

BB-C-101B  
April 15, 1971  
SUPERSEDING  
Fed. Spec. BB-C-101A  
October 27, 1964

FEDERAL SPECIFICATION

CARBON DIOXIDE (CO<sub>2</sub>): TECHNICAL AND U.S.P.

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers medicinal and nonmedicinal carbon dioxide gases.

1.2 Classification.

1.2.1 Grades. The carbon dioxide gases shall be of the following grades as specified see 6.2 and 6.3):

Grade A - Medicinal (U.S.P.).

Grade B - Nonmedicinal.

2. APPLICABLE DOCUMENTS

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

Federal Specification:

RR-C-901 - Cylinder, Compressed Gas, With Valve or Plug, ICC 3AA.

Federal Standard:

Fed. Std. No. 123 - Marking for Domestic Shipment (Civil Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

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(Single copies of this specification and other Federal Specifications, required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, MO., Fort Worth., Denver, San Francisco, Los Angeles, and Seattle, WA.)

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Specifications:

- MIL-V-2 - Valves, Cylinders, Gas (for Compressed or Liquefied Gases), General Specification for.
- MIL-T-704 - Treatment and Painting of Materiel.

Military Standards:

- MIL-STD-101 - Color Code for Pipelines and for Compressed-Gas Cylinders.
- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-147 - Pelletized and Containerized Unit loads 40" x 48" Pallets, Skids, Runners, or Pallet-Type Base.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

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 date of invitation for bids or request for proposal shall apply.

UNITED STATES PHARMACOPOEIAL CONVENTION, INC.

The United States Pharmacopoeia

(Application for copies should be addressed to the Mack Publishing Co.,  
20th and Northampton Streets, Easton, PA 18042.)

Laws and Regulations:

49 CFR 171-190 - Department of Transportation(DOT) Rules and Regulations  
for the Transportation of Explosives and other Dangerous  
Articles.

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are  
for sale on a subscription basis by the Superintendent of Documents, U.S.  
Government Printing Office, Washington, D.C. 20402. When indicated, reprints  
of certain regulations may be obtained from the Federal agency responsible  
for issuance thereof.)

### 3. REQUIREMENTS

#### 3.1 Material.

3.1.1 Grade A- medicinal. Grade A carbon dioxide shall conform to the  
requirements of the United States Pharmacopoeia (U.S.P.).

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

Table I. Properties of Grade B Carbon Dioxide

Properties	Requirements
Purity, minimum percent by volume.	99-5.
Acidity.	Successful completion of test specified in 4.4.2.2.
Moisture content, maximum milligrams water per liter of gas.	0.092.
Odor.	No objectionable odor.

3.2 Containers and valves. Unless otherwise specified herein, the  
carbon dioxide shall be contained in Government-furnished containers in  
accordance with 49 CFR 171-190 (see 6.4). When specified (see 6.2),  
cylinders shall be furnished by the supplier, shall be in accordance with  
RR-C-901 and shall be equipped with valves in accordance with MIL-V-2, When  
specified (see 6.2), the carbon dioxide shall be contained in supplier-owned  
DOT approved containers. When specified (see 6.2), the carbon dioxide shall  
be delivered to low pressure, bulk liquid storage units.

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3.3 Container maintenance. Government- and supplier-furnished containers that require maintenance shall be processed by the supplier for serviceability meet the requirements of this specification and 49 CFR 171-190 (see 6.5).

3.3.1 Painting. Government-furnished cylinders for carbon dioxide requiring repainting shall be cleaned, treated, and painted in accordance with MIL-T-704, and shall be color coded and marked in accordance with MIL-STD-101.

3.3.2 Valves. Unless otherwise specified (see 6.2), replacement valves for defective valves in Government-furnished cylinders shall be supplier-furnished and shall be in accordance with MIL-V-2.

3.4 Capacity. Cylinders shall be filled to rated capacity. Low pressure, bulk liquid storage units shall be filled with the quantity specified see 6.2).

3.5 Leakage. Containers and valves shall not leak after being filled.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection responsibility. The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary 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) Inspection of preparation for delivery (see 4.5).

4.3 Quality conformance inspection.

4.3.1 Sampling. Sampling for tests shall be in accordance with MIL-STD-105, inspection level S-1. Unless otherwise specified herein, sampling shall be from filled containers. All cylinders of carbon dioxide filled from the same source during a consecutive 24 hour period shall be considered a lot. Each delivery of carbon dioxide for filling a bulk storage unit shall be considered a lot.

4.3.2 Examination. Each container of carbon dioxide shall be examined as specified in 4.4.1. Presence of one or more defects shall be cause for rejection.

#### 4.3.3 Tests.

4.3.3.1 Individual. Each container of carbon dioxide shall be tested for leakage as specified in 4.4.2.4. Failure of the test shall be cause for rejection.

4.3.3.2 Samples. Samples selected in accordance with 4.3.1 shall be tested as follows:

- (a) Grade A - medicinal. Grade A carbon dioxide shall be tested as specified in The United States Pharmacopoeia. Failure to meet the acceptance criterion of one or more U.S.P. tests shall be cause for rejection.
- (b) Grade B - nonmedicinal. Grade B carbon dioxide shall be tested as specified in 4.4.2. AQL shall be 2.5 percent defective. For the moisture content determination specified in 4.4.2.3., carbon dioxide liquid from the container charging line may be sampled, 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 Inspection procedure.

