

METRIC

BB-C-101C  
21 January 2004  
SUPERSEDING  
BB-C-101B  
15 April 1971

## FEDERAL SPECIFICATION

### CARBON DIOXIDE (CO<sub>2</sub>): TECHNICAL AND USP

The General Services Administration has authorized the use of this federal specification by all federal agencies.

#### 1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers medicinal and non-medicinal carbon dioxide gases.

1.2 Classification. The carbon dioxide gases will be of the following grades as specified (see 6.2).

##### 1.2.1 Grade.

Grade A - Medical (United States Pharmacopeia (USP))

Grade B - Industrial

#### 2. APPLICABLE DOCUMENTS

2.1 Government publications. The issues of the following documents, in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

##### Federal Specifications

RR-C-901

- Cylinders, Compressed Gas: Seamless Shatterproof,  
High Pressure DOT 3AA Steel and 3AL Aluminum.

Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data that may improve this document should be sent to: STDZNMGT@dla.mil or Defense Supply Center Richmond, ATTN: DSCR-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616.

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### Federal Standards

FED-STD-123 - Marking for Domestic Shipment (Civil Agencies).

(Activities outside the federal government may obtain copies of federal specifications, standards, and commercial item descriptions as specified in the General Information section of the Index of Federal Specifications, Standards and Commercial Item Descriptions. The index is for sale on a subscription basis from the General Services Administration, Federal Supply Service, Specification Section, East 470 L'Enfant Plaza SW, Suite 8100, Washington, DC 20407.)

(Single copies of this specification, and other federal specifications and commercial item descriptions required by activities outside the federal government for bidding purposes are available without charge from the General Services Administration, Federal Supply Service, Specification Section, East 470 L'Enfant Plaza SW, Suite 8100, Washington, DC 20407.)

(Federal government activities may obtain copies of federal standardization documents and the Index of Federal Specifications, Standards and Commercial Item Descriptions from established distribution points in their agencies.)

### Military Specifications

MIL-DTL-2 - Valves, Cylinder, Gas (for Compressed or Liquefied Gases), General Specification for.

### Military Standards

MIL-STD-101 - Color Code for Pipelines and for Compressed Gas Cylinders.

MIL-STD-129 - Marking for Shipment and Storage.

MIL-STD-1411 - Inspection and Maintenance of Compressed Gas Cylinders.

MIL-STD-1916 - DoD Preferred Methods for Acceptance of Product.

(Copies of military specifications and standards required by contractors in connection with specific procurement functions are obtained from the Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094. Electronic copies of specifications and standards may be obtained from <http://assist.daps.dla.mil/quicksearch/>.)

### Code of Federal Regulations (CFR)

49 CFR 171-180, Subchapter C - Hazardous Materials Regulations.

(The Code of Federal Regulations (CFR) and the Federal Register are for sale on a subscription basis from the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. When indicated, reprints of certain regulations may be obtained from the federal agency responsible for issuing them. Electronic copies may be obtained from <http://www.access.gpo.gov/>.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on the date of invitation for bids or request for proposal shall apply.

United States Pharmacopeia (USP)

USP - NF - The United States Pharmacopeia.

(Private sector and civil agencies may purchase copies of these voluntary standards from the United States Pharmacopeia, 12601 Twinbrook Parkway, Rockville, MD 20852. Electronic copies of USP standards may be obtained from <http://www.usp.org/>.)

Compressed Gas Association (CGA)

CGA TB-17 - Test Methods for Evaluating Paints and Coatings on Refillable Steel Compressed Gas Cylinders.

(Private sector and civil agencies may purchase copies of these voluntary standards from the Compressed Gas Association, 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923. Electronic copies of CGA standards may be obtained from <http://www.cganet.com/>.)

### 3. REQUIREMENTS

3.1 Material. The carbon dioxide provided shall be of the grade specified.

3.1.1 Grade A - medical. Grade A carbon dioxide shall conform to the requirements of the USP.

3.1.2 Grade B - industrial. Grade B carbon dioxide shall conform to table I.

TABLE I. Properties of grade B carbon dioxide.

