CGA C-13—2018

STANDARD FOR PERIODIC VISUAL INSPECTION AND REQUALIFICATION OF ACETYLENE CYLINDERS

SEVENTH EDITION

CGA
Compressed Gas Association
The Standard For Safety Since 1913

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Work item 13-010
Acetylene Committee

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 calcu-lated 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 requalification 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 footring 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.

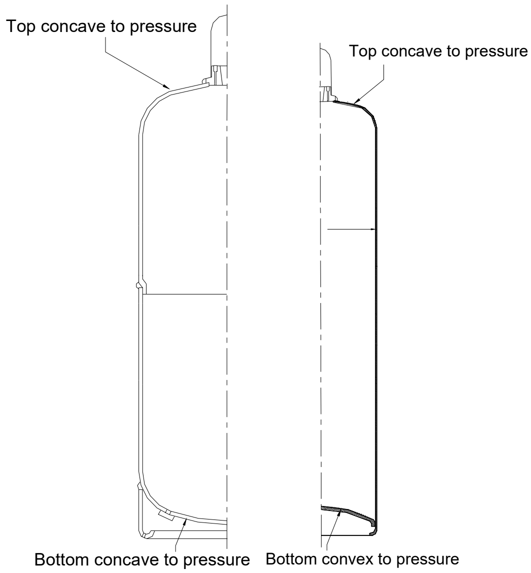


Figure 1—Illustration of concave versus convex to pressure

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 cylinder specifications	Approximate diameter		Industry minimum sidewall thickness (t_d) [1), 2), 3)]	
	in	mm	in	mm
8/8WM	12	305	0.152	3.861
8/8WM	10	254	0.127	3.226
8/8WM	8	203	0.105	2.667
8/8WM	7	178	0.095	2.413
8/8WM	6	152	0.087	2.210
8/8WM	4	102	0.065	1.651
8AL/8WAM	16	406	0.150	3.810
8AL/8WAM	12	305	0.120	3.048
8AL/8WAM	10	254	0.106	2.692
8AL/8WAM	8	203	0.102	2.591
8AL/8WAM	7	178	0.094	2.388
8AL/8WAM	6	152	0.087	2.210
8AL/8WAM	4	102	0.059	1.499

1) 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.

2) For those cylinders with top or bottom heads convex to pressure, the actual convex head thickness requirement shall be twice the industry minimum sidewall thickness (td).

3) For cylinders with top or bottom heads concave to pressure, the actual concave head thickness requirement shall be equal to the industry minimum sidewall thickness (td).

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. Dimethlyformamide (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.

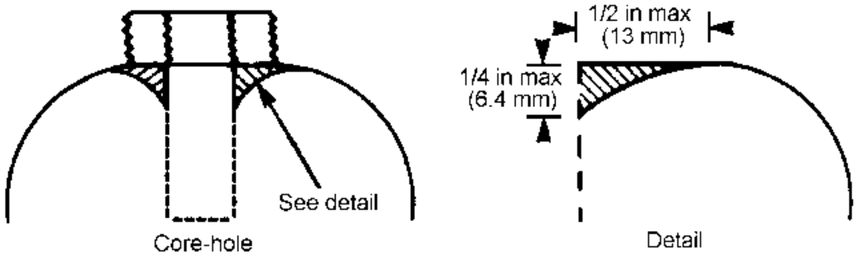


Figure 2—Top clearance of monolithic filler cylinder

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 footrings 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;

- fire damage, see 9.4.5, 9.4.5.1, 9.4.5.2, 9.4.5.3;
- footring area corrosion, see 9.4.10;
- thermally actuated pressure relief devices (fusible plugs), see 9.4.8;
- torch or arc burns, see 9.4.6; and
- unauthorized shell repairs, see 9.3.

8.1.1 Cylinder valve

Each cylinder valve shall be inspected to ensure it is free of defects such as a damaged stem, a damaged or missing handwheel, excessive wear on outlet threads, and nicks or damage to the valve outlet regulator mating surface. Reducing bushings are not permitted.

Acetylene cylinder valves containing left-handed bonnet nuts shall be replaced. Left-handed bonnet nuts are identified by notches or cutouts in the wrench flats of the bonnet nut as shown in Figure 3.

If the cylinder valve is removed, the cylinder core-hole packing shall be removed and the cylinder porous mass shall be inspected.

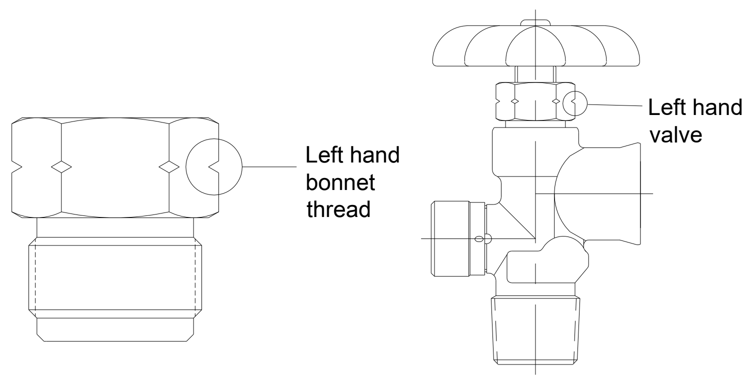


Figure 3—Illustration of left handed bonnet nuts

8.1.2 Stamped markings

Each cylinder shall be inspected for the presence of complete, readable, and required stamped markings. Any cylinder found to have unreadable, incomplete markings shall be removed from service.

8.1.2.1 Authorized tare weight marking modification

DOT and TC regulations authorize the modification of tare weights when cylinder valves are changed and/or permanently installed valve protective devices are modified (see 49 CFR 178.59, 49 CFR 178.60, 49 CFR 180.209, and CSA B339-14 [1, 2]. Modified tare weights shall have a line stamped across the original tare weight and a new tare weight stamped on the metal of the cylinder as close as possible to the original tare weight marking, or on a metal plate permanently secured to the cylinder.

8.1.2.2 Unauthorized marks

Each cylinder shall be inspected for the evidence of unauthorized alterations to the tare weight or other stamped markings.

8.1.3 Defects

Each cylinder shall be inspected for signs of damage or mechanical defects that can significantly weaken the shell or porous mass or affect the operability of the cylinder valve, external spud threads, or thermally actuated pressure relief devices (fusible plugs).

8.1.4 Conditions for removal from service

Any cylinder that exhibits any of the conditions listed in 8.1.1, 8.1.4, and 8.1.5 shall be removed from service.

8.2 Filling and post-filling inspection

Each cylinder shall be inspected for leaks. Leaks can originate in welded or brazed seams, at threaded openings, valves, thermally actuated pressure relief devices (fusible plugs), or from digs, gouges, or pits. Cylinders shall be examined for leaks both during and after charging. Any cylinder found to have a leak shall not be shipped and immediately removed from service.

9 Acetylene cylinder requalification

9.1 Authorized inspectors

Acetylene cylinder requalification shall be performed only by authorized acetylene cylinder requalification facilities registered either with DOT's Associate Director for OHMR or the Director General of the Transport Dangerous Goods Directorate of TC [1, 3]. Inspection of an acetylene cylinder's shell and porous mass shall be made only by competent and trained persons. The inspection results shall be recorded on an appropriate form (see 9.7). The completed forms shall be kept by the cylinder requalifier in accordance with 49 CFR 180.215 [1].

