

CGA C-6.1—2013

**STANDARD FOR VISUAL INSPECTION
OF HIGH PRESSURE ALUMINUM ALLOY
COMPRESSED GAS CYLINDERS**

SIXTH EDITION

(Corrected 4/14/2015)

CGA
Compressed Gas Association

The Standard For Safety Since 1913

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Work Item 10-027
Cylinder Specifications Committee

NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendices A, B, and C (Informative) are for information only.

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1 Introduction

The U.S. Department of Transportation (DOT) and Transport Canada (TC) require, unless otherwise provided for by special permit, equivalency certificate (formerly called permit of equivalent level of safety), or regulations, that cylinders used for the transportation of compressed gases are requalified periodically by visual inspection followed by hydrostatic testing if they are to remain in service (see CGA C-1, *Methods for Pressure Testing Compressed Gas Cylinders*) [1].¹ However, a cylinder that was charged or filled before the requalification became due may remain in service until it has been emptied. U.S. regulations in Part 180 Subpart C of Title 49 of the *Code of Federal Regulations* (49 CFR) and equivalent Canadian regulations in Clause 24 of Canadian Standards Association (CSA) B339, *Cylinders, Spheres, and Tubes for the Transportation of Dangerous Goods*, identify the inspection and hydrostatic testing requirements for most cylinders [2, 3]. Cylinders fabricated in accordance with DOT, TC, or the former Canadian Transport Commission (CTC) permits, equivalency certificate/permit of equivalent level of safety, or exemptions/special permits shall be requalified as specified in the exemption/special permit, equivalency certificate/permit, or CTC permit. These documents can be obtained from DOT, TC, or the manufacturer.

The approval of the 3AL specification in 49 CFR 178.46 (July 2, 1982) consolidated the majority of the exemptions and special permits for aluminum alloy cylinders into one manufacturing regulation [2]. Canadian specification TC-3ALM also consolidates specification CTC-3AL and permits for aluminum alloy cylinders into their regulations [3, 4].

Both DOT and TC have provisions in their regulations for introduction of new cylinder designs, materials, and fabrication techniques. Aluminum alloy cylinders, before implementation of CTC/DOT specification 3AL and TC specification 3ALM, had been manufactured under special permits and/or exemptions E 6498, E 7042, E 8107, E 8364, E 8422, CTC SP 890, or CTC SP 922. Permit or exemption numbers are stamped on the shoulder of the cylinder. These cylinders may be continued in use in Canada. In the United States, these cylinders (with the exception of CTC SP 922) may be continued in use but shall be remarked in compliance with 49 CFR 173.23 at the time of the first retest following July 2, 1982 [1]. Such remarking is not authorized for all permitted cylinders.

In the United States, DOT exemptions E 6498, E 7042, E 8107, E 8364, and E 8422 were previously issued that identified the manufacturing, usage, and inspection requirements of these cylinders. These exemptions have been superseded by DOT specification 3AL and copies of the exemptions are no longer required. Cylinders marked with "S.P." preceding the previously noted exemption numbers, which designate special permits, also are covered by DOT specification 3AL. Some cylinders with the previously noted markings might be preceded by "CTC" indicating compliance with the CTC requirements, for example, CTC/DOT E 6498-1800. Exemption and special permit cylinders shall be remarked at the time of the first hydrostatic testing occurring after July 2, 1982. Requirements for remarking can be found in 49 CFR 173.23(c), which states that after July 2, 1982, a seamless aluminum alloy cylinder manufactured in conformance with and for use under DOT exemption E 6498, E 7042, E 8107, E 8364, or E 8422 may be continued in use if marked before or at the time of the next retest with the specification identification 3AL immediately above the exemption number, or if the DOT mark (i.e., DOT-3AL 1800) is added in proximity to the exemption marking [2]. See Figures 1 and 2 for examples of exemption marked cylinders.

Experience in the inspection of cylinders is an important factor in determining the acceptability of a given cylinder for continued service. Inspectors evaluating cylinders shall consult the manufacturer or other knowledgeable sources.

