CGA S-1.1—2007

PRESSURE RELIEF DEVICE STANDARDS PART 1— CYLINDERS FOR COMPRESSED GASES

THIRTEENTH EDITION

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Work Item 05-46
Cylinder Valve Committee

NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendices A and B (Normative) are requirements.

FOREWORD

On April 16, 1981, the United States Department of Transportation promulgated new regulations to 49 CFR 173.34(d), which eliminated the need for pressure relief device approval by the Bureau of Explosives of the Association of American Railroads. It now becomes the responsibility of the individual manufacturer or shipper to conduct his own flow and/or fire tests on new pressure relief device combinations to show compliance with CGA S-1.1, CGA C-12, and CGA C-14 as applicable, and to retain test records of the compliance.

THIRTEENTH EDITION: 2007
TWELFTH EDITION: 2005
ELEVENTH EDITION: 2003
TENTH EDITION: 2002

Contents **Page**

Tables

Figure

Appendices

1 Introduction

This standard represents the minimum requirements for pressure relief devices considered to be appropriate and adequate for use on cylinders having capacities of 1000 lb (454 kg) of water or less. Refer also to Title 49 of the U.S. *Code of Federal Regulations* (49 CFR) 173.301(f) [1].[1] This standard also applies to DOT-3AX, DOT-3AAX, and DOT-3T cylinders having capacities over 1000 lb (454 kg) of water, and which comply with the design specifications and charging and maintenance regulations of the U.S. Department of Transportation (DOT) or the corresponding specifications and regulations of Transport Canada (TC) [1, 2]. This standard also covers requirements for pressure relief devices for CTC/DOT-4L and TC-4LM insulated cylinders containing cryogenic liquids. Pressure relief device requirements for multi-unit tank car tanks (DOT106A and DOT110A-W) are not covered by this standard (see 49 CFR 179.300-15) [1].

This standard includes Tables 1 to 6, which provide information pertaining to pressure relief devices. Table 1 contains information on the different types of pressure relief devices. Table 2 contains FTSC code classification for gases. Table 3 contains a listing of gases and their pressure relief device assignments. Table 4 contains temperature correction factors. Table 5 includes values for basic orifice factors flange taps for flow in cubic feet per minute. Table 6 contains values of G_i and G_u for rated burst pressure of rupture disks for CTC/DOT-4L and TC-4LM cylinders.

It is recognized that there are cylinders that conform to the specification requirements of DOT or TC, but are used in services beyond the jurisdiction of any of these authorities. In such cases, it is recommended that state, provincial/territorial, local, or other authorities having jurisdiction over these cylinders be guided by this standard in determining adequate pressure relief device requirements provided that the cylinders are charged and maintained in accordance with DOT or TC regulations.

It is further recognized that there may be cylinders that are used in services beyond the jurisdiction of DOT or TC that do not conform to the specification requirements of either authority. It is recommended that the authorities having jurisdiction over such cylinders be guided by this standard in determining pressure relief device requirements, provided that such cylinders are considered by the authority as having a construction at least equal to the equivalent DOT or TC specification requirements, and further provided that the cylinder shall be charged and maintained in accordance with DOT or TC requirements.

For cylinders that come within the jurisdiction of state, provincial/territorial, and local regulatory authorities, the user should check for compliance with all such regulations. A number of states and cities have pressure vessel laws and regulations that include requirements for pressure relief devices. This standard is prepared specifically for compressed gas cylinders, and the pressure relief devices may not be acceptable unless special permission is obtained from the authority having jurisdiction.

For newly constructed cylinders that come within the jurisdiction of DOT or TC, pressure relief devices shall comply with requirements of this standard. This publication is based on minimizing the number and optimizing the types of approved pressure relief devices specified for each specific gas. It does not prejudice the continued use of previously approved and installed devices unless stated otherwise in Table 3 and/or 49 CFR [1]. However, if a pressure relief device is replaced, the new device shall meet the requirements of this standard.

It is the filler's responsibility to ensure that the pressure relief device is correct.

For pressure relief device standards for bulk transport containers and stationary storage containers, see CGA S-1.2, *Pressure Relief Device Standards—Part 2—Cargo and Portable Tanks for Compressed Gases,* and CGA S-1.3, *Pressure Relief Device Standards—Part 3—Stationary Storage Containers for Compressed Gases* [3, 4].

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

2 Definitions

For the purpose of this standard, the following definitions apply.

2.1 Approach channel
Passage or passages through which fluid must pass from the cylinder to reach the operating parts of the pressure relief device.

2.2 CG-10 activation time
Time for a CG-10 device to achieve its full rated flow capacity using a standardized activation test (see 6.8.1.5).

2.3 CG-10 design life
Time the CG-10 device is designed to provide operation, within its design specification, while in normal service and use.

