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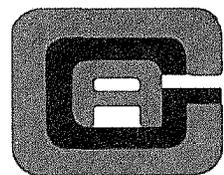
THE EXECUTIVE DIRECTOR
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OBSOLETE

**CGA P-1—1965
(OBSOLETE)**

**SAFE HANDLING OF
COMPRESSED GASES**

FIFTH EDITION



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1 Introduction

1.1

Compressed gas containers, when constructed according to the proper Interstate Commerce Commission (ICC) Specification and maintained in accordance with ICC Regulations, may be considered safe for the purposes for which they are intended. Accidents occurring during the transportation, handling, use and storage of these containers can almost invariably be traced to failure to follow ICC requirements or to abuse or mishandling of the containers.

1.2

The following rules compiled by the Compressed Gas Association Inc. are primarily for the guidance of users of compressed gases in cylinders and are based upon accident prevention experience within these industries. (General precautions are also included for tank car handling and reference is made to cargo tank handling). It should not be assumed that every acceptable safety precaution is contained herein, or that abnormal or unusual circumstances may not warrant or require further or additional procedure.

1.3

The information contained in this pamphlet was obtained from sources believed to be reliable and is based upon the experience of members of the Compressed Gas Association, Inc. However, by the issuance of this pamphlet the association and its members, jointly and severally, make no guarantee of results and assume no liability in connection with the information herein contained, or for the safety suggestions herein made.

2 Regulations applying to compressed gases

2.1

The transportation of compressed gases is regulated by the United States Government under the provisions of an Act of the Congress dated March 4, 1921, known as "The Transportation of Explosives Act." This Act is administered by the Interstate Commerce Commission for railway and for highway transport. The transportation of compressed gases by water comes under the jurisdiction of the United States Coast Guard. Transportation of compressed gases by air is regulated by the Federal Aviation Agency.

2.2

The storage and use of compressed gases are regulated by many state or municipal authorities.

2.3

For regulatory purposes a compressed gas is defined by the ICC as "... any material or mixture having in the container either an absolute pressure exceeding 40 pounds per square inch at 70 F, or an absolute pressure exceeding 104 pounds per square inch at 130 F, or both; or any liquid flammable material having a Reid vapor pressure exceeding 40 pounds per square inch absolute at 100 F." (See §700 of ICC Regulations.[1])

2.4

ICC Regulations require that compressed gases be shipped in containers manufactured to ICC specifications and maintained in accordance with ICC Regulations. In Canada, containers in which compressed gases are shipped by rail must comply with the specifications and regulations of the Board of Transport Commissioners for Canada (BTC).

2.5

Container specifications require, among other things, that the metals used meet certain chemical and physical requirements and that the container pass an initial hydrostatic pressure test.

2.6

"ICC Regulations for Transportation of Explosives and other Dangerous Articles by Land and Water in Rail Freight, Express and Baggage Services and By Motor Vehicle (Highway) and Water Including Specifications for Shipping Containers"[1] are published by the Bureau of Explosives of the Association of American Railroads. "Transportation of Explosives and Other Dangerous Articles"[2] covering the transportation of compressed gases by air is published by the Federal Aviation Agency. For transportation of gases by other means, see regulations published by other governing agencies, such as U. S. Coast Guard.

2.7

Person handling compressed gases should be aware that ICC Regulations govern the following subjects:

- a) The types of containers in which each gas may be shipped.
- b) The charging of containers as to amount of gas and conditions of filling.
- c) The requirements for marking and labeling of containers for transportation.
- d) The requirements for qualifying, maintaining and requalifying containers.
- e) The conditions under which a container may be transported.

3 Safe handling rules for cylinders of compressed gases(*)

The rules of this section apply generally to the handling of all cylinders containing compressed gases. References to other publications giving additional handling precautions for specific gases are listed in Section 6.

3.1 General**3.1.1**

Only cylinders meeting ICC Regulations should be used for the transportation of compressed gases.