Properties	Requirements
Purity, minimum (% by volume)	99.5
Acidity	Successful completion of test specified in 4.4.2
Moisture content, maximum	0.092 mg/l
Odor	No objectionable odor

3.2 Containers and valves. The carbon dioxide shall be contained in government owned and furnished cylinders conforming to RR-C-901 equipped with valves meeting all requirements of MIL-DTL-2. When specified (see 6.2), new cylinders and valves shall be purchased in accordance with RR-C-901 and MIL-DTL-2 respectively and furnished with the gas product.

3.2.1 Low-pressure containers. When specified (see 6.2), the carbon dioxide shall be delivered to low-pressure bulk liquid storage containers.

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3.3 Cylinder maintenance. Cylinders shall be inspected, maintained, or reconditioned in accordance with the procedures found in MIL-STD-1411 to meet all serviceability requirements of 49 CFR 171-180, Subchapter C.

3.3.1 Painting. Cylinders requiring painting shall be color coded and stenciled in accordance with MIL-STD-101. The paint and the painting process shall meet all requirements of CGA TB-17 tests 1, 3, 5, 6, and 8 as applicable.

3.3.2 Replacement valves. Unless otherwise specified (see 6.2), replacement valves for any defective valves found shall be furnished by the supplier and shall be qualified to meet all requirements of MIL-DTL-2.

3.4 Capacity. Cylinders shall be filled to their rated capacity. Low-pressure bulk liquid storage containers shall be filled with the quantity specified in the contract or acquisition order (see 6.2).

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or acquisition order (see 6.2), the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or acquisition order (see 6.2), the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the government. The government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Classification of inspection. Inspection shall be classified as follows:

- a. Quality conformance inspection (see 4.3).
- b. Test methods (see 4.4).

4.3 Quality conformance inspection.

4.3.1 Sampling. Sampling for tests shall be in accordance with level I of MIL-STD-1916. Unless otherwise specified herein, sampling shall be from filled containers.

4.3.2 Lot. A lot shall consist of all high-pressure cylinders filled from the same source during a consecutive 24-hour period. Each delivery of carbon dioxide for filling of a bulk storage container shall be considered a lot.

4.3.3 Examination. Containers of carbon dioxide shall be examined as specified herein for the following defects:

- a. Carbon dioxide having objectionable odor.
- b. Container or valve not as specified.
- c. Container maintenance not as specified.
- d. Capacity not as specified.

#### 4.3.4 Tests.

4.3.4.1 Individual container. Each container of carbon dioxide shall be tested for leakage as specified in 4.4.4. Failure of the test shall be cause for rejection.

4.3.5 Test sampling. Samples selected in accordance with 4.3.1 shall be tested in accordance with 4.3.5.1 or 4.3.5.2.

4.3.5.1 Grade A - medical. Grade A carbon dioxide shall be tested as specified in the USP - NF. Failure to meet the acceptance criteria of one or more USP tests shall be cause for rejection.

4.3.5.2 Grade B - industrial. Grade B carbon dioxide shall be tested as specified in 4.4. The moisture content determination specified in 4.4.3 may be sampled from the carbon dioxide liquid in the container charging line or continuously monitored by instrument in lieu of sampling from filled containers. The rate at which discrete samples are taken from a container charging line shall be commensurate with and not less frequent than sampling done as specified in 4.3.1.

#### 4.4 Test methods.

4.4.1 Purity. The purity of grade B carbon dioxide shall be determined by either gas chromatography or using an Orsat (volumetric) analyzer or equivalent with a capability of determining the purity with an accuracy of at least 0.1 percent. The carbon dioxide shall be drawn from the vapor phase of the container. The carbon dioxide container and its contents shall be at a temperature between 21 °C (70 °F) and 24 °C (75 °F). At least 90 percent by weight of the original contents shall remain in the container after determining the percentage of carbon dioxide. The percentage of carbon dioxide shall be calculated by volume. Purity of the grade B carbon dioxide not as specified in table I shall constitute failure of this test.