9.2 Cylinder inspection equipment

9.2.1 Shell inspection equipment

9.2.1.1 Depth gauges and scales

Exterior shell corrosion, dents, bulges, gouges, or digs are normally measured by direct measurement with scales or depth gauges. A rigid straightedge or other suitable device is placed over the defect, and a scale is used to measure the distance to the bottom of the defect. Also available are commercial depth gauges, which are especially suited for measuring the depth of cuts or pits. It is important when measuring such defects to use a straightedge that spans the entire affected area.

9.2.1.2 Ultrasonic devices

There are varieties of commercial ultrasonic devices that can be used to measure wall thickness. Ultrasonic devices need to be calibrated according to manufacturer's instructions.

9.2.2 Porous mass inspection equipment

Specifications DOT-8, DOT-8AL, TC-8WM, and TC-8WAM provide for overall shrinkage of the porous mass within the cylinder shell [1, 2]. To measure the longitudinal clearance between the interior surface of the shell under the valve opening and the porous mass, various feeler gauges of known thicknesses are used. Examination of the porous mass clearance and condition is made through the cylinder valve opening and thermally actuated pressure relief device (fusible plug) openings. If necessary, a dental mirror and a light source that is acceptable for hazardous locations may be used for a more detailed inspection. See 9.5.3.

9.3 Inspection for unauthorized cylinder shell repairs

Cylinders with unauthorized repairs (such as shell defects filled with plastic filler, grinding, welding, brazing, or soldering) shall be condemned. Cylinders authorized for use in Canada may be repaired or rebuilt in accordance with CSA B339 by facilities registered with TC [2].

9.4 External inspection of acetylene cylinder shells

This subsection covers external inspection of acetylene cylinder shells, which are exempt from the DOT/TC hydrostatic test requirements because of the internal porous mass. Acetylene cylinder shells are not subjected to internal corrosion and do not require internal shell inspection.

9.4.1 Preparation for shell inspection

Layered rust is an indication of severe corrosion and the cylinder shall be segregated for further inspection. In weld and crevice areas, judgment of the severity of corrosion shall be made before removal of layered rust unless measurements of the remaining metal thickness can be made. After determining the cylinder has been safely drained to atmospheric pressure or below 15 psi (103 kPa), the cylinder shall be sufficiently cleaned to facilitate the possibility of a successful examination of the shell surface. Cylinder handling equipment can facilitate inspection of the cylinder bottom. Bottom head inspection is essential because experience has shown this area to be the most susceptible to severe corrosion.

9.4.2 External sidewall and head inspection

Cylinder shells shall be examined as follows for corrosion, general distortion, or any other defect that can indicate a weakness that would render the shell unfit for further service. See Tables 2 through 5 for maximum defect size and industry minimum wall thickness at defects.

9.4.2.1 Corrosion and corrosion limits

To establish specific corrosion limits for all types, designs, and sizes of acetylene cylinders and include them in this standard is not practical. Failure to meet any of the following general rules is cause for condemning a cylinder.

9.4.2.1.1 Isolated pitting

A cylinder shall be condemned when the remaining sidewall or head thickness in an area having only isolated pitting is less than 1/3 of the industry minimum sidewall or head thickness. Figure 4 illustrates an example of isolated pitting.

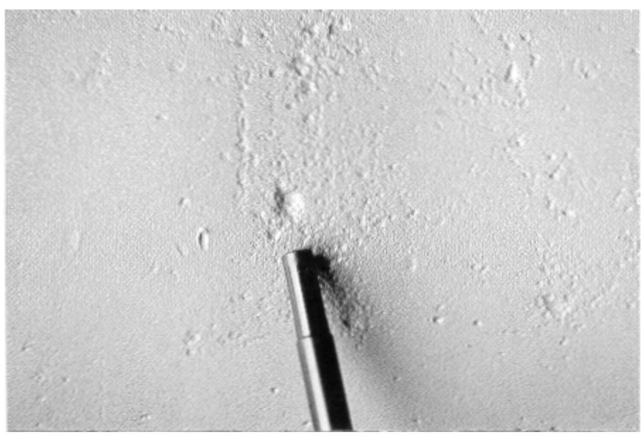


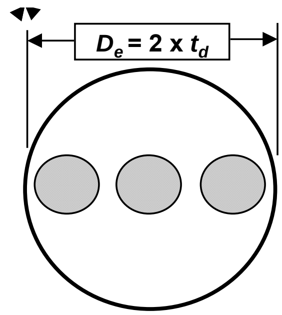
Figure 4—Isolated pitting

9.4.2.1.2 Cluster of pits

Clusters of pits (or multiple pits) are groups of pits that have a diameter less than two times the industry minimum sidewall thickness (t_d) and where the center to center distance between any two pits is less than the sum of the diameters of the two pits ($L < D_1 + D_2$).

To determine if a cluster of pits is considered to be an area of general corrosion or an isolated pit, an envelope is drawn around the entire cluster of pits.

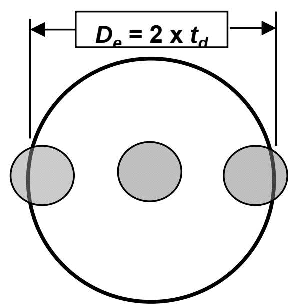
If the envelope is less than two times the industry minimum sidewall thickness (t ($D_e < 2\ t_d$), then the cluster of pits shall be considered an isolated pit (see Figure 5a). Isolated pits are as defined in 9.4.2.1.1. If the diameter of the envelope is greater than two times the industry minimum sidewall thickness, ($D_e > 2\ t_d$) then the cluster of pits shall be considered as an area of general corrosion with a size equal to the diameter of the envelope (see Figure 5b).



D_e = Diameter of the cluster envelope

t_d = Industry minimum sidewall thickness

Figure 5a—Consideration of cluster pitting, isolated pit



D_e = Diameter of the cluster envelope

t_d = Industry minimum sidewall thickness

Figure 5b—Consideration of cluster pitting, area of general corrosion

9.4.2.1.3 Line or crevice corrosion

Line or crevice corrosion is more serious than isolated pitting. Figures 6 and 7 illustrate examples of line and crevice corrosion. A cylinder shall be condemned when line or crevice corrosion on the cylinder sidewall or head is 3 in (76 mm) or longer, and the remaining thickness in the corrosion area is less than 3/4 of the industry minimum sidewall thickness. A cylinder shall also be condemned when line or crevice corrosion on the cylinder sidewall or head is less than 3 in (76 mm) long and the remaining sidewall thickness in the corrosion area is less than 1/2 of the industry minimum sidewall thickness.

