

CGA C-13—2018

**STANDARD FOR PERIODIC
VISUAL INSPECTION AND
REQUALIFICATION OF
ACETYLENE CYLINDERS**

SEVENTH EDITION

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NOTE—Technical changes from the previous edition are underlined.

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

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1 Introduction

This standard is one of a series compiled by the Compressed Gas Association, Inc. (CGA) to meet the demand for information on compressed gases, cryogenic liquids, and related products.

2 Background

The U.S. Department of Transportation (DOT) and Transport Canada (TC) minimum wall thickness is specified in the regulations based on calculations using the maximum yield strength. The recommended industry practice is to follow a typical minimum sidewall thickness recognizing that variables exist among manufacturers in steel grades and process methods used at the time a cylinder is produced. These variables, which exist among manufacturers' designs, make a calculation of minimum sidewall thickness difficult at the time of requalification considering the age of the population of in-service cylinders and limitations in obtaining specific design parameters for each cylinder. Therefore, manufacturers established a minimum wall thickness for each cylinder diameter based on the steel grade used and targeted metallurgical properties for the cylinder. However, while this calculated minimum wall thickness is set, manufacturers typically target a wall thickness greater than DOT/TC absolute minimum wall thickness to compensate for manufacturing process variables and additional safety factors, for the cylinder.

3 Scope

This standard covers the inspection and requalification of the acetylene cylinder shell and porous mass. It should be of interest to acetylene cylinder manufacturers, acetylene cylinder filling and distribution personnel, authorized acetylene cylinder requalification facilities, welding gas distributors, safety personnel, and users of acetylene.

This standard covers both the thorough prefill external visual inspection of acetylene cylinders and the periodic inspections of the cylinder shell and porous mass, which are required for acetylene cylinder requalification.

This standard applies to acetylene cylinders manufactured:

- under DOT Specifications 8 and 8AL found in Title 49 of the U.S. *Code of Federal Regulations* (49 CFR) Parts 178.59 and 178.60 [1];¹
- under Specifications TC-8WM and TC-8WAM found in Canadian Standards Association (CSA) B339, *Cylinder, Spheres, Tubes and Other Containers for the Transportation of Dangerous Goods* [2]; and
- required for service by the *Transportation of Dangerous Goods Regulations* of Transport Canada (TC) and CSA B340, *Selection of Cylinders, Spheres, Tubes, and Other Containers for the Transportation of Dangerous Goods, Class 2* [3, 4].

Until 1970, U.S. regulations applicable to acetylene cylinders were under the authority of the Interstate Commerce Commission (ICC). Those cylinders identified by an ICC stamping are now regulated according to DOT requirements. In Canada, the CSA standards came into effect in 1987. Before 1987, other regulatory agencies issued these cylinder specifications (the most recent being Canadian Transport Commission [CTC]). Canadian cylinders marked with CTC, Board of Transport Commissioners (BTC), or Canadian Railway Commission (CRC) stampings shall be requalified and inspected in accordance with the requirements of CSA B339 [2].

This standard also applies to acetylene cylinders with nonmonolithic or monolithic porous masses manufactured under exemptions or special permits issued by the DOT or TC.

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

4 Definitions

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

4.1 Publication terminology

4.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

4.1.2 Should

Indicates that a procedure is recommended.

4.1.3 May

Indicates that the procedure is optional.

4.1.4 Will

Used only to indicate the future, not a degree of requirement.

4.1.5 Can

Indicates a possibility or ability.

4.2 Technical definitions

4.2.1 Authorized regualification facility

Facility registered with the Office of Hazardous Materials Regulation (OHMR) of DOT or the Director General, Transport Dangerous Goods Directorate of TC, as appropriate, for the requalification of acetylene cylinders.

4.2.2 Bulge

Visible swelling of the cylinder.

4.2.3 Condemned

No longer fit for service, nonrepairable, and must be scrapped (see 9.6.2).

4.2.4 Corrosion

Loss of wall thickness due to rusting or other chemical processes.

4.2.5 Crevice corrosion

Line corrosion that occurs in the area of the intersection of the footing or protective collar and the cylinder.

NOTE—The bottom head of the cylinder can be especially susceptible to excessive and harmful corrosion.

4.2.6 Cut, dig, or gouge

Deformation of the cylinder shell, normally caused by contact with a sharp object, which decreases the metal thickness at the point of contact.

