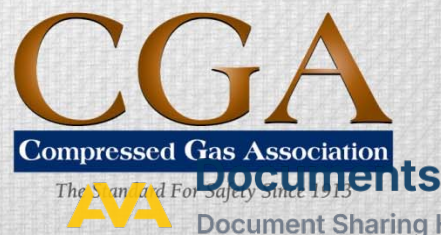


CGA P-2.5—2018

**STANDARD FOR TRANSFILLING
OF HIGH PRESSURE
GASEOUS OXYGEN USED
FOR RESPIRATION**

SEVENTH EDITION



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NOTE—Technical changes from the previous edition are underlined.

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1 Introduction

This publication is provided as a service by the Compressed Gas Association (CGA) for persons and organizations who transfill gaseous oxygen to be used for respiration. It is not a procedures guide for transfilling; rather, it points out the safety concerns, regulatory compliance requirements, and potential hazards of transfilling. Cylinders shall be filled only by trained and qualified personnel using components and equipment as set forth in this publication. Transfilling shall be performed only in facilities where controls and safety procedures have been established and are well understood and enforced.

CAUTION: *Transfilling attempted by unskilled, untrained persons (such as might be encountered in a private home environment) constitutes an extremely hazardous operation and is not condoned.*

Oxygen to be used for medical purposes is a prescription drug when used for therapeutic purposes and shall be prescribed by a physician. However, current practice permits medical oxygen for emergency use to be distributed without a prescription providing the users are properly trained in the administration of emergency oxygen. Its packaging requires specifically prescribed tests and compliance activity record keeping.

In the United States, the regulations of the Food and Drug Administration (FDA), Department of Transportation (DOT), and the Occupational Safety and Health Administration (OSHA) apply. In Canada, requirements of Transport Canada (TC); Canadian Standards Association (CSA); Health Canada, Therapeutic Products Programme; and other government agencies and publications also apply. The National Fire Protection Association's publication NFPA 99, *Standard for Health Care Facilities*, contains restrictions for transfilling in medical facilities [1].¹

2 Scope

This publication describes the primary hazards involved in the filling of high pressure gaseous oxygen cylinders for respiratory use from another high pressure oxygen cylinder. Before engaging in this practice, it is essential to be familiar with the hazardous properties of oxygen, required safety precautions, and the applicable government regulations. This publication also describes minimum requirements for equipment that is used in transfilling. This publication is not intended as guidance for liquid to gas high-pressure cylinder filling operations nor liquid to liquid container filling operations, see CGA P-15, Standard for the Filling of Industrial and Medical Nonflammable Compressed Gas Cylinders [2].

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**

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

3.1.5 **Can**

Indicates a possibility or ability.

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

4 Hazards of transfilling

Transfilling of gaseous oxygen from one or more cylinders to other cylinders involves hazards associated with the handling of gas under high pressure, the possibility that the repackaged oxygen could become contaminated, and the oxidizing property of oxygen, which supports vigorous combustion.

This publication applies to cylinders fitted with connection CGA 540, CGA 870, or the manufacturer's own proprietary connection being transfilled from cylinders having pressures not exceeding 3000 psi at 120 °F (20 680 kPa at 48.9 °C).²

Transfilling from high pressure cylinders is hazardous even if performed by qualified personnel and shall not be attempted without pressure regulation and equipment utilizing pressure relief devices (PRDs) consistent with the maximum allowable working pressure (MAWP).

Cylinders for oxygen are also available with different connections, such as CGA 577 for cylinders having pressures of 3001 psi to 4000 psi at 120 °F (20 690 kPa to 27 580 kPa at 48.9 °C), and CGA 701 for cylinders having pressures of 4001 psi to 5500 psi at 120 °F (27 590 kPa to 37 900 kPa at 48.9 °C). When transfilling is performed these pressures could be at or near the rupture pressure of the receiving cylinders.

If, with full knowledge of the associated potential hazards, transfilling is attempted from cylinders with higher pressures into lower pressure rated cylinders, a suitable pressure regulator and PRDs are necessary to protect the receiving cylinders.

4.1 Personnel qualifications

Transfilling shall only be performed by trained, qualified personnel who are knowledgeable of the precautions necessary to avoid the hazards listed in Section 4. They shall be knowledgeable of the procedures necessary to comply with the government regulations outlined in Section 5. See 5.2.2.2 for guidance on current good manufacturing practice.