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

- 101. Carbon dioxide having objectionable odor.
- 102. Container or valve not &a specified.
- 103. Container maintenance not an specified.
- 104. Capacity not as specified.

#### 4.4.2 Tests.

4.4.2.1 Purity. The purity of grade B carbon dioxide shall be determined (a) by gas chromatography, or (b) 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 70 deg. and 75 deg. 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 3.1 shall constitute failure of this test.

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4.4.2.2 Acidity. Pass 1 liter of the grade B carbon dioxide from the container through 50 milliliters (mls) of recently boiled distilled water which has been cooled to room temperature. Regulate the flow so as to require 15 minutes for the delivery of 1 liter of the gas. 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, with 50 mls 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 mls 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.

4.4.2.3 Moisture content. The moisture content of grade B carbon dioxide shall be determined by the accelerated gravimetric method specified in 4.4.2.3.1, by the dewpoint (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 4.4.2.3.1 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 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 milligrams of water per liter of gas, at 760 mm of mercury and 70 deg. F., shall constitute failure of this test.

4.4.2.3.1 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 glass-to-metal joint. (Rubber connections are not acceptable; however, a

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sleeve joint secured with "Tygon" 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 4 inches high and 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 70 deg. F. Compute the moisture content in term of milligrams per liter.

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

4.5 Inspection of preparation for delivery. The marking shall be examined to determine if any is missing, illegible, incorrect, or incomplete. Any one defect shall be cause for rejection.

## 5. PREPARATION FOR DELIVERY

5.1 Packing. Shipment of containers of carbon dioxide shall conform to 49 CFR 171-190.

5.1.1 Palletization. When specified (see 6.2)., cylinders shall be pelletized in accordance with MIL-STD-147.

5.2 Marking. The containers shall be marked in accordance with 49 CFR 171-190. Each container shall be stenciled or tagged with the grade carbon dioxide.

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5.2.1 Civil agencies. In addition to the marking specified in 5.2, the containers shall be marked in accordance with FED. STD. No. 123.

5.2.2 Military agencies. In addition to the marking specified in 5.2, the containers shall be marked in accordance with MIL-STD-129.

6. NOTE

6.1 Intended use.

Grade A - Intended for medical use and corresponds to U.S.P. grade.

Grade B - Intended for airborne,, life-raft inflation, for fire extinguishing apparatus and for general purpose applications.

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

- (a) Title, number, and date of this specification.
- (b) Grade of carbon dioxide required (see 1.2.1).
- (c) When supplier is to furnish cylinders (see 3.2).
- (d) When carbon dioxide is to be contained in supplier owned containers (see 3.2).
- (e) When carbon dioxide is to be delivered to low pressure, bulk liquid storage units (see 3.2).
- (f) When Government-furnished replacement valves are to be utilized (see 3.3.2).
- (g) Quantity required for low pressure bulk liquid storage units (see 3.5).
- (h) When cylinders are to be palletized (see 5.1.1).

6.3 Change in classification designation. The type I and the type II designations of grade B carbon dioxide have been discontinued. All uses are now considered to require very low moisture levels. Grade B requirements now @ the same as those of the grade B, type I in the previous edition, except that a 100 percent level of testing is not required.

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

6.5 Maintenance of Government-furnished containers. Purchasers should specify the extent to which Government-furnished containers that require maintenance should be processed by the gas supplier.



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6.5.1 The gas supplier should furnish at no additional cost all services which are required at each and every 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.

6.5.2 A schedule of allowable fees should be specified by the purchaser for the gas supplier's performance of services such as there placement 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.

6.6 Carbon dioxide should be purchased by weight. The weight of carbon dioxide supplied in each cylinder is the difference between the filled weight and the unfilled weight of the cylinder. The weight of carbon dioxide supplied in a low pressure, bulk liquid storage unit can be determined by metered transfer of liquid, or from the gross weight difference, before and after transfer, of either the delivery tank or the storage unit.

6.6.1 Carbon dioxide is available in several cylinder sizes ranging up to 100 pounds weight capacity. The most common service cylinder size is 50 pounds carbon dioxide capacity. The service pressure of the DOT specification 3A or 3AA cylinders for carbon dioxide is usually either 1800 or 2015 psi. Low pressure, bulk liquid storage units have mechanical refrigeration system which cool the contained carbon dioxide liquid and maintain relatively low vapor pressures. The temperatures usually maintained are in the range of minus 20 deg. F. to plus 4 deg. F., equivalent to vapor pressures of 200 psig. to 312 psig.

## MILITARY INTEREST:

## Custodians:

Army - ME  
Navy - SH  
Air Force - 68

## CIVIL AGENCIES INTEREST:

COM  
DC  
HEW  
INT  
VA  
GSA

## Review interest:

Navy - MS

## Preparing activity:

Army - ME

## User interest:

Army - MD, GL  
Navy - AS, OS

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