospheres [1, 2].¹

As a gas, oxygen is 1.1 times heavier than air. It can be compressed and cooled to a pale blue liquid that, under atmospheric pressure, boils at $-297.3\text{ }^\circ\text{F}$ ($-182.9\text{ }^\circ\text{C}$). As a liquid (at normal boiling point), oxygen is 1.14 times heavier than water. When heated above its critical temperature of $-181.4\text{ }^\circ\text{F}$ ($-118.6\text{ }^\circ\text{C}$), oxygen can exist only as a gas, regardless of the pressure that is exerted upon it.

Oxygen is denoted according to type and grade or quality verification level (QVL). Gaseous oxygen is denoted as Type I and liquefied oxygen as Type II. The QVLs specify the maximum amount of various impurities (also termed limiting characteristics) that can be present. Further details are given in CGA G-4.3, *Commodity Specification for Oxygen* [3].

Physical constants of oxygen are listed in Table 1.

3.2 Manufacture

The primary method of manufacturing oxygen is by fractional distillation after the liquefaction of air. Improved efficiency in utilization has led to a generally recognized industry standard of purity, which exceeds the 99% required by the *United States Pharmacopeia* and *National Formulary (USP-NF)* [4]. Oxygen of lower purity can be used in some chemical and metallurgical processes. Other methods of manufacturing oxygen include pressure swing adsorption, vacuum swing adsorption, membrane separation, electrolysis, and chemical reaction. These processes produce oxygen at lower purities than that obtained by fractional distillation at cryogenic temperatures.

For more information on the manufacture of oxygen, see CGA P-8, *Safe Practices Guide for Cryogenic Air Separation Plants* and CGA P-8.1, *Safe Installation and Operation of PSA and Membrane Oxygen and Nitrogen Generators* [5, 6].

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