Existing regulatory markings shall remain intact.

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

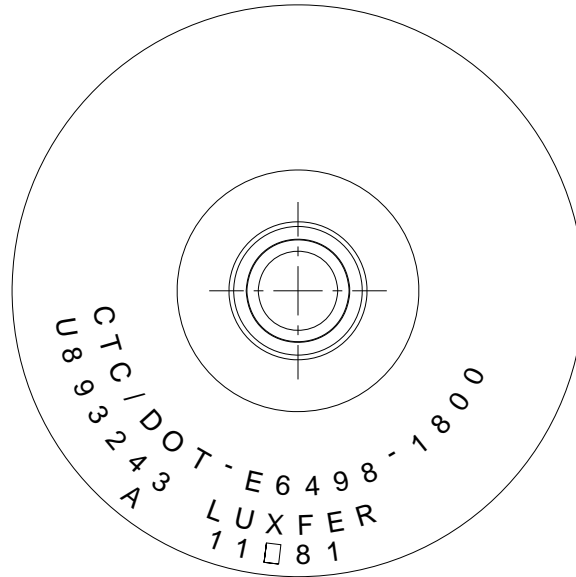


Figure 1—Exemption marked cylinder



Figure 2—3AL marked exemption cylinder

2 Scope

This standard has been prepared for the visual inspection of aluminum alloy compressed gas cylinders with service pressures of 1800 psi (12 410 kPa) or greater.² This standard does not address all cylinder manufacture defects. Cylinders authorized by regulation may require testing by ultrasonic examination (UE) or pressure testing. This standard does not include testing that may be required by regulation. UE of aluminum alloy cylinders shall meet the requirements of CGA C-20, *Methods for Ultrasonic Examination of Metallic, DOT and TC 3-Series Gas Cylinders and Tubes* [6]. Pressure testing shall meet regulatory requirements.

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].

Additional publications and standards prepared by the Compressed Gas Association, Inc. (CGA) that can be helpful include:

- CGA C-1, *Methods for Pressure Testing Compressed Gas Cylinders* [1];
- CGA C-6, *Standards for Visual Inspection of Steel Compressed Gas Cylinders* [7];
- CGA C-6.2, *Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders* [8];
- CGA C-6.3, *Standard for Visual Inspection of Low Pressure Aluminum Alloy Compressed Gas Cylinders* [9];
- CGA C-20 [6];
- CGA V-11, General Guidelines for the Installation of Valves into High Pressure Aluminum Alloy Cylinders [10];
- CGA P-38, Guidelines for Devalving Cylinders [11]; and
- CGA S-1.1, Pressure Relief Device Standards—Part 1—Cylinders for Compressed Gases [12].

This standard is directed at cylinders with a service pressure of 1800 psi (12 410 kPa) or greater. CGA C-6.3 shall be followed for cylinders with lower service pressure [9].

3 Definitions

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

3.1 Bow

Cylinder manufactured with a curve in it like a banana shape.

3.2 Bulge

Visible swelling of the container.

3.3 Condemned

No longer fit for service. A condemned cylinder is required to be removed from service.

3.4 Corrosion

Loss of metal thickness by some corrosive media and is usually apparent from a general loss of wall thickness or pitting.

NOTE—Corrosion of aluminum appears as a roughened and discolored area with a white deposit sometimes associated with the corrosion.

3.4.1 General corrosion

Somewhat uniform loss of metal in a relatively large area.

NOTE—General corrosion could be difficult to see unless it is very pronounced.

3.4.2 Line corrosion

Series of pits closely spaced as to appear to be in a line.

NOTE—This condition is considered more serious than isolated pitting.

3.4.3 Pitting corrosion

Most common form of attack on aluminum. Pits can be small and localized or larger and scattered.

NOTE—Small, isolated pits have very little effect on the strength of the cylinder but the degree of pitting and concentration of the pits determine if the cylinder may continue in service, see Figure 3.