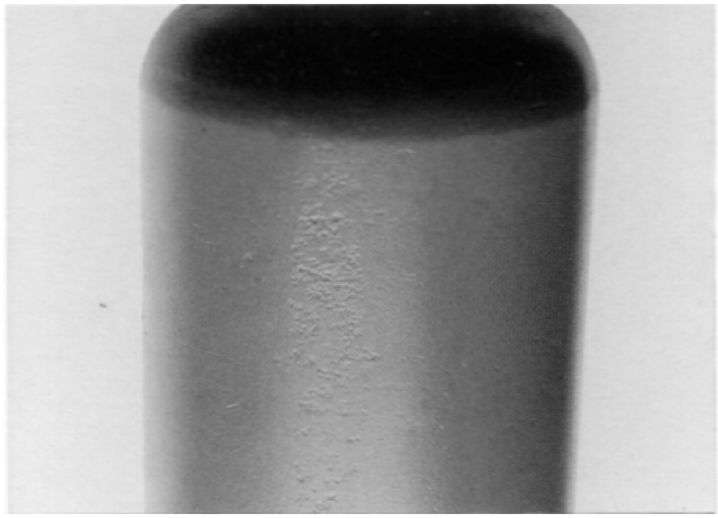


Figure 6—Line corrosion

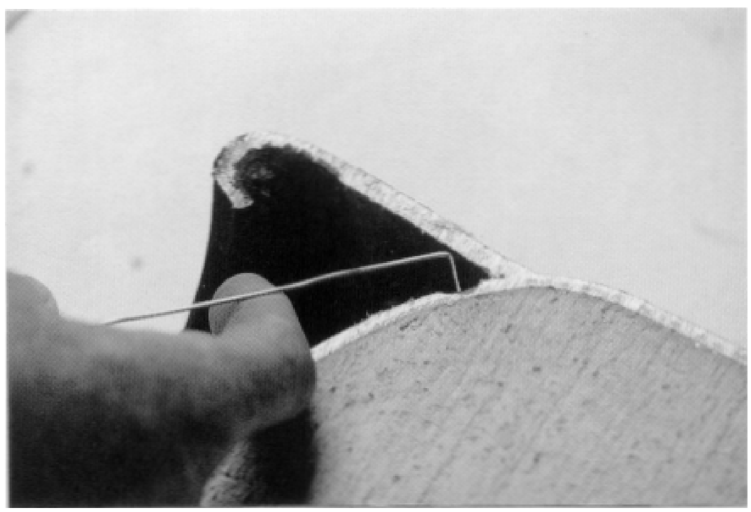


Figure 7—Crevice corrosion near the cylinder footring

9.4.2.1.4 General corrosion of sidewall and heads

It is often difficult to measure or estimate the depth of general corrosion because direct comparison with the original sidewall or head thickness cannot always be made. General corrosion is often accompanied by pitting.

A cylinder shall be condemned when the remaining sidewall thickness in an area of general corrosion having dimensions up to and including 10 in^2 (65 cm^2) (similar in length and width) is less than 1/2 of the industry minimum sidewall thickness, or when the remaining sidewall thickness in an area of general corrosion having dimensions greater than 10 in^2 (65 cm^2) (similar in length and width) is less than 3/4 of the industry minimum sidewall thickness.

A cylinder shall also be condemned when the remaining head (bottom or top) thickness in an area of general corrosion is less than 3/4 of the industry minimum head thickness. Figures 8 and 9 illustrate general corrosion with isolated pitting on a cylinder sidewall and bottom head.

9.4.2.2 Industry minimum sidewall and head thickness (bottom and top)

To use the criteria in 9.4.2.1, it is necessary to know the original sidewall and head thickness. 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 shell where corrosion has not taken place, or on another cylinder of same type not subjected to corrosion. Table 1 may be used as a guide in the absence of information on the original sidewall thickness or the industry minimum sidewall thickness (t_d).

Figure 8—General corrosion with isolated pitting on cylinder sidewall

Figure 9—General corrosion with pitting on bottom head

Table 2—Minimum wall thickness at defect for acetylene cylinders Specification 8AL/8WAM based on the industry minimum sidewall thickness(t_d)

Cylinder diameter	4 in (102 mm)	6 in (152 mm)	7 in (178 mm)	8 in (203 mm)	10 in (254 mm)	12 in (305 mm)	16 in (406 mm)
Industry minimum side-wall thickness (t_d)	0.059 in (1.499 mm)	0.087 in (2.210 mm)	0.094 in (2.388 mm)	0.102 in (2.591 mm)	0.106 in (2.692 mm)	0.120 in (3.048 mm)	0.150 in (3.810 mm)
Minimum wall thickness at defect when sidewall or head (concave) line and crevice corrosion are greater than or equal to 3 in (76 mm) in length	0.044 in (1.124 mm)	0.065 in (1.657 mm)	0.071 in (1.791 mm)	0.077 in (1.943 mm)	0.080 in (2.019 mm)	0.090 in (2.286 mm)	0.113 in (2.858 mm)
Minimum wall thickness at defect when sidewall or head (concave) line and crevice corrosion are less than 3 in (76 mm) in length	0.030 in (0.749 mm)	0.044 in (1.105 mm)	0.047 in (1.194 mm)	0.051 in (1.295 mm)	0.053 in (1.346 mm)	0.060 in (1.524 mm)	0.075 in (1.905 mm)
Minimum wall thickness at defect when head (convex) line and crevice corrosion are greater than or equal to 3 in (76 mm) in length	0.89 in (2.248 mm)	0.131 in (2.210 mm)	0.141 in (3.581 mm)	0.153 in (3.886 mm)	0.159 in (4.039 mm)	0.180 in (4.572 mm)	0.225 in (3.810 mm)
Minimum wall thickness at defect when head (convex) line and crevice corrosion are less than 3 in (76 mm) in length	0.059 in (1.499 mm)	0.087 in (2.210 mm)	0.094 in (2.388 mm)	0.102 in (2.591 mm)	0.106 in (2.692 mm)	0.120 in (3.048 mm)	0.150 in (3.810 mm)
Minimum wall thickness at defect for sidewall general corrosion in an area less than or equal to 10 in^2 (64 cm^2)	0.030 in (0.749 mm)	0.044 in (1.105 mm)	0.047 in (1.194 mm)	0.051 in (1.295 mm)	0.053 in (1.346 mm)	0.060 in (1.524 mm)	0.075 in (1.905 mm)
Minimum wall thickness at defect for sidewall general corrosion in an area greater than 10 in^2 (64 cm^2)	0.044 in (1.124 mm)	0.065 in (1.657 mm)	0.071 in (1.791 mm)	0.077 in (1.943 mm)	0.080 in (2.019 mm)	0.090 in (2.286 mm)	0.113 in (2.858 mm)
Minimum wall thickness at defect for head (concave) general corrosion	0.044 in (1.124 mm)	0.065 in (1.657 mm)	0.071 in (1.791 mm)	0.077 in (1.943 mm)	0.080 in (2.019 mm)	0.090 in (2.286 mm)	0.113 in (2.858 mm)
Minimum wall thickness at defect for sidewall and head (concave) when gouge is less than 3 in (76 mm) in length	0.030 in (0.749 mm)	0.044 in (1.105 mm)	0.047 in (1.194 mm)	0.051 in (1.295 mm)	0.053 in (1.346 mm)	0.060 in (1.524 mm)	0.075 in (1.905 mm)
Minimum wall thickness at defect for sidewall and head (concave) when gouge is greater than or equal to 3 in (76 mm) in length	0.044 in (1.124 mm)	0.065 in (1.657 mm)	0.071 in (1.791 mm)	0.077 in (1.943 mm)	0.080 in (2.019 mm)	0.090 in (2.286 mm)	0.113 in (2.858 mm)
Minimum wall thickness at isolated pitting sidewall and head (concave)	0.020 in (0.500 mm)	0.029 in (0.737 mm)	0.031 in (0.796 mm)	0.034 in (0.864 mm)	0.035 in (0.897 mm)	0.040 in (1.016 mm)	0.050 in (1.270 mm)

NOTE—The defect values stated in this table are based on the industry minimum sidewall thickness (t_d) listed in Table 1. Therefore, this table is not applicable if the cylinder is manufactured with wall thickness less than stated in Table 1.