3.1.2

Cylinders must not be charged except by the owner or with the owner's consent, and then only in accordance with the Regulations of the Interstate Commerce Commission.

3.1.3

The practice of transferring compressed gases from large to small cylinders by anyone other than the manufacturer or distributor is not recommended, except where consent by the owner has been given, and safe procedures for these operations are followed.

3.1.4

Compressed gas containers must not contain gases capable of combining chemically, nor should the gas service be changed without first removing the original content, and cleaning or purging to remove residues, if necessary.

3.1.5

It is illegal to remove or to change the prescribed numbers or marks stamped into cylinders without authority from the Bureau of Explosives, New York City.

(*) Rules pertaining to the storage and handling of cylinders apply with equal force to the storage and handling of spheres and drums where the alternate use of these containers is authorized by ICC Regulations.

3.1.6

If a cylinder leaks (†) and the leak cannot be remedied by simply tightening a valve gland or packing nut, close the valve and attach a tag stating that the cylinder is unserviceable. Remove the leaking cylinder out of doors to a well ventilated location. If the gas is flammable or toxic, place an appropriate sign at the cylinder, warning against these hazards. Notify the gas supplier and follow his instructions as to the return of the cylinder.

3.1.7

It is illegal to ship a leaking cylinder by common or contract carrier whether charged or partially charged. It is illegal to ship compressed gas in cylinders that have been exposed to fire. Consult your supplier for advice under these circumstances.

3.1.8

Each cylinder must bear the proper ICC label required for the compressed gas contained, except under certain specified conditions set forth in ICC Regulations.

3.1.9

Where the user is responsible for the handling of the cylinder and connecting it for use, such cylinders should carry a legible label or stencil identifying the content. See American Standard Method of Marking Portable Compressed Gas Containers to identify the Material Contained, Z413 [3], and CGA Pamphlet C-7, "A Guide to the Preparation of Labels for Compressed Gas Containers." [4]

3.1.10

Do not deface or remove any markings, labels, decals, tags and stencil marks used for identification of content attached by the supplier.

3.1.11

Before returning empty cylinders, close the valve and see that cylinder valve protective caps and outlet caps or plugs, if used, are replaced. Cover label with Empty Label meeting ICC requirements, or if cylinder is provided with combination shipping and caution tag remove lower portion.

3.1.12

Cylinders containing compressed gases should not be subjected to a temperature above 125 F. A flame should never be permitted to come in contact with any part of a compressed gas cylinder.

3.1.13

Cylinders should not be subjected to artificially created low temperatures without approval of the supplier. Many steels undergo decreased ductility at low temperatures.

3.1.14

Never tamper with the safety relief devices in valves or cylinders.

3.1.15

Never attempt to repair or to alter cylinders, valves, or safety relief devices.

3.1.16

Never use cylinders as rollers, supports, or for any purpose other than to contain the content as received.

(†) See 3.7 for safe handling of type ICC-4L cylinders for which venting is normal.

3.1.17

Keep cylinder valve closed at all times, except when the cylinder is in active use.

3.1.18

Notify owner of cylinder if any condition has occurred which might permit any foreign substance to enter the cylinder or valve giving details and cylinder serial number.

3.1.19

Do not place cylinders where they might become part of an electric circuit. When the cylinders are used in conjunction with electric welding, precautions must be taken against accidentally grounding compressed gas cylinders and allowing them to be burned by electric welding arc.

3.1.20

Do not repaint cylinders unless authorized by the owner.

3.1.21

When in doubt about the proper handling of a compressed gas cylinder or its content, consult the manufacturer or supplier of the gas.

3.2 Moving cylinders**3.2.1**

Where removable caps are provided for valve protection, such caps should be kept on cylinders at all times except when cylinders are in use.

3.2.2

Do not lift cylinders by the cap.

3.2.3

Never drop cylinders nor permit them to strike against each other or against other surfaces violently.

3.2.4

Never handle a cylinder with a lifting magnet. Slings, ropes or chains should not be used unless provisions have been made on the cylinder for appropriate lifting attachments, such as lugs. A crane may be used when a safe cradle or platform is provided to hold the cylinders.