4.2.7 Dent

Deformation of the cylinder shell, normally caused by contact with a blunt object, which does not materially decrease the metal thickness.

4.2.8 Flashback

Decomposition that propagates through the valve passage into the cylinder either as a result of improper operation of the torch or from other causes external to the cylinder.

4.2.9 Footring

Nonpressure retaining cylindrical attachment welded or fixed to the base of the cylinder to give the cylinder stability in the upright position.

4.2.10 General corrosion

Corrosion of uniform nature that covers a given surface area.

4.2.11 Head (concave)

Cylinder end that is curved away from the pressure. See Figure 1.

4.2.12 Head (convex)

Cylinder end that is curved toward the pressure. See Figure 1.

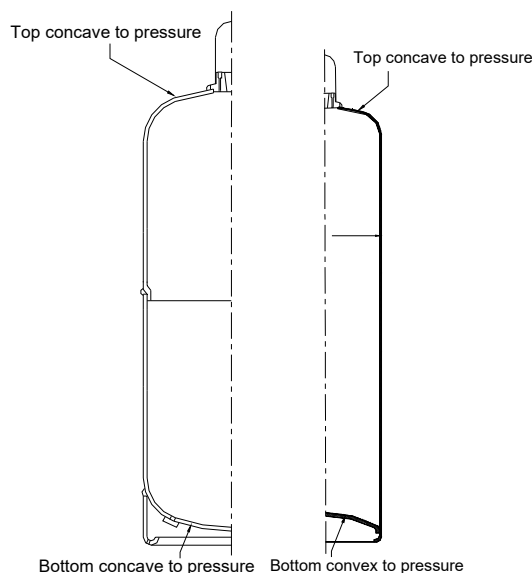


Figure 1—Illustration of concave versus convex to pressure

4.2.13 Industry minimum sidewall thickness (t_d)

Accepted range of values representing the sidewall thickness for a given diameter cylinder of a given cylinder specification that has been adopted by the industry as a result of efficiency of manufacturing capabilities. These values are more conservative than the DOT or TC specification design minimum wall requirements. See Table 1.

NOTE—The TC wall stress calculation for the TC 8WAM cylinders typically requires use of 50% minimum tensile strength, as determined by tensile test or 241 MPa, whichever is lesser.² For DOT 8AL cylinders, the calculated wall stress at 750 psi may not exceed 35 000 psi, or one half of the minimum ultimate strength of the steel, whichever value is smaller. The TC wall stress calculation for the TC 8WM cylinders typically requires use of 50% minimum tensile strength, as determined by tensile test or 179 MPa, whichever is lesser.

4.2.14 Industry minimum head thickness

Industry minimum bottom head thickness and the industry minimum top head thickness required by the specification under which the cylinder was manufactured.

4.2.15 Line corrosion

General corrosion or pitting in a continuous pattern or where pits are connected in a narrow band or line.

NOTE—This condition is more serious than isolated pitting.

4.2.16 Protective collar

Nonpressure retaining attachment welded or fixed to the top of the cylinder to provide valve protection.

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

4.2.17 Pitting

Corrosion of an isolated nature that occurs at discrete points.

4.2.18 Remove from service

Designate the cylinder as not being fit to be filled or transported pending further examination. Physically separate the cylinder from those that can be filled.

4.2.19 Shell

Pressure-retaining portion of the acetylene cylinder.

Table 1—Industry minimum sidewall thickness (t_d)

DOT and TC <u>cylinder</u> specifications	Approximate diameter		Industry minimum sidewall thickness (t_d) ^{1), 2), 3)}	
	in	mm	in	mm
8/8WM	12	305	<u>0.152</u>	<u>3.861</u>
8/8WM	10	254	<u>0.127</u>	<u>3.226</u>
8/8WM	8	203	<u>0.105</u>	<u>2.667</u>
8/8WM	7	178	<u>0.095</u>	<u>2.413</u>
8/8WM	6	152	<u>0.087</u>	<u>2.210</u>
8/8WM	4	102	<u>0.065</u>	<u>1.651</u>
8AL/8WAM	16	406	<u>0.150</u>	<u>3.810</u>
8AL/8WAM	12	305	<u>0.120</u>	<u>3.048</u>
8AL/8WAM	10	254	<u>0.106</u>	<u>2.692</u>
8AL/8WAM	8	203	<u>0.102</u>	<u>2.591</u>
8AL/8WAM	7	178	<u>0.094</u>	<u>2.388</u>
8AL/8WAM	6	152	0.087	2.210
8AL/8WAM	4	102	<u>0.059</u>	<u>1.499</u>
¹⁾ <u>The original sidewall and head thickness can be determined from the cylinder manufacturer, or by ultrasonic measurement of the cylinder sidewall and head in an area of the cylinder where corrosion has not taken place.</u> ²⁾ For those cylinders with top or bottom heads <u>convex</u> to pressure, the actual convex head thickness requirement shall be twice the <u>industry</u> minimum sidewall thickness (t_d). ³⁾ For cylinders with top or bottom heads <u>concave</u> to pressure, the actual concave head thickness requirement shall be equal to the <u>industry</u> minimum sidewall thickness (t_d).				

