CGA

Compressed Gas Association

The Standard For Safety Since 1913

CGA V-1—2023

STANDARD FOR COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS

SIXTEENTH EDITION

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Work Item 26-20
Cylinder Valve Committee

NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendix I (Normative) is a requirement.

NOTE—Appendices II and III (Informative) are for information only.

SIXTEENTH EDITION: 2023
FIFTEENTH EDITION: 2021
FOURTEENTH EDITION: 2019 (Corrected 9/13/2019)
THIRTEENTH EDITION: 2013
TWELFTH EDITION: 2005

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V-1 MAJOR CHANGES

V-1, 1987, Sixth Edition

The 1987 edition included 65 valve outlet connections providing standards or alternate standards for almost 200 different compressed gases and mixtures.

- The following connections and their assigned gases were unchanged except in the instances where their use as alternate standards was phased out.

  165 180 182 200 240 280 295 410 440 450 500 520
  540 580 792 795 800 820 845 850 855 870 880 890
  900 910 920 930 940 950 960 965

- One connection was eliminated because it reached its phase out date of January 1, 1982.

  840

- The following connections were unchanged but their gas assignments were revised.

  296 320 330 350 510 670 677 679

- Ten new connections were added.

  347 415 577 600 680 695 701 702 703 973

- Most drawings were changed to provide tolerances and to update minor details. The following drawings underwent significant changes.

  326 346 705 860

- Ten connections were changed from alternate standard (due to be phased out) to standard or limited standard.

  110 160 170 290 300 555 590 660 677 678

- Three connections were changed from standard to alternate standard.

  668 750 755

V-1, 1994, Seventh Edition

The 1994 edition included 86 cylinder valve outlet connections providing standards for almost 200 different compressed gases and mixtures.

- The following connections and their assigned gases were unchanged except in the instances where their use as alternate standards was phased out.

  160 240 330 510 660 677 679

- Three connections were eliminated because they reached the phase out date of January 1, 1992.

  668 750 755

- One connection was eliminated because it reached the phase out date of January 1, 1993.

  410

- The following connections were unchanged but their gas assignments were revised.

  165 320 350 510 660 670

- Twenty-five new connections were added.

  167 621 622 624 632 634 636 638 640 642 712 714
  716 718 720 722 724 726 728 790 820C 852 977 981
  985

V-1, 2000, Eighth Edition

The 2000 edition included 113 valve outlet connections providing standards or alternate standards for 264 different compressed gases and mixtures.

- The following connections were unchanged but their gas assignments were revised.

  632 642 716 724 728

- Five new connections were added.

  724 791 810 851 853

- The following connection was revised to include standard or limited standard.

  320

- The following connection's header page definitions were modified.

  590 851 853

- Other major technical changes included:
  - Added plating allowance on NGO external outlet threads.
  - Updated Appendix III to include limited standards and new assignments.

    320 330 555 590 625 632 626 660 716 724 728 791
    810 851 853

- Plus several international changes:
  - Revised to reflect dimensional and pictorial changes.

    630 710

  - The following CGA Technical Bulletins were added.

    TB-14 TB-16

  - Connection No. 410 was a limited standard for Canada, which expired January 1, 1992, and was removed for the 1994 edition. At that time, connection 415 became the active standard for uses in Canada. Due to requests from Canada, connection 410 was reinstated and connection 415 was made obsolete.

V-1, 2001, Ninth Edition

The 2001 edition includes 115 valve outlet connections providing standards or alternate standards for 268 different compressed gases and mixtures.

- The following connections were unchanged but their gas assignments were revised.

  716 660 350 724

- Two new connections were added.

  323 989

- The following connection's header page definitions were modified.

  621

- Other major technical changes included:

  - Added unique test protocol for ultra high integrity connections since there were differences with the existing test protocol for the standard connections.

  - Requirements were added to eliminate unauthorized field changes for outlet connections on liquid and medical gas cylinders.

V-1, 2002, Tenth Edition

The 2002 edition includes 115 valve outlet connections providing standards or alternate standards for 268 different compressed gases and mixtures.

- Major technical changes included:

  - Added a pin configuration as an option for the antirotational feature for the ultra high integrity connections and their outlet seal caps.

  - Revised statements associated with inlet threads and their installation into cylinders.

V-1, 2003, Eleventh Edition

The 2003 edition includes 115 valve outlet connections providing standards or alternate standards for 268 different compressed gases and mixtures.

- The following connections were unchanged but their gas assignments were revised.

  728 716

- Figure 1 was revised.

- Appendix I was updated.