3.2.5

Avoid dragging or sliding cylinders. It is safer to move cylinders even short distances by using a suitable truck.

3.2.6

Use suitable hand truck, fork truck, roll platform or similar device with cylinder firmly secured for transporting and unloading.

3.3 Storing cylinders

3.3.1

Cylinders should be stored in accordance with all local, state and municipal regulations and in accordance with appropriate standards of the Compressed Gas Association and the National Fire Protection Association, (See Bibliography).

3.3.2

Cylinder storage areas should be prominently poster with the names of the gases to be stored.

3.3.3

Where gases of different types are stored at the same location, cylinders should be grouped by types of gas, and the groups arranged to take into account the gases contained, e.g. flammable gases should not be stored near oxidizing gases.

3.3.4

Charged and empty cylinders should be stored separately with the storage layout so planned that cylinders comprising old stock can be removed first with a minimum handling of other cylinders.

3.3.5

Storage rooms should be dry, cool and well ventilated. Where practical, storage rooms should be fire-resistant. Storage in subsurface locations should be avoided. Cylinders should not be stored at temperatures above 125 F, nor near radiators or other sources of heat.

3.3.6

Do not store cylinders near highly flammable substances such as oil, gasoline or waste.

3.3.7

Cylinders should not be exposed to continuous dampness and should not be stored near salt or other corrosive chemicals or fumes. Rusting will damage the cylinders and may cause the valve protective caps to stick.

3.3.8

Protect cylinders from any object that will produce a cut or other abrasion in the surface of the metal. Do not store cylinders near elevators or gangways, or in locations where heavy moving objects may strike or fall on them. Where caps are provided for valve protection, such caps should be kept on cylinders in storage.

3.3.9

Cylinders may be stored in the open but should be protected from the ground beneath to prevent rusting. Cylinders may be stored in the sun except in localities where extreme temperatures prevail, or in the case of certain gases where the supplier's recommendation for shading shall be observed. If ice or snow accumulate on a cylinder, thaw at room temperature, or with water at a temperature not exceeding 125 F.

3.3.10

Cylinders should be protected against tampering by unauthorized individuals.

3.4 Withdrawing cylinder content

3.4.1

Compressed gases should be handled only by experienced and properly instructed persons.

3.4.2

The user responsible for the handling of the cylinder and connecting it for use should check the identity of the gas by reading the label or other markings on the cylinder before using. If cylinder content is not identified by marking, return cylinder to the supplier without using.

3.4.3

Removable type valve protective caps should remain in place until ready to withdraw content, or to connect to a manifold.

3.4.4

Before using cylinder, be sure it is properly supported to prevent it from being knocked over.

3.4.5

Suitable pressure regulating devices must be used in all cases where gas is admitted to systems having pressure rating limitations lower than the cylinder pressure.

3.4.6

Never force connections that do not fit. Threads on regulator connections or other auxiliary equipment must be the same as those on cylinder valve outlet. Detailed, dimensioned drawings of standard cylinder valve outlet and inlet connections are published in the "American and Canadian Standard Compressed Gas Cylinder Valve Outlet & Inlet Connections" (ASA-B5 and CSA-B96).[5]

3.4.7

Where compressed gas cylinders are connected to a manifold, such a manifold and its related equipment, such as regulators, must be of proper design.

3.4.8

Regulators, gages, hoses and other appliances provided for use with a particular gas or group of gases must not be used on cylinders containing gases having different chemical properties unless information obtained from the supplier indicates that this can be done safely.

3.4.9

Open cylinder valve slowly. Point the valve opening away from yourself and other persons. Never use wrenches or tools except those provided or approved by the gas manufacturer. Avoid the use of a wrench on valves equipped with handwheels. Never hammer the valve wheel in attempting to open or close the valve. For valves that are hard to open, or frozen because of corrosion, contact the supplier for instructions.

3.4.10

Never use compressed gas to dust off clothing, as this may cause serious injury to the eyes or body, or create a fire hazard.