4.4.2 Acidity. Pass 1 liter of the grade B carbon dioxide from the container through 50 milliliters (ml) of recently boiled distilled water that has been cooled to room temperature. Regulate the flow so that the delivery of 1 liter of the gas takes 15 minutes. The delivery tube shall have an orifice approximately 1 millimeter (mm) in diameter and shall extend to within 2 mm of the bottom of the vessel containing the distilled water. The vessel employed shall give a hydrostatic column of from 12 to 14 centimeters (cm), with 50 ml of distilled water. The gas shall be measured by means of a gas meter after its passage through the distilled water. After the passage of the gas, pour the liquid into one of two similar comparator tubes, "A", and then add two drops of methyl orange indicator. To tube "B" containing 50 ml of cooled recently boiled distilled water, add 1 ml of 0.01N hydrochloric acid solution and two drops of methyl orange indicator. Viewed downward over a white surface, the liquid in tube "A" showing a deeper shade of red than that in tube "B" shall constitute failure of this test.

4.4.3 Moisture content. The moisture content of grade B carbon dioxide shall be determined by the accelerated gravimetric method specified in 4.4.3.1, by the dew point (frost) method, by the electrolytic hygrometer method, or by the electrical conductivity method. The carbon dioxide sample shall be drawn from the container as a liquid. Vapor phase samples shall be conditioned either as described in 4.4.3.1 or by vaporization within a sampling cylinder before being admitted to the test apparatus. The conditioning procedure shall assure that all of the water present goes

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into the vapor phase with the carbon dioxide. If vaporized in a sampling cylinder the sample quantity should not be more than 10 percent of the normal capacity of the sampling cylinder. The sampling cylinder may be gradually heated to evaporate water condensed during the liquid carbon dioxide vaporization. Grade B carbon dioxide containing more than 0.092 mg of water per liter of gas at 760 mm of mercury and 21 °C (70 °F) shall constitute failure of this test.

4.4.3.1 Accelerated gravimetric method. Determine the increase in weight of phosphorus pentoxide ( $P_2O_5$ ) when subjected to a flow of a measured volume of carbon dioxide as follows. Connect the carbon dioxide container to the test apparatus by means of a length of bent, seamless, stainless steel tubing, a high-pressure union, a needle valve, and a glass-to-metal joint. Rubber connections are not acceptable; however, a sleeve joint secured with Tygon<sup>®</sup> or equivalent is acceptable. Connect a mercury safety valve between the low-pressure outlet of the needle valve and the first absorber. Use steel tubing of a fabrication that will have a capability of first passing through a water bath at room temperature and then into a second bath at a temperature above the critical temperature of liquid carbon dioxide. Use an apparatus consisting of three U-tube absorbers in series, each 10.2 centimeters (cm) (4 inches) high and 1.3 cm (1/2 inch) in diameter, and containing phosphorus pentoxide on glass wool and connected through a water-saturator to a calibrated wet test meter of 1/20-cubic-foot size equipped with a 1-liter dial. Flush the needle valve connecting the container to the absorber with carbon dioxide so that only gas discharged from the container will pass through the absorber. Bring the absorbers to constant weight in a stream of dry carbon dioxide before weighing so that when the absorbers are weighed they will be at all times filled with carbon dioxide. Before each weighing of the absorbers, open the absorbers momentarily to the air and then close, clean, and expose to radiation from a quartz mercury arc for 2 minutes to remove static charges. Discharge 100 liters through the apparatus at a rate not to exceed 0.4 liter per minute. Calculate the gas volume corresponding to the gain in weight to 760 mm of mercury and (21 °C) 70 °F. Compute the moisture content in terms of milligrams per liter.

4.4.4 Leakage. Each container shall be tested for leakage after filling by applying a soap solution to all portions of the valve and the junction of the valve and cylinder. Care shall be taken to ensure that the solution utilized does not contaminate the valve outlet or chemically react with the product in the cylinder. Any evidence of leakage of gas as evidenced by bubbling of the soap solution shall constitute failure of this test.

## 5. PACKAGING

5.1 Packing, packaging, and marking. Packing, packaging, and marking shall be as specified in the contract or acquisition order (see 6.2).

## 6. NOTES

INFORMATION FOR GUIDANCE ONLY. (This section contains information of a general or explanatory nature that is helpful, but is not mandatory.)