5 Compliance schedule

In the United States, regulations covering acetylene cylinder requalification by DOT became effective January 15, 1992 and similar requirements were enacted in December 1991 in Canada by TC [1, 3]. It is the cylinder owner's responsibility to ensure the cylinder porous mass and shell are requalified no sooner than five years after date of manufacture and at least once every ten years.

6 Necessary inspection experience

Rejection or acceptance of acetylene cylinders for continued use in accordance with the limits stated in this publication represents practice that has been satisfactorily used in the compressed gas industry. Experience in the inspection of an acetylene cylinder's shell and porous mass is an important factor in determining the acceptability of that cylinder for continued service. Acetylene cylinder owners or acetylene cylinder charging companies lacking the authorization, and having cylinders requiring requalification, shall return the cylinders to an authorized acetylene cylinder requalification facility.

7 Construction of acetylene cylinders

7.1 Porous mass (filler)

Acetylene compressed to increasingly higher pressure becomes less stable and can decompose into its constituent elements, carbon and hydrogen. To reduce the possibility of decomposition and to suppress its propagation, acetylene cylinders are constructed in a unique way that sets them apart from all other compressed gas cylinders. For example, they are filled with a porous mass composed of small interconnected pores or cells. The total volume of these millions of cells can be as much as 92% of the volume of the cylinder. The purpose of the porous mass is to suppress an acetylene decomposition, should it be initiated, thereby reducing the potential of a violent cylinder failure. Ideally, the heat of decomposition of the acetylene in one cell is absorbed by the walls of the cell and interconnected passages so the temperature is reduced below that required to propagate the decomposition. If no porous mass is present or if a void of significant size in the porous mass exists within the cylinder, the decomposition could progress at a rate that could cause violent failure of the cylinder.

7.1.1 Nonmonolithic porous mass

Since the early 1900s, acetylene cylinders have been constructed with many different porous mass materials. Some of the earliest masses were made with corn pith, balsa wood, animal hair, asbestos fiber, or granular solids similar to dry clay or porous stone. Some porous masses consisted of a mixture of two or more of these ingredients. Some asbestos-filled cylinders used multiple disks of compressed asbestos held together with a water glass (sodium silicate) binder. These are classed as nonmonolithic porous masses. Because some of these porous masses may have shrunk or settled in normal service creating excessive clearances or voids, most of these cylinders have been rebuilt or condemned. Cylinders containing nonmonolithic porous masses were made as late as the 1950s. From the nonmonolithic porous masses listed previously, only balsa wood porous masses are permitted in service.

7.1.2 Monolithic porous mass

The second category of porous masses is called monolithic, meaning a one-piece porous mass. The ingredients are mixed together with water, put into the cylinder shell as a slurry, and then the slurry solidifies into a single mass. These porous masses first appeared about 1925 and used a mixture of asbestos fiber, charcoal, finely divided silica, and Portland cement as a binder. The disadvantages of these early monolithic cylinders were relatively low porosities of 70% to 80% and heavy weight. Porous masses beginning in the late 1940s used calcium silicate as the binder and are sometimes referred to as lime-silica porous masses. Beginning in the early 1980s, some lime-silica porous mass cylinders used glass fibers, carbon, or other reinforcement fibers. Porosities for the lime-silica porous mass cylinders vary between 83% and 92%. This type of porous mass has a tendency to shrink slightly upon drying during manufacture, leaving some clearance between the porous mass and shell. Maximum allowable clearances at the time of manufacture are established in specifications DOT-8, DOT-8AL, TC-8WM, and TC-8WAM. For additional information on the chronology of acetylene cylinder construction, see Appendix A [1, 2].