Table 3—Minimum wall thickness at defect for acetylene cylinders Specification 8/8WM based on the industry minimum sidewall thickness (t_d)

Cylinder diameter	4 in (102 mm)	6 in (152 mm)	7 in (178 mm)	8 in (203 mm)	10 in (254 mm)	12 in (305 mm)
Industry minimum sidewall thickness (t_d)	0.065 in (1.651 mm)	0.087 in (2.210 mm)	0.095 in (2.413 mm)	0.105 in (2.667 mm)	0.127 in (3.226 mm)	0.152 in (3.861 mm)
Minimum wall thickness at defect when sidewall or head (concave) line and crevice corrosion are greater than or equal to 3 in (76 mm) in length	0.049 in (1.238 mm)	0.065 in (1.657 mm)	0.071 in (1.810 mm)	0.079 in (2.000 mm)	0.095 in (2.419 mm)	0.114 in (2.896 mm)
Minimum wall thickness at defect when sidewall or head (concave) line and crevice corrosion are less than 3 in (76 mm) in length	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)
Minimum wall thickness at defect when head (convex) line and crevice corrosion are greater than or equal to 3 in (76 mm) in length	0.098 in (2.277 mm)	0.131 in (3.315 mm)	0.143 in (3.620 mm)	0.158 in (4.001 mm)	0.191 in (4.839 mm)	0.228 in (5.791 mm)
Minimum wall thickness at defect when head (convex) line and crevice corrosion are less than 3 in (76 mm) in length	0.065 in (1.651 mm)	0.087 in (2.210 mm)	0.095 in (2.413 mm)	0.105 in (2.667 mm)	0.127 in (3.226 mm)	0.152 in (3.861 mm)
Minimum wall thickness at isolated pitting sidewall and head (concave)	0.022 in (0.550 mm)	0.029 in (0.737 mm)	0.032 in (0.804 mm)	0.035 in (0.889 mm)	0.042 in (1.075 mm)	0.051 in (1.287 mm)
Minimum wall thickness at isolated pitting head (convex)	0.043 in (1.101 mm)	0.058 in (1.473 mm)	0.063 in (1.609 mm)	0.070 in (1.778 mm)	0.085 in (2.151 mm)	0.101 in (2.574 mm)
Minimum wall thickness at defect for sidewall general corrosion in an area less than or equal to 10 in^2 (64 cm^2)	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)
Minimum wall thickness at defect for sidewall general corrosion in an area greater than 10 in^2 (64 cm^2)	0.049 in (1.238 mm)	0.065 in (1.657 mm)	0.071 in (1.810 mm)	0.079 in (2.000 mm)	0.095 in (2.419 mm)	0.114 in (2.896 mm)
Minimum wall thickness at defect for head (concave) general corrosion	0.049 in (1.238 mm)	0.065 in (1.657 mm)	0.071 in (1.810 mm)	0.079 in (2.000 mm)	0.095 in (2.419 mm)	0.114 in (2.896 mm)
Minimum wall thickness at defect for head (convex) general corrosion	0.098 in (2.477 mm)	0.131 in (3.315 mm)	0.143 in (3.620 mm)	0.158 in (4.001 mm)	0.191 in (4.839 mm)	0.228 in (5.791 mm)
Minimum wall thickness at defect when sidewall or head (concave) gouge is less than 3 in (76 mm) in length	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)
Minimum wall thickness at defect sidewall or head (concave) when gouge is greater than or equal to 3 in (76 mm) in length	0.049 in (1.238 mm)	0.065 in (1.657 mm)	0.071 in (1.810 mm)	0.079 in (2.000 mm)	0.095 in (2.419 mm)	0.114 in (2.896 mm)
Minimum wall thickness at defect head (convex) when gouge is less than 3 in (76 mm) in length	0.065 in (1.651 mm)	0.087 in (2.210 mm)	0.095 in (2.413 mm)	0.105 in (2.667 mm)	0.127 in (3.226 mm)	0.152 in (3.861 mm)
Minimum wall thickness at defect when head (convex) gouge is greater than or equal to 3 in (76 mm) in length	0.098 in (2.477 mm)	0.131 in (3.315 mm)	0.143 in (3.620 mm)	0.158 in (4.001 mm)	0.191 in (4.839 mm)	0.228 in (5.791 mm)
NOTE—The defect values stated in this table are based on the industry minimum sidewall thickness (t_d) listed in Table 1. Therefore, this table is not applicable if the cylinder is manufactured with wall thickness less than stated in Table 1.						

Table 4—Maximum allowable defect depth for acetylene cylinders Specification 8AL/8WAM based on the industry minimum sidewall thickness (t_d)

Cylinder diameter	4 in (102 mm)	6 in (152 mm)	7 in (178 mm)	8 in (203 mm)	10 in (254 mm)	12 in (305 mm)	16 in (406 mm)
Industry minimum sidewall thickness (t_d)	0.059 in (1.499 mm)	0.087 in (2.210 mm)	0.094 in (2.388 mm)	0.102 in (2.591 mm)	0.106 in (2.692 mm)	0.120 in (3.048 mm)	0.150 in (3.810 mm)
Maximum depth of defect when sidewall or head (concave) line and crevice corrosion are greater than or equal to 3 in (76 mm) in length	0.015 in (0.375 mm)	0.022 in (0.552 mm)	0.024 in (0.597 mm)	0.026 in (0.648 mm)	0.027 in (0.673 mm)	0.030 in (0.762 mm)	0.038 (0.953 mm)
Maximum depth of defect when sidewall or head (concave) line and crevice corrosion are less than 3 in (76 mm) in length	0.030 in (0.749 mm)	0.044 in (1.105 mm)	0.047 in (1.194 mm)	0.051 in (1.295 mm)	0.053 in (1.346 mm)	0.060 in (1.524 mm)	0.075 in (1.905 mm)
Maximum depth of defect when head (convex) line and crevice corrosion are greater than or equal to 3 in (76 mm) in length	0.030 in (0.749 mm)	0.044 in (1.105 mm)	0.047 in (1.194 mm)	0.051 in (1.295 mm)	0.053 in (1.346 mm)	0.060 in (1.524 mm)	0.075 in (1.905 mm)
Maximum depth of defect when head (convex) line and crevice corrosion are less than 3 in (76 mm) in length	0.059 in (1.499 mm)	0.087 in (2.210 mm)	0.094 in (2.388 mm)	0.102 in (2.591 mm)	0.106 in (2.692 mm)	0.120 in (3.048 mm)	0.150 in (3.810 mm)
Maximum depth of isolated pitting sidewall and head (concave)	0.039 in (0.999 mm)	0.058 in (1.473 mm)	0.063 in (1.592 mm)	0.068 in (1.727 mm)	0.071 in (1.795 mm)	0.080 in (2.032 mm)	0.100 in (2.540 mm)
Maximum depth of defect for sidewall general corrosion in an area less than or equal to 10 in^2 (64 cm^2)	0.030 in (0.749 mm)	0.044 in (1.105 mm)	0.047 in (1.194 mm)	0.051 in (1.295 mm)	0.053 in (1.346 mm)	0.060 in (1.524 mm)	0.075 in (1.905 mm)
Maximum depth of defect for sidewall general corrosion in an area greater than 10 in^2 (64 cm^2)	0.015 in (0.375 mm)	0.022 in (0.552 mm)	0.024 in (0.597 mm)	0.026 in (0.648 mm)	0.027 in (0.673 mm)	0.030 in (0.762 mm)	0.038 (0.953 mm)
Maximum depth of defect for head (concave) general corrosion	0.015 in (0.375 mm)	0.022 in (0.552 mm)	0.024 in (0.597 mm)	0.026 in (0.648 mm)	0.027 in (0.673 mm)	0.030 in (0.762 mm)	0.038 (0.953 mm)
Maximum depth of defect when gouge is less than 3 in (76 mm) in length	0.030 in (0.749 mm)	0.044 in (1.105 mm)	0.047 in (1.194 mm)	0.051 in (1.295 mm)	0.053 in (1.346 mm)	0.060 in (1.524 mm)	0.075 in (1.905 mm)
Maximum depth of defect when gouge is greater than or equal to 3 in (76 mm) in length	0.015 in (0.375 mm)	0.022 in (0.552 mm)	0.024 in (0.597 mm)	0.026 in (0.648 mm)	0.027 in (0.673 mm)	0.030 in (0.762 mm)	0.038 (0.953 mm)

NOTE—The defect values stated in this table are based on the industry minimum sidewall thickness (t_d) listed in Table 1. Therefore, this table is not applicable if the cylinder is manufactured with wall thickness less than stated in Table 1.

