



CGA G-4.14—2017
DESIGN, MANUFACTURE,
INSTALLATION, OPERATION,
AND MAINTENANCE OF
VALVES USED IN LIQUID
OXYGEN AND COLD
GASEOUS OXYGEN SYSTEMS

SECOND EDITION
(Corrected 7/13/2018)

PREFACE

As part of a program of harmonization of industry standards, the Compressed Gas Association (CGA) has issued CGA G-4.14, *Design, Manufacture, Installation, Operation, and Maintenance of Valves Used in Liquid Oxygen and Cold Gaseous Oxygen Systems* jointly produced by members of the International Harmonization Council and originally published by the European Industrial Gases Association (EIGA) as EIGA Doc 200, *Design, Manufacture, Installation, Operation, and Maintenance of Valves Used in Liquid Oxygen and Cold Gaseous Oxygen Systems*.

This publication is intended as an international harmonized standard for the worldwide use and application of all members of the Asia Industrial Gases Association (AIGA), Compressed Gas Association (CGA), European Industrial Gases Association (EIGA), and Japan Industrial and Medical Gases Association (JIMGA). Each association's technical content is identical, except for regional regulatory requirements and minor changes in formatting and spelling.

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 web site, 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 at Phone: 703-788-2700, ext. 799. E-mail: customerservice@cganet.com.

Work Item 20-041
Atmospheric Gases and Equipment Committee

NOTE—Technical changes from the previous edition are underlined.

SECOND EDITION: 2017 (Corrected 7/13/2018)
FIRST EDITION: 2015

© – Reproduced with permission from, the European Industrial Gases Association. All rights reserved.

| Contents | Page |
|---|-------------|
| 1 Introduction..... | 1 |
| 2 Scope | 1 |
| 3 Definitions..... | 1 |
| 3.1 Publication terminology | 1 |
| 3.2 Technical definitions | 2 |
| 4 Oxygen properties, hazards, and hazard analysis and risk assessment | 2 |
| 4.1 Oxygen properties | 2 |
| 4.2 Oxygen hazards | 2 |
| 4.3 Oxygen hazard analysis and risk assessment | 3 |
| 5 Kindling chain, ignition mechanisms, and contributing factors | 6 |
| 5.1 Kindling chain and ignition mechanisms | 6 |
| 5.2 Contributing factors | 8 |
| 6 Material selection | 9 |
| 6.1 Selection of metallic materials | 9 |
| 6.2 Metallic material ranking | 9 |
| 6.3 Selection of nonmetallic materials | 10 |
| 6.4 Specific requirements for lubricants and locking compounds..... | 11 |
| 7 Design philosophy | 12 |
| 7.1 General system design..... | 12 |
| 7.2 Valve design | 12 |
| 8 Valve cleaning for oxygen service..... | 17 |
| 8.1 Valve cleaning strategy | 17 |
| 8.2 Cleanliness inspection..... | 17 |
| 8.3 Standard of cleanliness | 18 |
| 8.4 Packaging, storage, and handling | 18 |
| 8.5 Records | 18 |
| 9 Site installation | 19 |
| 10 Operations..... | 20 |
| 10.1 Personnel | 20 |
| 10.2 Isolation, drain, and vent valves | 20 |
| 10.3 Pressure relief valves | 20 |
| 10.4 Pressurizing piping systems | 20 |
| 10.5 Valve leaks | 20 |
| 10.6 Shutdown and startup of piping systems..... | 21 |
| 11 Maintenance..... | 21 |
| 11.1 General considerations..... | 21 |
| 11.2 Maintenance of valves..... | 23 |
| 11.3 Assembly and installation | 23 |
| 11.4 Spares | 24 |
| 11.5 Supervision and inspection..... | 25 |
| 11.6 Documentation | 25 |
| 11.7 System restart after maintenance..... | 26 |
| 12 Training | 26 |
| 12.1 Training scope and elements of the training program | 26 |
| 13 Quality assurance, quality control measures for valves and spare parts | 27 |
| 13.1 Valve manufacturer control..... | 27 |
| 13.2 Construction site management..... | 29 |
| 14 References | 30 |

Figures

Figure 1—Flowchart showing an oxygen hazard analysis 5
Figure 2—Generic kindling chain 7
Figure 3—Example for a bypass system 14

1 Introduction

This publication has been prepared by a group of experts in industrial gases technology or oxygen equipment representing oxygen manufacturers and is based on technical information and experience currently available.

The use of incompatible materials, unsuitable lubricants, improper cleaning and/or ingress of impurities, and procedural failures have been identified as root causes of a number of severe incidents that occurred over the past few years involving liquid oxygen valves with concentrations greater than 90 mol% of oxygen. This indicates the need for continual improvement in the fundamental knowledge of design, material selection, manufacturing, cleaning, installation, operation, maintenance processes, and storage related to valves in liquid oxygen service. This is necessary for liquid oxygen valve specifiers, suppliers, and manufacturers as well as those who clean, assemble, install, operate, and maintain these valves.

In order to avoid similar incidents with potentially fatal consequences, requirements for cold oxygen systems are outlined in this publication.

The information contained in this publication only applies to new installations designed after the publication of this document and not to existing installations. However, the information contained in this publication may benefit existing installations or those in the project phase. Furthermore, to the extent that they exist, national laws may supersede the practices included in this publication. It should be noted that all local regulations, tests, safety procedures, or methods are not included in this publication and that abnormal or unusual circumstances could warrant additional requirements.

The industrial gases industry has demonstrated that personnel who are involved in the design, selection, manufacturing, handling, cleaning, installation, and maintenance of valves in cold oxygen service require training in these respective areas.

2 Scope

This publication covers isolation valves, control valves, check valves, pressure relief valves, drain, and vent valves in air separation units (ASUs), their backup and storage piping system, and customer station bulk storage tank systems. It addresses the design, material selection, manufacturing, cleaning, installation, operation, and maintenance of oxygen service valves operating at temperatures less than -22°F (-30°C).

Valves in warm service connecting instrumentation devices are excluded from the scope of this publication. Some of the principles discussed in this publication may be used for other cold oxygen applications.

3 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicates that the procedure is optional.

3.1.4 Will

Used only to indicate the future, not a degree of requirement.

3.1.5 Can

Indicates a possibility or ability.