7.2 Solvent

The porous mass contains a prescribed amount of solvent, commonly acetone, which has a high solvency for acetylene. Dimethylformamide (DMF) is typically used in special applications, such as cylinders used in trailers or bundles. When the acetylene is charged into a cylinder, it goes into solution in the solvent (it is absorbed by the solvent). By using the porous mass and solvent, it is possible for a cylinder to contain approximately eight times the volume of acetylene that could safely be compressed into the same cylinder without solvent.

Due to density variations and gas absorption characteristics, different solvents must not be mixed.

7.3 Core-hole with packing

Most acetylene cylinders also have another unique feature, which is a core-hole with packing immediately under the valve (see Figure 2). The packing consists of one or more brass, Monel®, or stainless steel screens, one of which is in contact with or incorporated into the base of the valve. The core-hole also may contain one or more felt disks, charcoal, asbestos fibers, or other packing material.

Core-holes may be up to 1 in (25 mm) in diameter, and as much as 6 in (152 mm) deep; other cylinders may have no depression. An early practice was to pack granular charcoal to all but the top 1/4 in (6.4 mm) of the core-hole with a felt disk and a screen placed between it and the base of the valve.

The core-hole packing can contribute to the capability of a cylinder to cope with a flashback. Whenever a cylinder valve is removed or replaced, the core-hole packing shall also be replaced. When the core-hole packing is replaced, sufficient packing shall be used so it is compressed by the base of the valve. Felt packing shall be used to replace other packing materials, such as charcoal and asbestos fibers.

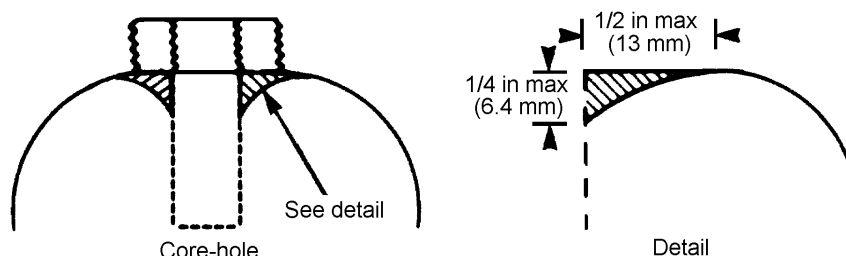


Figure 2—Top clearance of monolithic filler cylinder

7.4 Thermally actuated pressure relief device (fusible plug)

Each cylinder has one or more thermally actuated pressure relief device (fusible plug) intended to release the acetylene and prevent excessive internal pressure whenever the temperature of the fusible metal alloy is raised to approximately the boiling point of water, 212 °F (100 °C). The actual melting range is between 208 °F and 224 °F (97.8 °C and 106.7 °C). The fusible metal is usually contained in a channel in an externally threaded plug. In some cylinders, especially the small sizes, the channel is in the body of the valve. Regardless of placement, the relief device is *not* designed to function because of pressure. The temperature must cause the alloy to melt before the relief device can function to relieve the pressure. See [CGA S-1.1, Pressure Relief Device Standards—Part 1—Cylinders for Compressed Gases](#) for additional requirements [6].

7.5 **Shell**

Steel shall be used for acetylene cylinder construction and shall meet DOT-8, DOT-8AL, or TC-8WM, TC-8WAM specifications [1, 2].

8 **Acetylene cylinder inspection**

One of the most important aspects of maintaining acetylene cylinders in an acceptable condition for charging, transportation, and use is an inspection before each cylinder charging. Cylinders shall be inspected for shell defects such as dents, gouges, grinding scars, torch or arc burns, fire damage, corrosion, and damaged footings and protective collars. The cylinder valve and valve outlet shall also be inspected for defects (such as a damaged valve stem or broken handwheel), and excessive wear or damage to the valve outlet threads.

8.1 **Prefill cylinder inspection**

Each acetylene cylinder shall be inspected for the conditions that follow. Guidelines including acceptance and rejection criteria are contained in Section 9 in the paragraphs listed for each condition as follows:

- attachments (footring, protective collar, marking plate), see 9.4.9, 9.4.9.1, 9.4.9.2;
- bulges, see 9.4.7;
- corrosion or pitting of sidewall or heads, see 9.4.2.1.1, 9.4.2.1.2, 9.4.2.1.3, 9.4.2.1.4;
- cuts, digs, or gouges, see 9.4.4;
- dents, see 9.4.3;