Table 5—Maximum allowable defect depth for acetylene cylinders Specification 8/8WM based on the industry minimum sidewall thickness (t_d)

Cylinder diameter	4 in (102 mm)	6 in (152 mm)	7 in (178 mm)	8 in (203 mm)	10 in (254 mm)	12 in (305 mm)
Industry minimum sidewall thickness	**0.065 in (1.651 mm)**	**0.087 in (2.210 mm)**	**0.095 in (2.413 mm)**	**0.105 in (2.667 mm)**	**0.127 in (3.226 mm)**	**0.152 in (3.861 mm)**
Maximum depth of defect when sidewall or head (concave) line and crevice corrosion are greater than or equal to 3 in (76 mm) in length	0.016 in (0.413 mm)	0.022 in (0.552 mm)	0.024 in (0.603 mm)	0.026 in (0.667 mm)	0.032 in (0.806 mm)	0.038 in (0.965 mm)
Maximum depth of defect when sidewall or head (concave) line and crevice corrosion are less than 3 in (76 mm) in length	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)
Maximum depth of defect when head (convex) line and crevice corrosion are greater than or equal to 3 in (76 mm) in length	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)
Maximum depth of defect when head (convex) line and crevice corrosion are less than 3 in (76 mm) in length	0.065 in (1.651 mm)	0.087 in (2.210 mm)	0.095 in (2.413 mm)	0.105 in (2.667 mm)	0.127 in (3.226 mm)	0.152 in (3.861 mm)
Maximum depth of defect at isolated pitting sidewall and concave head	0.043 in (1.101 mm)	0.058 in (1.473 mm)	0.063 in (1.609 mm)	0.070 in (1.778 mm)	0.085 in (2.151 mm)	0.101 in (2.574 mm)
Maximum depth of defect at isolated pitting convex head	0.087 in (2.201 mm)	0.116 in (2.946 mm)	0.127 in (3.217 mm)	0.140 in (3.556 mm)	0.169 in (4.301 mm)	0.203 in (5.148 mm)
Maximum depth of defect for sidewall general corrosion in an area less than or equal to 10 in^2 (64 cm^2)	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)
Maximum depth of defect for sidewall general corrosion in an area greater than 10 in^2 (64 cm^2)	0.016 in (0.413 mm)	0.022 in (0.552 mm)	0.024 in (0.603 mm)	0.026 in (0.667 mm)	0.032 in (0.806 mm)	0.038 in (0.965 mm)
Maximum depth of defect for head (concave) general corrosion	0.016 in (0.413 mm)	0.022 in (0.552 mm)	0.024 in (0.603 mm)	0.026 in (0.667 mm)	0.032 in (0.806 mm)	0.038 in (0.965 mm)
Maximum depth of defect for head (convex) general corrosion	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)
Maximum depth of defect when sidewall or head (concave) gouge is less than 3 in (76 mm) in length	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)
Maximum depth of defect when sidewall or head (concave) gouge is greater than or equal to 3 in (76 mm) in length	0.016 in (0.413 mm)	0.022 in (0.552 mm)	0.024 in (0.603 mm)	0.026 in (0.667 mm)	0.032 in (0.806 mm)	0.038 in (0.965 mm)
Maximum depth of defect when head (convex) gouge is less than 3 in (76 mm) in length	0.065 in (1.651 mm)	0.087 in (2.210 mm)	0.095 in (2.413 mm)	0.105 in (2.667 mm)	0.127 in (3.226 mm)	0.152 in (3.861 mm)
Maximum depth of defect when head (convex) gouge is greater than or equal to 3 in (76 mm) in length	0.033 in (0.826 mm)	0.044 in (1.105 mm)	0.048 in (1.207 mm)	0.053 in (1.334 mm)	0.064 in (1.613 mm)	0.076 in (1.930 mm)

NOTE—The defect values stated in this table are based on the industry minimum sidewall thickness (t_d) listed in Table 1. Therefore, this table is not applicable if the cylinder is manufactured with wall thickness less than stated in Table 1.

9.4.3 Dents

Dents are of concern where the metal deformation is sharp or creased to significantly increase stress, and such cylinders shall be condemned. Where metal deformation is not sharp, dents of greater magnitude may be tolerated. Figure10 illustrates a dent.

Where denting occurs, the cylinder shall be condemned if the depth of the dent is greater than 1/10 of the greatest dimension of the dent.

On cylinders exceeding 40 ft^3 (1.13 m^3) capacity, the depth of the dent shall not exceed 0.75 in (19.1 mm). On 40 ft^3 (1.13 m^3) cylinders and smaller, the maximum allowable dent depth shall be 0.375 in (9.5 mm).

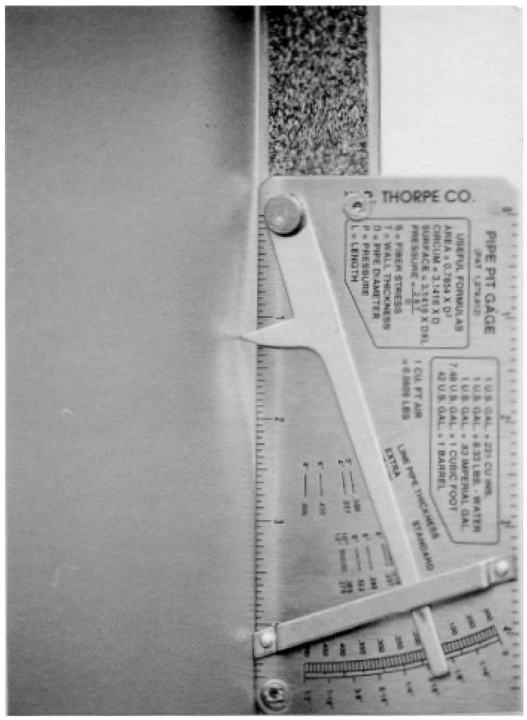


Figure 10—Measuring the length and depth of typical dent

9.4.4 Cuts, digs, or gouges

Cuts, digs, or gouges reduce the wall thickness of the cylinder and can increase stress. A cylinder shall be condemned if the depth of the cut, dig, or gouge exceeds 1/2 the industry minimum sidewall thickness or the industry minimum head thickness and is less than 3 in (76 mm) in length. When the length of the defect is 3 in (76 mm) or more, the limit shall be reduced to 1/4 of the industry minimum sidewall thickness or the industry minimum head thickness. When measuring cuts, the upset metal shall be removed or compensated for so that only the actual depth of metal removed from the cylinder wall is measured.

9.4.5 Fire damage

Cylinders shall be examined for evidence of exposure to fire.

9.4.5.1 Inspection for fire damage

As per 49 CFR 180.205 the cylinder shall be visually examined in accordance with this publication [1]. This provides that if the cylinder is undamaged and the porous mass is unchanged and intact, the cylinder may be returned to service [1]. TC regulations require compliance with CSA B340, which in turn requires inspection and maintenance in accordance with this publication [4].

Common evidence of exposure to fire is:

- burnt or melted valve;
- burnt or scarfed metal;
- charred, burnt, cracked, or checkered protective coating;
- distortion of the cylinder shell; or
- melted out thermally actuated pressure relief device(s) (fusible plug[s]).

