



CGA V-7—2021

STANDARD METHOD OF DETERMINING CYLINDER VALVE OUTLET CONNECTIONS FOR INDUSTRIAL GAS MIXTURES

SEVENTH EDITION

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Cylinder Valve Committee

NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendix A (Normative) is a requirement.

NOTE—Appendix B (Informative) is for information only.

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1 Introduction

CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections* provides valve outlet connections for numerous pure gases but only includes a few mixtures that have a history of being commercially or medically important and for which standards were in demand [1].¹

In recent years, there has been a tremendous increase in the number of industrial, specialty, and semiconductor gas mixtures entering the commercial market, and the need to have some separation in the applicability of valve outlets to the thousands of gas mixtures is apparent. CGA undertook the development of a procedure for providing some safe separation of valve outlets for gas mixtures having similar properties.

It was recognized that it was physically impossible to establish a sufficient number of different valve outlets to provide a major separation for these thousands of gas mixtures. After much consideration, CGA concluded that a practical and reasonable separation could be achieved by selecting a limited number of existing connections and assigning these to mixtures having similar properties. This was intended to minimize the misconnection of gas mixtures whereby a serious hazard could occur.

CGA V-1 provides outlet connections in a logical and orderly manner [1]. The method for determining a cylinder valve outlet connection for various industrial gas mixtures is based on a four-digit numerical code assigned to each gas based on its fire potential, toxicity, state of the gas, and corrosiveness (FTSC). FTSC codes have been consolidated into CGA P-47, *Guidelines for FTSC Codes and Current Gas Listings* and as such, the application of this standard requires referencing CGA P-47 [2].

References in this standard to valve outlet connection numbers are those contained in CGA V-1 [1].

Medical gases and medical gas mixtures are given special treatment because of their applications, which involve the care and critical handling of medical patients. For this reason, outlet connections for mixtures of medical gases are considered on a mixture-by-mixture basis and are not covered in this standard. They are covered in CGA V-7.1, *Standard Method of Determining Cylinder Valve Outlet Connections for Medical Gases* [3].

2 Scope and purpose

2.1 Scope

This standard applies to the selection of a suitable cylinder valve outlet connection for industrial, specialty, and semiconductor gas mixtures for pressures up to 3000 psi at 70 °F (20 680 kPa at 21.1 °C).² It applies to cylinders filled for individual use, cylinders filled individually for the purpose of assembling into a cylinder bundle, and for all cylinder bundle manifold outlet connections.

This standard does not apply to cylinders contained within an assembled cylinder bundle filled as one individual unit by use of the cylinder bundle manifold outlet connections. It also does not apply to medical gas mixtures (see CGA V-7.1) [3].

For the assignment of ultra high integrity service (UHIS) connections for mixtures, see Appendix A. Appendix A is reproduced with permission from International Organization for Standardization (ISO) 10692-1:2001, *Gas cylinders—Gas cylinder valve connections for use in the micro-electronics industry—Part 1: Outlet connections* [5].

For the purpose of this standard, a mixture is understood to be the purposeful combination of two or more components. An odorant shall be considered a component when added to either a pure gas or a mixture. Blanketing of a pure gas or mixture is not considered the generation of a new mixture. However, the effect of the pressure increase needs to be considered when determining the FTSC code.

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

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, *Guideline for Metric Practice in the Compressed Gas Industry* [4].

2.2 Purpose

The purpose of this standard is to establish a method for selecting the proper cylinder valve outlet connection for mixtures of two or more industrial gases. This standard does not attempt to identify which gas mixtures can be manufactured safely and successfully as this is the responsibility of the mixture manufacturer. Further, it does not describe any means or techniques for making mixtures.

3 Definitions

For the purpose of this standard, 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.

3.2 Technical definitions

3.2.1 Corrosive

Value of 1, 2, or 3 for the C value of the FTSC code.

3.2.2 Highly oxidizing

Value of 4 for the F value of the FTSC code, which is an equivalent oxygen concentration greater than 23.5%.

3.2.3 Oxidizing

Value of 1 for the F value of the FTSC code, which is an equivalent oxygen concentration greater than 5% but less than or equal to 23.5%.

3.2.4 Toxic

Value of 3 for the T value of the FTSC code, which is equivalent to an LC₅₀ less than or equal to 200 ppm.

NOTE—Materials with a T value of 2 (LC₅₀ less than or equal to 5000 ppm and greater than 200 ppm) may also be classified as toxic.

4 Description of the method

4.1 General

The standard method described herein shall be used in conjunction with the latest edition of CGA V-1 and CGA P-47 [1, 2]. Drawings for all of the connection numbers referred to in this standard can be found in CGA V-1 [1].

4.2 FTSC code classification

Each gas is classified with a FTSC numerical code based on the four properties described in Table 1 in this standard from which the initials FTSC derive, namely fire potential, toxicity, state of the gas, and corrosiveness.

A numerical scale (0 to 9) is used to assign a level within each of the four property categories as shown in Table 1 in this standard and these numbers produce the four-digit FTSC code for each gas shown in Table 2 of CGA P-47 [2].

The FTSC code established identifies the gas by its properties and allows similar gases to be grouped under the same FTSC code.

When the final mixture is flammable or oxidizing and contains components that are toxic, corrosive, or can decompose or polymerize, additional evaluation and segregation shall be made according to Table 2 in this standard.

Table 3 in this standard lists mixture component rating numbers (MCRNs) assigned to various FTSC codes and the high and low pressure connections assigned to these MCRNs.

If all the components of a mixture are listed in Table 2 of CGA P-47, specific connections can be selected by applying the procedures in Section 8 in this standard [2]. If one or more components of a mixture are not listed in Table 2 of CGA P-47, follow the procedures in Section 9 in this standard [2]. Examples for selecting valve outlet connections are given in Section 10 in this standard.

5 Principles for valve outlet selection

5.1 General

The principles for valve outlet selection are based on MCRNs as found in Table 3 in this standard. If all components have the same MCRN and the same connection assignment, the specified connection shall be used.

When one component of the mixture has a larger MCRN than all the others, that component shall determine the valve outlet connection. When the final mixture is flammable or oxidizing, then an additional evaluation and segregation shall be made according to Table 2 in this standard.

For more information on the preparation of compressed oxidant-fuel gas mixtures, see CGA P-58, *Safe Preparation of Compressed Oxidant-Fuel Gas Mixtures in Cylinders* [6]. To prevent the inadvertent production of explosive mixtures, strict rules and procedures shall be followed.

WARNING: *Due to the inherent nature of oxidant-fuel gas mixtures, there is the possibility of an explosive mixture being produced, which can result in serious injury or death.*

When the largest MCRN is shared by two or more components, the connection shall be determined by the final properties of the mixture.

If the largest MCRN is shared by two or more components and these components also have the same percentage, the determining component shall be the one with the largest corrosiveness as determined by the fourth digit of the FTSC code, and shall be determined by the final properties of the mixture. For example, flammable versus oxidizing according to Table 2 in this standard.

If the components have equal corrosiveness, then the component having the largest toxicity as determined by the second digit of the FTSC code shall determine the choice of the valve outlet connection.

5.2 Gas concentration

Varying concentrations of the same gases in mixtures do not affect the choice of valve outlet connection except as specified in this standard for air, nitrous oxide, oxygen, and refrigerant gases (see 6.3). For example, 5 ppm hydrogen in nitrogen uses the same connection as 50% hydrogen and 50% nitrogen.