V-1, 2005, Twelfth Edition

The 2005 edition includes 113 valve outlet connections providing standards or alternate standards for 268 different compressed gases and mixtures.

- The following connections were unchanged but their gas assignments were revised.

  320 634

- Added liquid cylinder venting designations to the following connection.

  350

- The following connections were revised to include a limited standard:

  - For liquid cylinder venting of carbon dioxide: 622

  - For liquid cylinder venting of hydrogen: 795

- Connections 851 and 853 were removed from the standard.

V-1, 2013, Thirteenth Edition

The 2013 edition includes 115 valve outlet connections providing standards or alternate standards for 270 different compressed gases and mixtures.

- Three new connections were added.

  789 793 812

- The following connections were unchanged but their gas assignments were revised.

  330 580 634 636

- Two connections were changed to include a standard or limited standard.

  166 660 678 679

- The established pressure range for intermediate high pressure connections was revised.

  347 621 680 695

- Two established intermediate pressure ranges were revised for oxygen.

  577 701

- The established high pressure range was revised.

  677 702 703

- Most drawings were changed to provide tolerances and to update minor details. The following drawings underwent significant changes.

  790 791 800 845 860

- The pressure at temperature rating was changed from 120 °F to 70 °F (48.9 °C to 21.1 °C) to the standard, intermediate high, and high pressure range connections for a number of reasons:

  - The DOT now allows UN 200 BAR cylinders to be transported. The pressure ratings of these connections have been increased to allow them to be used on these UN 200 BAR cylinders.

  - Qualification testing of these connections was performed at pressures associated with cylinders filled to 3000 psi at 70 °F with successful results;

  - This change makes all the pressure at temperature ratings consistent, at 70 °F instead of some connections at 70 °F and some at 120 °F.

V-1, 2019, Fourteenth Edition

The 2019 edition includes 124 valve outlet connections providing standards or alternate standards for 274 different compressed gases and mixtures.

- Seven new connections were added.

  164 320R 540R 580R 590R 802 803

- One connection was changed to include a standard or limited standard.

  510

- Twenty-one connections were corrected 13 Sep 2019, more specifically, numerical values given for valve outlets, hexagon nuts, washers, etc. were incorrectly transcribed from the 13th edition to 14th edition. These corrections are noted in shaded text. Connections affected:

  110 160 180 200 240 290 295 300 320R 323 326 350
  500 510 540R 580R 590R 677 802 803 860

V-1, 2021, Fifteenth Edition

The 2021 edition includes 129 valve outlet connections providing standards or alternate standards for 275 different compressed gases and mixtures.

- Five new connections were added.

  346R 347R 350R 555R 680R

- The following connection was unchanged but gas assignments were revised.

  510 555 634 695

- The following drawings had tolerances updated.

  540R 580R 590R

- Appendix I was updated to include design requirements and testing protocols for residual pressure valve fill connectors.

V-1, 2023, Sixteenth Edition

The 2023 edition includes 129 valve outlet connections providing standards or alternate standards for 278 different compressed gases and mixtures.

- One new connection was added.

  971

- The following connections were unchanged but gas assignments were revised.

  350 660 724

- The following drawings had tolerances updated.

  860

FOREWORD

HISTORY

The first efforts to develop standards for compressed gas cylinder valve connections followed immediately after World War I and were inspired by the difficulties encountered both by industry and by military services because of the multiplicity of connections then in use and because of the danger from using the same connection for incompatible gases.

Through the activity of the Gas Cylinder Valve Thread Committee of the Compressed Gas Manufacturers' Association, Inc. (CGMA), substantial progress was made through the years that followed and, when the United States became involved in World War II, gas industries materially improved this situation. Several compressed gas industries had achieved virtual standardization at tremendous cost for replacement of valve equipment. Their standards, however, were not completely formalized nor fully coordinated with other related standards. Much of the progress between World War I and World War II was the result of interest in this problem by the Federal Specifications Board.

These circumstances surrounding industrial and military users of compressed gases during World War II brought into clear focus the need for acceleration of the standardization project for cylinder valve needs. They created not only the necessity but also an opportunity for the compressed gas industry, military services, and other federal agencies to cooperatively study standardization problems of valve outlet threads. These studies resulted in closer definition and appreciation of each valve outlet and a more balanced relationship between many types and sizes.