6.1 Intended use. Grade A carbon dioxide gas is intended for medical use. Grade B carbon dioxide gas is intended for airborne use, life raft inflation, fire extinguishing apparatus, and general purpose use.

6.2 Acquisition requirements. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- a. Title, number, and date of this specification.
- b. Grade of carbon dioxide required (see 1.2).
- c. Purchase of new cylinder and valves, if required (see 3.2).
- d. Delivery to low-pressure bulk liquid storage containers, if required (see 3.2.1).
- e. Replacement valves, if required (see 3.3.2).
- f. Quantity required for low-pressure bulk liquid storage containers, if required (see 3.4).
- g. Responsibility for inspection, if other than the contractor (see 4.1).
- h. Inspection facility, if other than contractor selected (see 4.1).
- i. Packing, packaging, and marking requirements (see 5.1).

6.3 Materials safety data sheet (MSDS). Contracting officers will identify those activities requiring copies of completed MSDS prepared in accordance with FED-STD-313 and meeting the requirements of 29 CFR 1910.1200. The pertinent government mailing addresses for submission of the data are listed in FED-STD-313, and 29 CFR 1910.1200 requires that the MSDS for each hazardous chemical used in an operation must be readily available to personnel using the material. Contracting officers will identify the activities requiring copies of the MSDS.

6.4 Sampling and testing precautions. This specification requires inspection of chemical material that is potentially hazardous to personnel. This specification does not purport to address all of the safety problems associated with its use. Sulfuric acid is very corrosive and dangerous when improperly handled. Contact with the body results in rapid destruction of tissues and severe burns. Adequate protection against any contact should be provided for all parts of the body. Although the acid itself is not flammable, it may cause ignition by contact with combustible materials; a highly flammable gas (hydrogen) is generated by the action of the acid on most metals. Concentrated sulfuric acid (class I) should not be stored in lead containers. Air pressure should never be used to empty carboys. It is the responsibility of the user of this specification to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

6.5 Submission of alternate inspection provisions. Proposed alternative inspection provisions should be submitted by the contractor to the procuring contracting officer for evaluation and approval by the technical activity responsible for preparation of this specification.

6.6 Government furnished containers. The contracting officer should arrange to furnish the containers specified in 3.2.

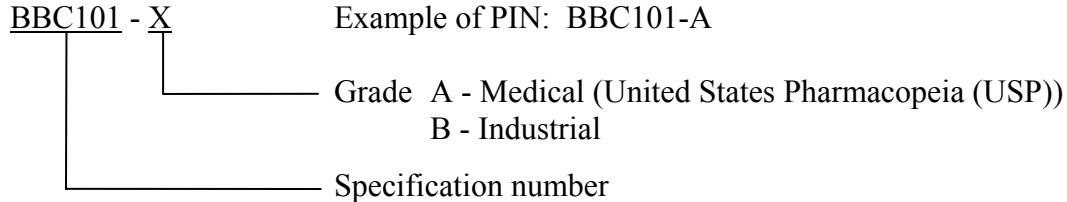
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6.6.1 Maintenance of government furnished cylinders. The contracting officer should specify the extent of the maintenance to be processed by the gas supplier for government furnished containers.

6.6.2 Customary services. The gas supplier should furnish, at no additional cost, all services that are required at each filling of a container to comply with applicable regulations and normal good practice. Such services should include, but not be limited to, all inspection, testing, evacuation, draining of condensed water, and handling services required for the gas supplied.

6.6.3 Allowable fees. A schedule of allowable fees should be specified by the contracting officer for the gas supplier's performance of services, such as the replacement of valves, valve parts, and cylinder caps, hydrostatic testing, painting, color coding, marking, and handling of unserviceable containers as required. All materials and components for these services should be furnished by the gas supplier.

6.7 Part or identification number. The following PIN procedure is for government purposes and does not constitute a requirement for the contractor.



6.8 Subject term (key word) listing.

cylinder  
fire  
inflation  
life raft  
medical

6.9 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

MILITARY INTERESTS:

Custodians:

Army - AV  
Navy - SH  
Air Force - 68

Review Activities:

Navy - AS, MS

CIVIL AGENCY  
COORDINATING ACTIVITY:

GSA - 7FLE

Preparing Activity:

DLA - GS3

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