3.4.11

Never use compressed gases where the cylinder is apt to be contaminated by the feedback of process materials unless protected by suitable traps or check valves.

3.4.12

Connections to piping, regulators, and other appliances should always be kept tight to prevent leakage. Where hose is used, it should be kept in good condition.

3.4.13

Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator.

3.5 Flammable gases**3.5.1**

Do not store cylinders near highly flammable solvents, combustible waste material and similar substances, or near unprotected electrical connections, gas flames or other sources of ignition.

3.5.2

Never use a flame to detect flammable gas leaks. Use soapy water.

3.5.3

Do not store reserve stocks of cylinders containing flammable gases with cylinders containing oxygen. They should be segregated. Inside of buildings, stored oxygen and fuel gas cylinders should be separated by a minimum of 20 feet, or there should be a fire-resistive partition between the oxygen and fuel gas cylinders. This is in accordance with NFPA Standard No. 51. "Gas Systems for Welding and Cutting." [6]

3.6 Poison gases**3.6.1**

Personnel handling and using poison gases should have available for immediate use gas masks or self-contained breathing apparatus of a design approved by U. S. Bureau of Mines for the particular service desired. Such equipment should be located convenient to the place of work, but kept out of the area most likely to be contaminated.

3.6.2

Poison gases should be used only in forced ventilation areas or, preferably, in hoods with forced ventilation or out-of-doors. Poison gases emitted from equipment in high concentration should be discharged into appropriate scrubbing equipment which will remove it from effluent streams.

3.6.3

Before using, read all label information and data sheets associated with the use of the particular poison gas.

3.6.4

Use poison gases in cylinder sizes that will insure complete usage of the cylinder content in a reasonable amount of time.

3.6.5

The Interstate Commerce Commission requires that containers charged with the following materials when offered for transportation bear the poison gas label and be subject to all other regulations prescribed by the ICC for such materials:

Bromoacetone

Cyanogen

Cyanogen Chloride (Containing less than % water)

Diphosgene

Ethylidichloroarsine

Hydrocyanic Acid

Lewisite
Methyldichloroarsine
Mustard Gas
Nitric Oxide
Nitrogen Peroxide (Nitrogen Tetroxide)
Phenylcarbylamine Chloride
Phosgene

3.6.6

Because of the hazardous nature of poison gases, persons handling such gases are advised to contact the supplier for more complete information.

3.7 Pressurized liquid oxygen, nitrogen and argon

3.7.1

ICC specification cylinders containing pressurized liquid oxygen, nitrogen or argon must be transported, stored, and used in an upright position. These materials are maintained at extremely low temperatures, and cylinders must be kept upright to permit venting of vapor periodically to maintain safe internal pressures.

3.7.2

Persons handling these pressurized liquids are advised to contact the supplier for more complete handling information.

4 General precautions for tank cars

4.1

Tank cars containing compressed gases must not be shipped unless they are charged by or with the consent of the owner thereof.

4.2

Care must be taken that compressed gases are charged only in tank cars designed and marked for the particular gas to be charged. Before a tank car can be charged with a compressed gas other than that for which commodity use has been approved by the Tank Car Committee of the Association of American Railroads, approval must be obtained from this committee by the car owner or party authorized by the owner.

4.3

Tank cars must not contain gases capable of combining chemically, nor should the gas service be changed without first removing the original content, and cleaning or purging to remove residues, if necessary.

4.4

Approval must be obtained from the Tank Car Committee of the Association of American Railroads by the car owner or party authorized by the car owner for any alterations or welded repairs to existing tanks.

4.5

In addition to car markings required by ICC Regulations, individual tanks should carry a stencil identifying the content.

4.6

Charged tank cars must carry the ICC "Dangerous" placard.

4.7

Follow ICC Regulations regarding placard requirements and the condition of empty tank cars before returning to the shipper. Before releasing empty tank cars, the dome cover should be tightly closed and the ICC "Dangerous" placard reversed, displaying the ICC "Dangerous-Empty" placard.