When standards associations representing Great Britain, Canada, and the United States met in Ottawa in October 1945 to consider unification of screw threads, a well-developed plan for standardization of compressed gas cylinder valve threads was presented to the conference by the Valve Standardization Committee of CGMA. These proposed standards represented the experience and knowledge of compressed gas manufacturers and needs and requirements of varied users of gas cylinder valves, including military services and other federal agencies. Approval of these standards, to the extent to which they were then developed, was given by U.S. Department of Commerce, U.S. Army, and U.S. Navy through the Interdepartmental Screw Thread Committee following a joint meeting with the representatives of CGMA in July 1945. Much progress was made later in that year at the Canadian Section Meeting of CGMA to unify United States and Canadian practices. During January 1946, through conference between representatives of the CGMA Valve Thread Standardization Committee and the Interdepartmental Screw Thread Committee in Washington, agreements were reached that resulted in final approval of considerable additional gas cylinder valve thread data for inclusion in the *National Bureau of Standards Handbook* H-28.

CGMA changed its name in January 1949 to the Compressed Gas Association (CGA), and its Valve Thread Standardization Committee became the Valve Standards Committee. In 1971, the Valve Standards Committee became the Connections Standards Committee to recognize a broadened scope to cover all compressed gas connections. During the interval between January 1946 and February 1949, this committee had developed its standards sufficiently to present them to the American Standards Association (ASA) and the Canadian Standards Association (CSA). They were accepted as National Standards for Canada and the United States in 1949, accomplishing an objective established some 30 years before. Since that date, additional connections have been developed and have been included in subsequent editions of the standard. Similarly, alternate standard connections were removed as they became obsolete.

With the growth of electronic, chemical, and other high technology industries where new gases were developed within the past 15 to 20 years, the need to classify all gases became a reality. A system was developed in the late 1960s that took into account fire potential, toxicity, state of the gas, and corrosiveness of each gas, known as the FTSC Code. New connections were designed to fit into the existing system of noninterchangeable connections. These were tested and then assigned to new gases or other various groups of gases as needed. A goal of only one standard valve outlet connection for each gas was established. All these changes appeared in the 1977 edition of V-1.

The 1977 edition of V-1 also established phase out dates for all alternate connections for the first time. Industry believed that it was not necessary to make arbitrary changes to a new or different connection when many years of safe operation and proven performance were considered.

Therefore, the 1987 edition of V-1 reflected the more realistic requirements of industry and public safety. It allowed for more than one connection to be used for some gases where safety is not compromised. It recognized that the use of a valve outlet connection, per se, does not ensure complete safety from interconnection and that proper labeling shall be used to identify the gas involved. Four pressure ranges were established to clearly separate the choice of connections that apply to gases in each pressure range and to protect directly connected downstream equipment against overpressurization. Finally, all numerical data listed in the 1987 edition was shown in metric as well as English units.

The 1994 edition of V-1 continued the philosophy of the 1987 edition to allow for more than one connection to be used for some gases where safety is not compromised. An entirely new set of connections with a unique design for ultra high integrity service [UHIS] (630 and 710 series) was developed for specific gases used by the electronic industry for high integrity service.

The 2000 edition of V-1 established additional gas assignments for ultra high integrity connections (630 and 710 series). In addition, two connections were added to accommodate the propane industry's requirement for connections that can be made without the use of tools, which also would not allow the flow of gas before a connection was made. These new connections (791 and 810) were intended to maximize safety in the making and breaking of gas connections performed by nonprofessionals in user applications. Finally, new connections (851 and 853) were assigned for breathing mixtures containing various percentages of oxygen for the self-contained underwater breathing apparatus (SCUBA) industry.

Connections 851 and 853 were eliminated in the 2005 edition because they were not properly used by the diving industry.

The 2013 edition of V-1 added new connections for vapor withdrawal of liquefied petroleum gas in vapor engine fuel service and for propane gas withdrawal. In addition, the connection rating temperature was changed from 120 °F to 70 °F (48.9 °C to 21.1 °C) to several pressure connection ranges to allow the connections to be used on UN 200 BAR cylinders that are now permitted by DOT; qualification testing of these connections was performed with successful results; and this change makes all the pressure at temperature ratings consistent, at 70 °F instead of some connections at 70 °F and some at 120 °F.

The 2013 edition also addresses requirements for the diameter of the valve inlet to minimize propulsion effects should the valve be accidentally severed at the top of the cylinder neck. Seal gasket requirements were added to CGA 860 pin index yoke connections. Lastly, the Pin Index Safety System connections should be limited to E size of smaller cylinders and shall be labeled as a drug or medical device (use of certain cylinders with just one exception—connection no. 950). Connections in the Pin Index Safety System may also be used for calibration gases.