9.4.5.2 Evaluation of fire damage to cylinder shell

DOT regulations state that a DOT cylinder that has been subjected to, and damaged by, the action of fire shall not again be placed in service [1]. TC regulations state that a TC cylinder that has been subjected to, and damaged by, the action of fire shall not again be placed in service until it has been reconditioned in accordance with TC requirements [2]. The intent of this requirement is to condemn those cylinders that have been subjected to the action of fire that has changed the metallurgical structure or the strength properties of the steel, or caused breakdown of the porous mass. This is normally a determination made by visual examination as covered previously with particular emphasis on the condition of the protective coating. If there is evidence that the protective coating has been burned completely off any portion of the cylinder surface, or if the cylinder body is burned, warped, or distorted, the cylinder shall be condemned. However, if the protective coating is only smudged, discolored, or blistered, and is found by examination to be intact underneath, the cylinder may be returned to service.

9.4.5.3 Evaluation of fire damage to cylinder porous mass

The porous mass shall be inspected through the valve opening and all thermally actuated pressure relief device (fusible plug) openings for evidence of charring, disintegration, or heavy carbon deposits. Core-hole packing, if used, shall be removed for examination of the porous mass at the valve opening. If the porous mass is firm and not damaged (as evidenced by the absence of charring, crumbling, powdering, or heavy carbon deposits), the cylinder may be returned to service.

9.4.6 Torch and arc burns

Cylinders shall be condemned when torch or arc burns result in either of the following conditions:

- removal of metal by cratering or deposit of metal; or
- removal of metal by scarfing.

9.4.7 Bulges

Cylinders are manufactured with a symmetrical shape. Those cylinders with a definite visible sidewall, top, or bottom head bulge shall be condemned. Cylinders manufactured with heads convex to pressure that have a bulge, best described as a partial bulge or a reverse bending of the head, shall be condemned upon verification of bulging (see cylinder bottom in Figure 11).

9.4.8 Thermally actuated pressure relief devices (fusible plugs)

Thermally actuated pressure relief devices (fusible plug) shall be examined for:

- bent condition;
- corrosion;
- extruded metal; and
- peened fusible metal.

Defective thermally actuated pressure relief devices (fusible plugs) shall not be peened, altered, or repaired; they shall be replaced.

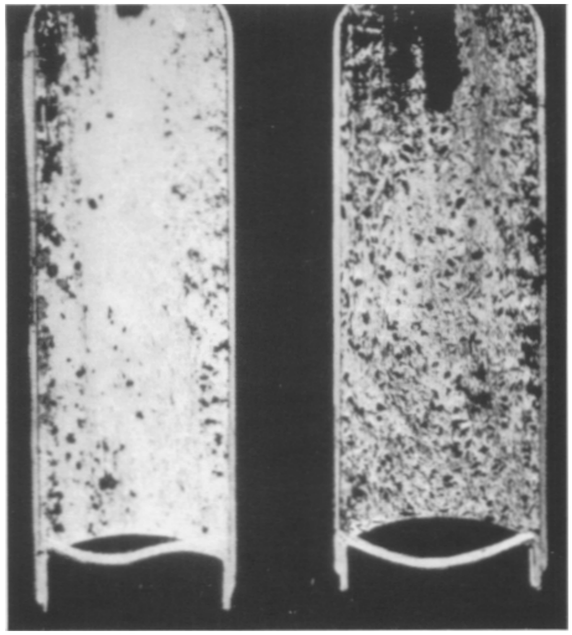


Figure 11—Cylinders manufactured with bottom head convex to pressure that have become bulged (partial bulge or reverse bending of the bottom)

9.4.9 Attachments

Attachments (such as footrings, protective collars, marking plates, and lifting lugs) found on cylinders can lose their intended function through service abuse. These attachments and the associated portion of the cylinder shall be inspected.

9.4.9.1 Footrings and protective collars

Footrings and protective collars shall be examined for distortion, looseness, excessive corrosion, and failure of welds.

Cylinders with footrings unable to maintain the cylinder in a stable and upright position, or protect the bottom thermally actuated pressure relief devices (fusible plugs), shall be removed from service. Cylinders with protective collars unable to protect the valve and the thermally actuated pressure relief device (fusible plug) shall be removed from service.

Repairs to footrings and protective collars shall only be performed by an authorized repair facility.

9.4.9.2 Marking plate

In the case of a marking plate not completely sealed, any evidence of corrosion between it and the shell shall require removal of the plate and visual inspection of the cylinder wall. However, removal and reattachment of the plate shall be undertaken only by authorized repair facilities, or original cylinder manufacturers, as noted in the 49 CFR 180 Subpart C or TC requirements [1, 2].

9.4.10 Bottom head-to-sidewall weld corrosion on press-fit footring cylinders

A cylinder of the press-fit footring design manufactured from the mid-1930s until the later 1950s can be identified by the one-piece shell and the absence of a weld where the footring is secured to the sidewall (see Figure 12). There were several types of bottom head-to-sidewall weld arrangements.

In the press-fit footring construction, the bottom head is convex to pressure, and the rolled bottom lip of the footring is very close to the bottom head-to-sidewall weld. This design allows dirt and moisture to accumulate resulting in severe corrosion of the weld filler material, thereby reducing the strength of the weld joint. Severe corrosion of this bottom head weld is sometimes accompanied by severe corrosion between the top of the footring and the sidewall.

All press-fit footring design cylinders, particularly the large 12 in (305 mm) diameter sizes, shall be inspected in the horizontal or inverted position for the following three conditions:

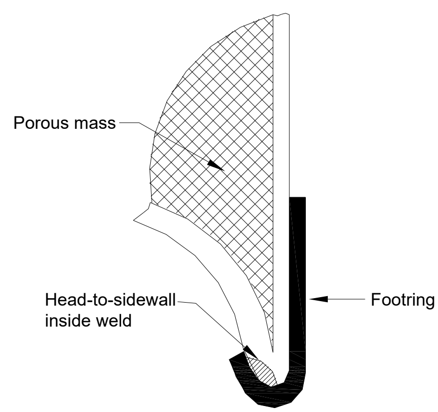
- Any cylinder with an accumulation of rust in the weld joint area judged to have significantly weakened the strength of the weld shall be removed from service. DOT and dual marked cylinders shall be condemned. Cylinders authorized for use in Canada may be rebuilt in accordance with CSA B339 by facilities registered with TC [2];

- Any cylinder with sidewall or head corrosion that results in a sidewall or head thickness of less than that permitted in 9.4.2 shall be condemned; and

- Any cylinder with rust between the inside top of the footring and the sidewall exceeding 0.187 in (4.75 mm) shall be removed from service. DOT and dual marked cylinders shall be condemned. Cylinders authorized for use in Canada may be rebuilt in accordance with CSA B339 by facilities registered with TC [2].

The quantity of rust accumulated and removed is indicative of the severity of corrosion. For the most effective evaluation of rust accumulation, the weld shall be examined both before and after carrying out shot blasting or other methods of rust removal.

Any DOT cylinder that has had the footring removed shall be removed from service and scrapped. Cylinders authorized for use in Canada may be repaired or rebuilt in accordance with CSA B339 by facilities registered with TC [2].



NOTE—One of several types of bottom head-to-sidewall weld arrangements.