4.8

A defective or leaking tank car must not be shipped.

4.9

Safe handling of types 106A and 110A tanks ("Ton containers") should follow the recommendations as specified for cylinders.

4.10

Numbers or marks stamped into compressed gas tank cars must not be changed without written authority from the Bureau of Explosives.

4.11

Never tamper with the safety relief devices in tank car tanks or valves. In the event of a leak in the tank car or fittings which cannot be repaired by simple adjustments, telephone the supplier for instructions.

4.12

Shipper's detailed instructions and diagrams for unloading should always be followed and all caution markings on both sides of the tank or dome must be read and observed. Angle valves should be opened slowly to avoid closing of check valves in the eduction pipe. The use of a hammer on valve or cover plate to release a check valve should be avoided.

4.13

Cars must be unloaded on a properly protected private track of the consumer, or under alternate conditions as set forth in ICC Regulations.

4.14

When possible, railway sidings on which compressed gas tank cars are placed for unloading should be level and be devoted solely to this purpose.

4.15

Unloading operations should be carefully supervised and should be performed only by reliable persons properly instructed and made responsible for careful compliance with all safety regulations. Operators should be provided with proper personal protective equipment.

4.16

When a tank car is spotted on a siding for unloading, brakes must be set and wheels blocked. Caution signs must be so placed on the track or car as to give necessary warning to persons approaching car from open end or ends of siding and must be left up until after car is unloaded and disconnected. Signs must be of metal, at least 12 by 15 inches in size and bear the words "STOP - TANK CAR CONNECTED," or "STOP - MEN AT WORK," the word "STOP" being in letters at least 4 inches high and the other words in letters at least 2 inches high. The letters must be white on blue background.

4.17

Derails should be placed at one or both ends of the unloading track approximately one car length from the car being unloaded, unless the car is protected by a closed and locked switch or gate.

4.18

Cars should be electrically grounded before unloading if content is flammable.

4.19

For further information on tank car unloading, refer to "How to Receive and Unload Liquefied Compressed Gases." [7]

5 Cargo tank motor vehicles**5.1**

Cargo tanks mounted on motor vehicles are normally not handled by the gas user. However, in cases where a cargo tank is handled by the user, he should consult the gas supplier for instructions on safe handling procedures.

6 Bibliography**6.1**

For detailed data and safety precautions applicable to specific gases, the following references are recommended:

Acetylene—Pamphlet G-1, Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, N. Y.

Air: Tentative Standard for Compressed Air for Human Respiration—Pamphlet G-7, Compressed Gas Association, Inc.

Ammonia: American Standard Safety Requirements for the Storage and Handling of Anhydrous Ammonia, K6.1.1, Pamphlet G-2.1, Compressed Gas Association, Inc.

Anhydrous Ammonia—Pamphlet G-2, Compressed Gas Association, Inc.

Carbon Dioxide—Pamphlet G-6, Compressed Gas Association, Inc.

Chlorine Manual—The Chlorine Institute, 342 Madison Avenue, New York 17, N. Y.

Hydrogen—Pamphlet G-5, Compressed Gas Association, Inc.

Hydrogen: Standard for Gaseous Hydrogen Systems at Consumer Sites—Pamphlet G-5.1, Compressed Gas Association, Inc.

Hydrogen Sulfide—Safety Data Sheet SD-36, Manufacturing Chemists Association, Inc., 264 Woodward Bldg., 15th & H Streets N. W., Washington, D. C.

Liquefied Petroleum Gases: NFPA 58, Standard for the Storage and Handling of Liquefied Petroleum Gases, National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass.

Medical Gases, Characteristics and Safe Handling of—Pamphlet P-2, Compressed Gas Association, Inc.

Medical Vacuum Systems in Hospitals, Standard for—Pamphlet P-2.1, Compressed Gas Association, Inc.

Medical Gases: Standard for Nonflammable Medical Gas Systems—NFPA 565, National Fire Protection Association.

