CGA
Compressed Gas Association
The Standard For Safety Since 1913

7TH EDITION

ANSI/CGA G-2.1 — 2024

REQUIREMENTS FOR THE STORAGE AND HANDLING OF ANHYDROUS AMMONIA

Approved American National Standard
ANSI

DEDICATION

This publication is dedicated in the memory of Patrick “Pat” Hodges, who served as an active participant of the Consensus body that developed this publication and contributed his knowledge and expertise to the ammonia industry for over 40 years.

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Work Item 08-061
Specialty Gases Committee

NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendix A (Normative) is a requirement.

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SIXTH EDITION: 2014
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Approved as an American National Standard on June 18, 2024.

FOREWORD

(This Foreword is not a part of American National Standard *Requirements for the Storage and Handling of Anhydrous Ammonia*.)

This standard represents the consensus of interested parties concerning minimum safety requirements for the storage, transportation, and handling of anhydrous ammonia. It is intended to serve as a guide for regulatory authorities in writing their own regulations as well as to assist designers of ammonia installations and others having an interest in its requirements such as safety engineers, insurance organizations, and transportation carriers.

The first edition of the K61.1 Standard was published in 1960 and was based on a standard of the Compressed Gas Association, Inc. (CGA) completed in 1950, and submitted to the then American Standards Association for adoption as an American Standard. CGA's standard was used to assist in developing regulations during the early period of the expanded use of anhydrous ammonia for agricultural purposes. This took place in the late 1940s and early 1950s.

In 1953 the Agricultural Ammonia Institute (AAI) published its first standard (M-1) for the storage and handling of agricultural ammonia, which has been revised at frequent intervals to remain current with progress in the agricultural ammonia industry.

When the first American Standard for ammonia was approved in 1960, it made available to those concerned two standards on ammonia from which to choose. Many of the states had already adopted as their regulations, the M-1 standard of the AAI, and from then on the ammonia industry was continually faced with the conflict of having two differing standards available dealing with safety requirements for anhydrous ammonia.

The American Standard was revised in 1966 under the sponsorship of CGA and the second edition was made available to interested parties along with revised editions of the similar standards of AAI.

In 1968 the Agricultural Nitrogen Institute (ANI), successor to AAI, requested cosponsorship of the K61 project. CGA supported cosponsorship to achieve the endorsement of a single American National Standard that could be supported jointly by ANI and CGA.

The ANI has since merged with the National Plant Food Institute to become The Fertilizer Institute (TFI).

As cosecretariats of the K61 Project, CGA and TFI reconciled the differences between the American National Standard K61.1-1966 and the M-1 Standard of The Fertilizer Institute. A revision was prepared and submitted to the K61 Committee for consideration.

The 1972 and subsequent editions of the K61.1 Standard not only replace the 1966 edition of the American National Standard K61.1, but also supersede the 1966 edition of CGA G-2.1 and the 1968 edition of The Fertilizer Institute M-1 Standard.

Following the 1984 revision of the 1981 edition of the K61.1 Standard, The Fertilizer Institute withdrew from cosponsorship of the K61.1 Standard in 1987, however, TFI elected to continue as an active participant on the K61 Committee.

The 1989 edition represented a substantial reorganization and expansion of material contained in prior editions with individual sections devoted to ammonia safety and the use of water in emergencies. A new section regarding tank cars was added in recognition of the importance of the rail transportation mode. Other sections were updated to reflect major changes in the areas of technology and regulatory matters.

The 1998 edition incorporated the International System of Units (SI) in recognition of the global harmonization movement. The Pressure Relief Device section underwent a major rewrite to provide consistency and account for excessive heat or fire protection. There were also some marking and labeling changes in the regulatory area.

The 2014 edition includes updated ammonia exposure information and extensive revision of the safety section to incorporate current regulatory and safety requirements and regulations. This edition also includes revised requirements for the re-installation of large pressure vessels, for the repair or alteration of pressure vessels, and for dealing with pressure vessels with missing dataplates by incorporating provisions of the National Board

Inspection Code (NBIC). A new section defines specifications and inspection requirements for pressure transfer hoses used specifically in ammonia service (Information about pressure transfer hose requirements was previously addressed in an appendix to the 1999 edition). Another new section defines the requirements for heating devices for containers. The refrigerated storage pressure relief valves section also underwent another rewrite to address abnormal operating conditions and fire scenarios with respect to relief requirements.