Figure 12—Press-fit footring cylinder head-to-sidewall inside weld

9.5 Inspection of acetylene cylinder porous mass

This subsection covers the internal inspection of the porous mass of the monolithic and nonmonolithic types. Regulations permit clearance between the porous mass and internal surface of the cylinder shell at the time of manufacture, if such clearances do not impair the functions of the porous mass. A feeler or thickness gauge may be used to determine the maximum top clearance between the porous mass and internal surface of the cylinder (see 9.5.3). This inspection procedure requires experience and only authorized, trained personnel may perform this inspection.

9.5.1 Preparation for inspection

The cylinder shall be safely drained of acetylene to atmospheric pressure and allowed to warm up to ambient temperature to remove any acetylene remaining due to cooling of the cylinder during draining. The cylinder pressure and weight can be checked before removal of the valve to help ensure that the cylinder is not pressurized because of plugged core-hole packing or damaged valve. Absence of pressure on the pressure gauge is not always an indication that a cylinder is empty. Additional tests should be performed, such as blowing low pressure nitrogen into the valve opening for several seconds and then listening for the nitrogen to be expelled. Porous mass inspection shall be performed in a well-ventilated area away from sources of ignition and electrical equipment not approved for hazardous locations. The valve and core-hole packing shall be removed.

9.5.2 Porous mass inspection

The inspector shall use a brass or Monel®

metal wire probe or a gloved finger to feel the porous mass for disintegration. Insert the probe or gloved finger into the opening against all porous mass surfaces that can be reached. If a wire probe is used, do not jab the probe into the porous mass. If the porous mass is excessively soft or is powdery, crumbling, or broken down, the cylinder shall be condemned. Visual inspection of the porous mass with a dental mirror and a light source that is acceptable for hazardous locations will assist in determining the extent of the clearances and the condition of the porous mass.

9.5.3 Porous mass clearance measurement

A measurement of top head-to-porous mass clearance shall be made. Cylinders with acceptable head-to-porous mass clearance, as shown in Table 6, will normally be within the acceptable limits of sidewall clearance. Figure 13 gives details of a typical clearance gauge, which may be used to ensure that top head-to-porous mass clearance does not exceed maximum limits.

Typically, a top clearance maximum limit gauge is constructed with a thickness (*t*) corresponding to the maximum allowable top head-to-porous mass clearance for the porous mass length being requalified.

The top head-to-porous mass clearance is gauged and determined to be acceptable if:

- the maximum top clearance gauge cannot be inserted;
- the maximum top clearance limit gauge can be inserted into the top clearance at any point, and provided that the fit of the gauge in the top clearance is a snug fit, without vertical movement; or
- the maximum top clearance limit gauge can be inserted into the top clearance area with vertical movement and radial movement up to a total of 180 degrees.

When the top clearance gauge fits loosely into the top clearance space with more than a total of 180-degree radial movement, the cylinder shall be removed from service.

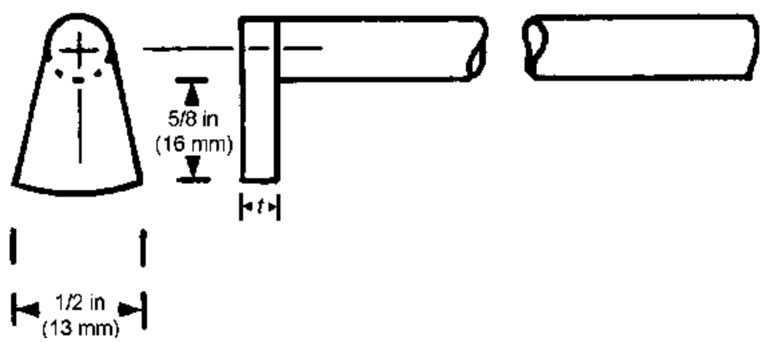
Cylinders authorized for use in Canada may be rebuilt in accordance with CSA B339 by facilities registered with TC [2]. An enlarged core-hole may be repacked in accordance with the note under Table 6. Where the porous mass clearance is not uniform on the top surface, the gauge shall be used around the entire circumference of the cylinder inlet. If a porous mass does not have acceptable top clearance based on the above criteria and does not exceed the dimensions shown in Figure 2, a 7 in (178 mm) or larger diameter cylinder may either be repacked as described in the note under Table 6 or be condemned. Cylinders that exceed the dimensions as shown in Figure 2 shall be condemned.

Table 6—Maximum top head-to-porous mass clearance for nonmonolithic and monolithic porous mass cylinders

Typical cylinder design in (mm)	Maximum allowable head-to-porous mass clearance in (mm)	Maximum allowable head-to-porous mass clearance for shell with center circumferential weld 1) in (mm)
4 × 13 (102 × 330)	0.060 (1.5)	0.060 (1.5)
6 × 20 (152 × 508)	0.090 (2.3)	0.060 (1.5)
7 × 25 (178 × 635)	0.120 (3.0)	0.080 (2.0)
7 × 31 (178 × 787)	0.125 (3.2)	0.084 (2.1)
8 × 25 (203 × 635)	0.125 (3.2)	0.084 (2.1)
10 × 32 (254 × 813)	0.125 (3.2)	0.084 (2.1)
10 × 38 (254 × 965)	0.125 (3.2)	0.084 (2.1)
12 × 27 (305 × 686)	0.125 (3.2)	0.084 (2.1)
12 × 33 (305 × 838)	0.125 (3.2)	0.084 (2.1)
12 × 41 (305 × 1041)	0.125 (3.2)	0.084 (2.1)
16 × 52 (406 × 1321)	0.125 (3.2)	0.084 (2.1)
20 × 38 (508 × 965)	0.125 (3.2)	0.084 (2.1)

NOTE—Monolithic porous mass cylinders having enlarged core-holes directly under the valve within the dimensions shown in Figure 2 may be replaced with material such as felt.

1) Where bottom clearance is measured, total clearance must not exceed maximum top clearance allowed in column to the left.



NOTE—Dimensions shown are suggested for 0.75 in and 1 in (20 mm and 25 mm) cylinder openings.

Figure 13—Typical clearance gauge

9.5.3.1 Monolithic porous mass clearance measurement without center circumferentially welded shell

The top head-to-porous mass clearance shall not exceed 0.5% of the porous mass length, but in no case be more than 0.125 in (3.175 mm).

9.5.3.2 Monolithic porous mass clearance measurement with center circumferentially welded shell

The top head-to-porous mass clearance shall not exceed 0.5% of the porous mass length, but in no case be more than 0.084 in (2.134 mm). Where bottom clearance is measured, total clearance shall not exceed maximum top clearances allowed in 9.5.3.1.

9.5.3.3 Nonmonolithic porous mass clearance measurement

Nonmonolithic porous masses, other than balsa wood, shall be condemned. The top head-to-porous mass clearance shall not exceed 0.5% of the porous mass length, but in no case shall be more than 0.125 in (3.175 mm).

9.5.3.4 Alternate method of checking B and MC cylinders

On B cylinders (40 ft^3 [1.13 m^3]) and MC cylinders (10 ft^3 [0.28 m^3]), check the porous mass by holding the cylinder longitudinally in an inverted position at 45 degrees and shaking the cylinder to detect any movement of the porous mass (see Figure 14). Rotate the cylinder 90 degrees and shake again. The cylinder is acceptable if no movement is felt or heard. Therefore, valve removal and measurement of the head-to-porous mass is not necessary. If movement can be detected in either position, refer to 9.5.2 and 9.5.3.