Methyl Chloride—Safety Data Sheet SD-40, Manufacturing Chemists Association, Inc.

Nitrous Oxide: Standard for Installation of Nitrous Oxide Systems at Consume Sites—Pamphlet G-8.1, Compressed Gas Association, Inc.

Oxygen—Pamphlet G-4, Compressed Gas Association, Inc.

Oxygen: Standard for Bulk Oxygen Systems at Consumer Sites—NFPA 566, National Fire Protection Association.

Sulfur Dioxide—Pamphlet G-3, Compressed Gas Association, Inc.

Welding and Cutting, Standards for the Installation and Operation of Gas Systems for—NFPA 51, National Fire Protection Association.

6.2

For additional information concerning compressed gas containers, their testing and safety relief devices, the following pamphlets are available from the Compressed Gas Association, Inc. Request order form and price list from the Association, 500 Fifth Avenue, New York 36, N. Y.

<u>PAMPHLET</u>	<u>TITLE</u>
Pamphlet C-1	<i>Methods for Hydrostatic Testing of Compressed Gas Cylinders</i>
Pamphlet C-2	<i>Recommendations for the Disposition of Unserviceable Compressed Gas Cylinders</i>
Pamphlet C-3	<i>Standards for Welding and Brazing on Thin Walled Containers</i>
Pamphlet C-4	<i>American Standard-Method of Marking Portable Compressed Gas Containers to Identify the Material Contained, Z48.1</i>
Pamphlet C-5	<i>Cylinder Service Life, Seamless, High-Pressure Cylinder Specifications ICC-3, ICC-3A, ICC-3AA</i>
Pamphlet C-6	<i>Standards for Visual Inspection of Compressed Gas Cylinders</i>
Pamphlet C-7	<i>A Guide for the Preparation of Labels for Compressed Gas Containers</i>
Pamphlet C-8	<i>Standard for Requalification of ICC-3HT Cylinders</i>
Pamphlet P-4	<i>Safe Handling of Cylinders by Emergency Rescue Squads</i>
Pamphlet P-5	<i>Suggestions for the Care of High Pressure Air Cylinders for Underwater Breathing</i>
Pamphlet S-1	<i>Safety Relief Device Standards (in three parts)</i>
Part 1	<i>Cylinders</i>
Part 2	<i>Cargo and Portable Tanks</i>
Part 3	<i>Storage Containers</i>
Pamphlet V-1	<i>American Standard-Canadian Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections (ASA-B57.1; CSA-B96)</i>
Pamphlet V-4	<i>The Elimination of Co-Standard Connection No. 320 for Oxygen Service</i>
Pamphlet V-5	<i>Diameter-Index Safety System for Non-Interchangeable Low Pressure Connections for Medical Gases, Air and Suction.</i>

7 References

[1] "Interstate Commerce Commission Regulations for Transportation of Explosives and Other Dangerous Articles by Land and Water in Rail Freight, Express and Baggage Services and By Motor Vehicle [Highway] and

Water Including Specifications for Shipping Containers" — Published by the Bureau of Explosives, 63 Vesey Street, New York 7, New York.

[2] "Transportation of Explosives and Other Dangerous Articles" — Published by the Federal Aviation Agency, Washington, D. C.

[3] "American Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained," Z48.1— CGA Pamphlet C-4, available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, N. Y. and American Standards Association, Inc., 10 East 40th Street, New York 16, N. Y.

[4] "A Guide to the Preparation of Labels for Compressed Gas Containers" — Pamphlet C-7, available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York, 36, N. Y.

[5] "American and Canadian Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections" — CGA Pamphlet V-1, available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, N. Y. and American Standards Association, Inc., 10 East 40th Street New York 16, N. Y.

[6] "Gas Systems for Welding and Cutting" — NFPA Standard No. 51, published by National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass.

[7] "How to Receive and Unload Liquefied Compressed Gases" — F. R. Fetherston [CGA], Chemical Engineering, November 2, 1959, pgs. 83-98. Reprints available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, N. Y.