The 2023 edition includes new definitions, updates to information and valves and gaskets, updated requirements for pressure testing of hoses, and a new section addressing hydrostatic relief valves. This edition also combines information on applicator tanks and nurse tank systems mounted on farm wagons into one section with a separate section addressing ammonia application systems.

Suggestions for improvements of this standard will be welcome. They should be sent to the American National Standards Institute, Inc., 1180 Avenue of the Americas, 10th Floor, New York, NY 10036, or to the Compressed Gas Association, Inc., 8484 Westpark Drive, Suite 220, McLean, VA 22102.

This standard was revised and approved for submittal to ANSI by American National Standard Committee on Safety Requirements for the Storage and Handling of Anhydrous Ammonia. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the CGA G-2.1 ANS Consensus Body had the following voting members:

Organization Represented	**Name of Representative**
Agribusiness Association of Iowa	Neal Vaughn
Airgas Specialty Products	Blaine Davis, Chair
Ammonia Safety and Training Institute	Kent Anderson
CF Industries, Inc.	David Shea
CHS, Inc.	Ken Mueller
	Mary Blel (Alternate)
Circle K Manufacturing Company	Chuck Thompson
Continental NH3 Products	Judd Stretcher
Gas Equipment Company	Roy Nichols
Illinois Department of Agriculture	Chuck Cawley
Illinois Fertilizer and Chemical Association	John Rebholz
Koch Company Services	George Edwards
MaXfield, Inc.	Tyler Rishel
MFA Incorporated	Stanley Thessen
	David Imhoff (Alternate)
Minnesota Department of Agriculture	Ed Kaiser
The National Board of Boiler and Pressure Vessel Inspectors	Terrence Hellman
Nutrien	Chad Szymesko
	Cliff Hayes (Alternate)
Office of Indiana State Chemist	Danny Starke
Pirkle Solutions, Inc.	Billy Pirkle
ProValue Insurance	Scott Anderson
Quality Steel Corporation	Tom Vandini
	Timothy Memmer (Alternate)
RegO Products	Cody Reeves
Safety with HEART, LLC	Mike Wollner
Squibb Taylor Inc.	Bruce Kasten
Tanner Industries, Inc	David Binder

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1 Introduction

1.1 Scope

This standard is intended to apply to the design, construction, repair, alteration, location, installation, maintenance, and operation of anhydrous ammonia systems including refrigerated ammonia storage systems.

This standard does not apply to:

- Ammonia manufacturing plants;
- Refrigeration systems where ammonia is used solely as a refrigerant. Such systems are covered in ANSI/International Institute of Ammonia Refrigeration (IIAR) 2, *American National Standard for Design of Safe Closed-Circuit Ammonia Refrigeration Systems* [1][1];
- Ammonia transportation pipelines; and
- Ammonia barges and tankers.

1.2 General

Where certain provisions of this standard impose undue hardship or where literal adherence to such provisions fails to provide adequate safety in the opinion of the authority having jurisdiction (AHJ), the AHJ may permit deviation from the standard.

The values stated in customary units are to be regarded as standard. Metric equivalents where shown in this standard may not be exact, and meet the requirements of ANSI/Institute of Electrical and Electronics Engineers (IEEE) SI 10, *American National Standard for Metric Practice* procedures in this regard [2].

1.3 Physical/chemical properties of ammonia

1.3.1

Gaseous ammonia liquefies under pressure at ambient temperature. Ammonia is usually shipped or stored as a liquid under pressure. When refrigerated to or less than its normal boiling point of –28 °F (–33.3 °C), it may be shipped or stored as a liquid at or near atmospheric pressure.

1.3.2

Some physical properties of ammonia are listed in Table 1.

1.3.3

During liquid releases, ammonia aerosol can form. This aerosol can reach temperatures approaching –100 °F (–73 °C) near the point of release [3].

1.3.4

Ammonia is extremely hard to ignite and is a relatively stable compound. It begins to dissociate into nitrogen and hydrogen at approximately 850 °F (454 °C) at atmospheric pressure. Experiments conducted by a nationally recognized laboratory showed that an ammonia-air mixture in a standard quartz test container does not ignite at less than 1562 °F (850 °C). Ammonia gas is flammable in air in the range of 16% to 25% by volume. Conditions favorable for ignition are seldom encountered during normal operations due to the high ignition temperature required.

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