The 2019 edition added new connections for use on valves that contain residual pressure valves (RPV). These "R" connections (e.g., 320R) were created to standardize the connection pin lengths in order to provide consistent RPV actuation and prevent RPV damage. These connections are only intended for fill plant use and are not intended for field use.

The 2019 edition also added new connections (164, 802 and 803) for specific applications. Outlet connection No. 164 was added for ASHRAE A2L type designated refrigerants. Connection Nos. 802 (helium) and 803 (hydrogen) were added for higher pressure applications.

The 2021 edition added new connections for use on valves that contain RPVs (346R, 347R, 350R, 555R, 680R) These connections are only intended for fill plant use. The standard connections shall be used in the field.

The 2023 edition added and clarified technical definitions used in this publication. Additionally, one new connection was added: CGA 971. Changes were made to the gas assignments for connections CGA 350, 660, 716, and 724. For CGA 860, dimensional tolerances were updated.

1 Introduction

CGA's Cylinder Valve Committee, applying the experience and knowledge of gas producers, valve manufacturers, military services, federal agencies, and gas users, established detailed dimensions for the manufacture of new cylinder valve outlet and inlet connections.

2 Scope

The scope of this standard is to provide connections that minimize the possibility of hazardous misconnections. This standard is based on a coordinated plan for the inclusion of future connections as they are required on cylinders that are not permanently manifolded during transport and use. Standard outlet connections for respective gases are fully defined and complete in themselves. These outlet connections are designed to minimize the possibility of hazardous misconnections.

2.1 Material specifications

Material specifications are not covered by this standard except where they are essential for maintaining the integrity of noninterchangeability between connections intended for different gas services. See connection nos. 860, 630, and 710. Chemical and physical properties of gases, including pressure, shall be considered to determine the strength and suitability of materials used.

2.2 Commodities

Some of the commodities covered by this standard do not meet the generally accepted definition of compressed gas, as defined by the U.S. Department of Transportation (DOT) [1].[1] Some products are handled in compressed gas cylinders. In these cases, the cylinder shall have the standard outlet to minimize hazardous misconnections even though it is not required for safe packaging.

2.3 Liquid and gas withdrawal

Standards for any of the liquefied gases are suitable for both liquid and gas withdrawal except where a connection standard is limited to liquid withdrawal.

2.4 Dimensional units

All dimensions are in inches (millimeters).

In 1970, Canadian Parliament unanimously endorsed the *White Paper on Metric Conversion in Canada*, proposing the adoption of the most up-to-date metric system of measurement, système international d'unités or SI. The Metric Commission was established in June 1971 to prepare an overall plan for metric conversion. Today, many sectors of industry and commerce in Canada, including the gas industry, sell their products in metric sizes and packages. Since CGA V-1 is used in Canada, it is published with dual units. Conversion factors can be found in CGA P-11, *Guideline for Metric Practice in the Compressed Gas Industry* [2].

Unless otherwise specified, the metric conversion in this standard is soft and affects no change in the shape of the threads and dimensions to maintain complete interchangeability between parts made either from U.S. customary units or SI measurements. Metric dimensions appear within parentheses and are in millimeters, unless otherwise specified. Exceptionally, the nominal designations of threads (for example, .825-14NGO-RH-EXT) have not been metricated.

Metric thread dimensions have been rounded toward the interior of the tolerance zone. Maximum limits have been rounded downward, while minimum limits have been rounded upward. This method of rounding was selected to permit the use of existing gauges. Other dimensions have been rounded to the nearest significant digit.

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

2.5 Marking and labeling of containers

Although the main purpose in standardizing valve outlets is to prevent interconnection with noncompatible gases, relying only on the valve outlet as the sole method of preventing such interconnection is not advised. The primary means for identifying the contents of any container of compressed gas shall be by means of the chemical name or the commercially accepted name of the material legibly marked on the container.

All cylinders shall be well marked as to contents in accordance with CGA C-7, *Guide to Classification and Labeling of Compressed Gases* [3]. The user shall rely on such markings to identify contents and understand the properties of the gas or gases to be used to ensure system compatibility.

2.6 Effective date

Unless otherwise stated, the effective date of this edition of this standard is July 6, 2023 and shall not be applied retroactively.

2.7 Blunting

Modification of the lead thread (blunting) is allowed as long as there is no loss of sealing or structural integrity. Blunting is used to reduce galling.

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 Blunting
Intentional and controlled flattening of the crest of the lead thread of externally threaded portions of cylinder valve connections.

3.2.2 Check valve
Valve designed to provide for flow in one direction.

NOTE—The internal components of the valve are designed to prevent flow in the reverse direction.