2.4 CG-10 service life
Specific term to be applied to those devices (CG-10) that have been shown by special analysis or testing to demonstrate a fixed service life within its service (see 6.8.1.8 and 6.8.1.9).

2.5 Combination rupture-disk/fusible-plug device
Rupture disk in combination with a low temperature melting material intended to prevent bursting of the disk at its predetermined bursting pressure, unless the temperature is high enough to first cause yielding or melting of the fusible material.

2.6 Compressed gas in solution
Nonliquefied compressed gas that is dissolved in a solvent (such as acetylene dissolved in acetone).

2.7 Compressed gas
Any material that exerts in the container an absolute pressure of at least 280 kPa (40.6 psi) at 20 °C (68 °F).[2]

2.8 Cryogenic liquid
Liquid with a normal boiling point below –90 °C (–130 °F) at 1 atm pressure absolute.

2.9 Cylinders
Pressure vessels as described in 49 CFR 171.8 and applicable TC regulations [1, 2].

2.10 Discharge channel
Passage or passages beyond the operating parts of the pressure relief device through which fluid must pass to reach the atmosphere.

2.11 Flow capacity
For a pressure relief device, the capacity in cubic feet per minute (cubic meters per minute or cubic meters per second) of free air discharged at the required flow rating pressure.

2.12 Flow rating pressure
Inlet static pressure at which the flow capacity of a pressure relief device is measured for flow capacity rating purposes.

2.13 Free air or free gas
Air or gas measured at a pressure of 14.696 psia and at 60 °F (101.325 kPa abs at 15.6 °C).

2.14 Fusible plug device
Nonreclosing pressure relief device designed to function by the yielding or melting of a plug of fusible material within the specified temperature range (see Section 3).

[2] kPa shall indicate gauge pressure unless otherwise noted as (kPa, abs) for absolute pressure or (kPa, differential) for differential pressure. All kPa values are rounded off per CGA P-11, *Metric Practice Guide for the Compressed Gas Industry* [5].

2.15 Fusible trigger device
Nonreclosing pressure relief device designed to function by activation of a trigger incorporating a fusible material that yields, melts, or is otherwise activated by heat.

NOTE—The trigger activates a mechanism that permits the release of gas.

2.16 Hazard zone A
Material with a toxicity LC_{50} less than or equal to 200 ppm.

2.17 Hazard zone B
Material with a toxicity LC_{50} greater than 200 ppm and less than or equal to 1000 ppm.

2.18 Hazard zone C
Material with a toxicity LC_{50} greater than 1000 ppm and less than or equal to 3000 ppm.

2.19 Hazard zone D
Material with a toxicity LC_{50} greater than 3000 ppm and less than or equal to 5000 ppm.

2.20 Lethal concentration fifty (LC_{50})
Concentration of a substance in air, exposure to which for a specified length of time is expected to cause the death of 50% of the entire defined experimental animal population.

2.21 Liquefied compressed gas
A gas when packaged under pressure for transportation is partially liquid at temperatures above −50 °C (−58 °F). A liquefied compressed gas is further categorized as follows:

- High pressure liquefied gas with a critical temperature between −50 °C (−58 °F) and 65 °C (149 °F); and
- Low pressure liquefied gas with a critical temperature above 65 °C (149 °F).

2.22 Metal hydride
Compound consisting of a metal alloy and hydrogen.

NOTE—As it pertains to this standard, these compounds are used in a metal hydride system where the hydrogen absorbs and desorbs from the metal alloy.

2.23 Metal hydride system
Group of components assembled as a package to contain metal-hydrogen compound(s) for which there exists an equilibrium condition where the metal alloy(s), hydrogen gas, and the metal-hydrogen compound(s) co-exist.

NOTE—Changes in pressure, temperature, and/or electrical potential shifts the equilibrium favoring the formation or decomposition of the metal-hydrogen compound(s) with respect to the metal alloy(s) and hydrogen gas.

2.24 Nonliquefied compressed gas
A gas when packaged under pressure for transportation is entirely gaseous at −50 °C (−58 °F) with a critical temperature less than or equal to −50 °C (−58 °F).

2.25 Pressure control valve
Device that vents only to maintain the proper operating pressure in the container under normal working conditions.

2.26 Pressure opening
Orifice in a pressure relief device through which pressure is relieved; in a rupture disk device, this is the orifice against which the disk functions.

2.27 Pressure relief device
Pressure and/or temperature-activated device used to prevent the pressure in a normally charged cylinder from rising above a predetermined maximum, thereby preventing rupture of the cylinder when subjected to a standard fire test as required by 49 CFR 173.301(f)(1) or clause 4.3.2 of CSA B340-02, *Selection and Use of Cylin-*