4.2 Operating instructions

Detailed written operating instructions should be provided by the manufacturer of the equipment to be used in the transfilling procedure and should include equipment inspection and maintenance procedures. See 5.2.2.2 for guidance on current good manufacturing practice. In the case that the manufacturer does not provide these instructions, appropriate SOPs shall be developed.

4.3 Description of gaseous and liquid oxygen

Oxygen is an element that at ambient pressure and temperature exists as a colorless, odorless, tasteless gas. About one-fifth of the earth's atmosphere is oxygen (20.95% by volume). Oxygen is 1.1 times heavier than air. Above its critical temperature of -181.4 °F (-118.6 °C), oxygen can exist only as a gas regardless of the pressure. [CGA G-4](#), *Oxygen*, provides additional information [4].

Liquid oxygen is light blue in color and flows like water. It boils at -297.3 °F (-182.9 °C) at standard atmospheric pressure and is 1.14 times heavier than water. Gaseous oxygen at ambient pressure and temperature will occupy a volume approximately 860 times the volume occupied by the same amount of oxygen in its liquid form.

The significant properties of oxygen are its abilities to sustain life and to support combustion.

4.4 Some hazards of high pressure gaseous oxygen

Although oxygen itself is nonflammable, materials that burn in air burn much more vigorously and at a higher temperature in oxygen-enriched atmospheres. If ignited, combustibles such as oil burn in oxygen with explosive violence. Other materials that do not burn in air burn vigorously in oxygen-enriched atmospheres.

² kPa shall indicate gauge pressure unless otherwise noted as (kPa, abs) for absolute pressure or (kPa, differential) for differential pressure. All kPa values are rounded off per [CGA P-11](#), *Metric Practice Guide for the Compressed Gas Industry* [3].

A hazardous condition exists if high pressure oxygen equipment becomes contaminated with hydrocarbons such as oil, grease, or other combustible materials including oil from the operator's hands or contaminated tools. Ignition temperatures are reduced in oxygen-enriched atmospheres. There have been incidents where explosive rupture and burning of system components have resulted under these circumstances. Further details are provided in NFPA 410, *Standard on Aircraft Maintenance* [5].

A hazardous condition can also exist if the high pressure cylinder to be filled has been used in the offshore marine industry. If the receiving cylinder was previously used in this type of environment, see [CGA P-70 Standard for the Safe Handling of Oxygen Cylinders in the Offshore Marine Industry](#) for additional precautions [6].

Oxygen under pressure presents a hazard in the form of stored energy. Accidents can result when this energy is not controlled. As stated in NFPA 410, "Physical damage to or failure of oxygen containers, valves, or piping can result in explosive rupture and fire in oxygen systems with danger to life, limb, and property" [5].

The rapid release of high pressure oxygen through orifices, needle valves, etc., in the presence of foreign particles can cause friction or impact resulting in temperatures that can be sufficient to ignite combustible materials and rapidly oxidize metals.

A cylinder heats as it is filled from a high pressure source. The more rapidly the cylinder is filled, the higher the temperature rise in the cylinder resulting from the heat of compression of the gas. During filling, the cylinder temperature should not exceed 130 °F (54.4 °C). Excessive temperature can result in the ignition of any combustible materials that are present and can affect the seal between the valve and cylinder.

5 Government regulations

5.1 General

Persons or organizations engaged in the filling or transfilling of oxygen cylinders shall understand and comply with the applicable regulations. The following is a partial list of the regulations that apply to the filling or transfilling of oxygen.

5.2 U.S. regulations

5.2.1 Department of Transportation—Title 49 of the *Code of Federal Regulations* [7]

- 49 CFR 172.200—Describes requirements for shipping papers
- 49 CFR 172.400—Describes general labeling requirements, including cylinders
- 49 CFR 172.700—Outlines training requirements for hazmat employees (including personnel preparing gas cylinders for shipment)
- 49 CFR 180.205—Describes the requirements for qualification, maintenance, and use of compressed gas cylinders
- 49 CFR 173.301—Describes general requirements for shipment of compressed gases in cylinders, including the need for the cylinder owner's consent before filling and the requirement that a cylinder cannot be filled and shipped if it is beyond its prescribed requalification interval
- 49 CFR 173.302—Describes charging of cylinder with nonliquefied compressed gases (including detailed requirements and special filling limits)

5.2.2 Food and Drug Administration

5.2.2.1 Federal Food, Drug, and Cosmetics Act, as amended by the FDA Modernization Act of 1997 [8]

- Section 201, Definitions
- Chapter III, Prohibited Acts and Penalties