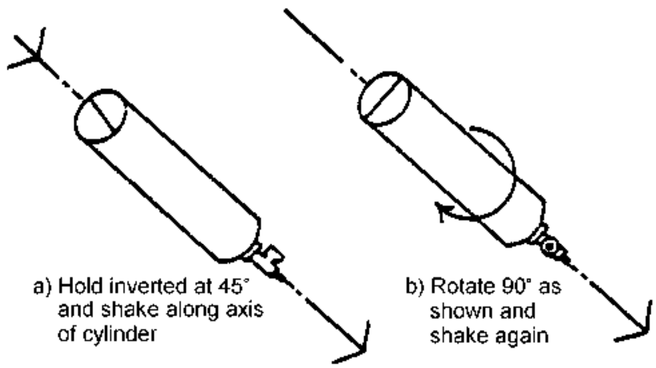


Figure 14—Method of checking B and MC cylinders

9.6 Inspection markings

9.6.1 Marking of approved cylinders

Each cylinder that passes shell and porous mass requalification shall be marked with the date (month and year) plainly and permanently stamped into the metal of the cylinder or on a metal plate permanently secured onto the cylinder. Between the month and year numbers, the requalifier identification number (RIN) mark of the authorized requalification facility (*) shall be stamped, for example, 4-*-96 for April 1996.

Stamping shall be in accordance with the requirements of DOT specifications 8 and 8AL, CTC specifications 8, 8AL, and 8WC and TC specifications 8WM and 8WAM. The date of the previous tests shall not be obliterated. In the case of cylinder shell inspection without porous mass inspection, the letter S shall be stamped following the initial requalification date stamping. For example, 4-*-96 S identifies that only the shell inspection was made. In the case of shell and porous mass inspections at the initial requalification date, the letters F and S shall be stamped following date stamping. For example, 4-*-96 FS identifies that both the shell and porous mass inspections were made.

9.6.2 Marking of condemned cylinders

Each cylinder that does not pass shell or porous mass requalification shall be marked according to applicable national regulations. For the U.S., each cylinder shall be marked according to 49 CFR 180.205 [1]. For Canada, each cylinder shall be marked according to CSA B339 [2].

9.7 Sample visual inspection and requalification report

The results obtained under requirements of this standard shall be recorded and a record kept by the retester until either expiration of the requalification period or until the cylinder is again requalified, whichever occurs first. A sample visual inspection and requalification report form is shown in Appendix B. An equivalent form may be used.

10 References

Unless otherwise specified, the latest edition shall apply.

[1] *Code of Federal Regulations*, Title 49 (Transportation) Parts 100-180, U.S. Government Printing Office. www.gpo.gov

[2] CSA B339, *Cylinders, spheres, and tubes for the transportation of dangerous goods*, Canadian Standards Association. www.csa.ca

[3] *Transportation of Dangerous Goods Regulations*, Transport Canada, Canadian Government Publishing. www.tc.gc.ca

[4] CSA B340, *Selection and use of cylinders, spheres, tubes, and other containers for the transportation of dangerous goods*, *class 2,* Canadian Standards Association. www.csa.ca

[5] CGA P-11, *Metric Practice Guide for the Compressed Gas Industry,* Compressed Gas Association, Inc. www.cganet.com

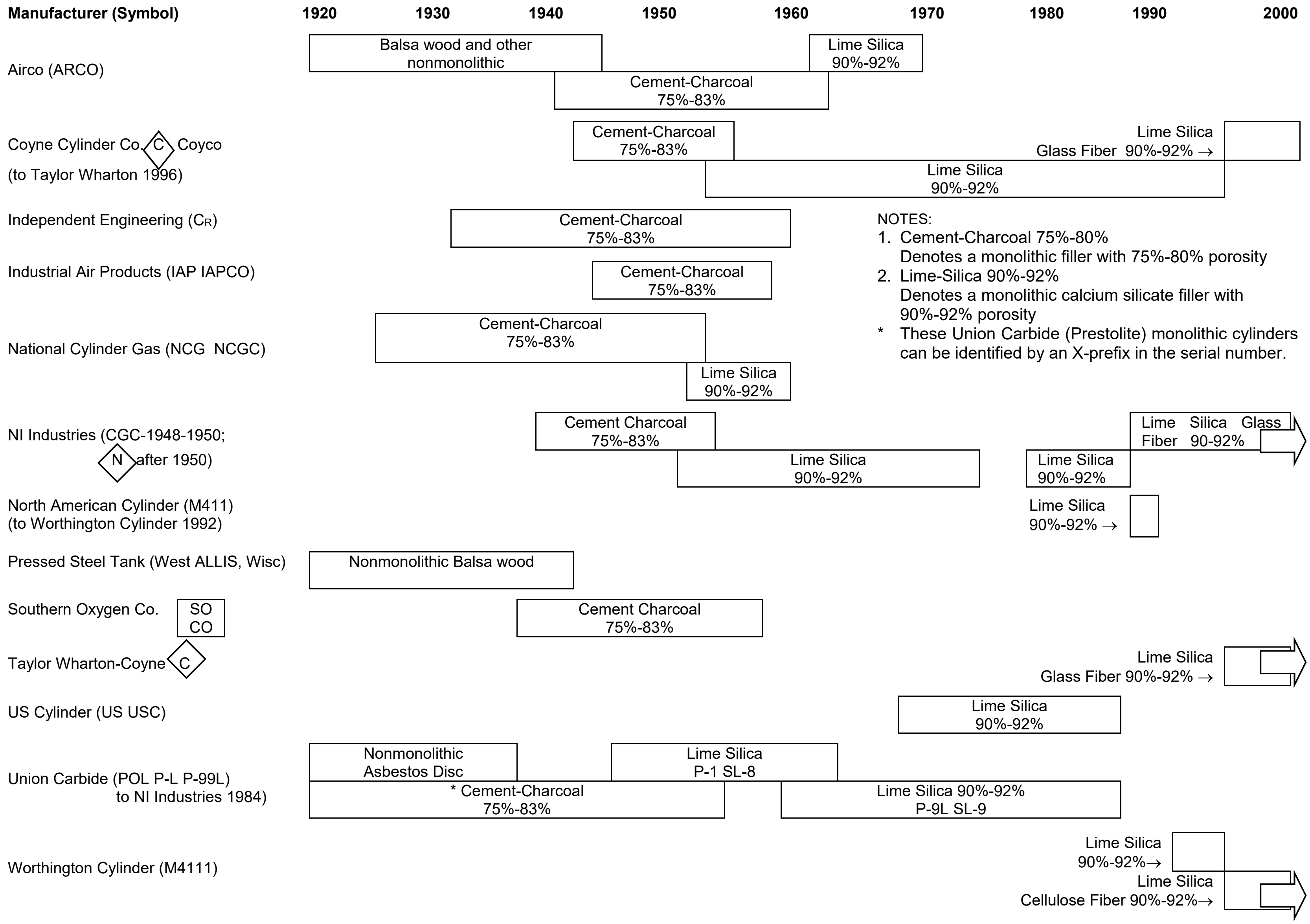
[6] CGA S-1.1, *Pressure Relief Device Standards–Part 1–Cylinders for Compressed Gases,* Compressed Gas Association, Inc. www.cganet.com

11 Additional references

CGA SB-4, *Handling Acetylene Cylinders in Fires*, Compressed Gas Association, Inc.. www.cganet.com

CGA C-12, *Qualification Procedure for Acetylene Cylinder Design*, Compressed Gas Association, Inc. www.cganet.com

Appendix A—Chart of chronological history of acetylene cylinder construction (Informative)



Appendix B—Acetylene cylinder periodic visual inspection and requalification report (Informative)

(Sample form)

Company   Date
                                                    Month   Year

Plant   Responsible Manager   Inspector
                                          Signature   Signature

Cylinder Identification					Shell Inspection						Porous Mass Inspection								Disposition		
Serial no.	Symbol	ICC/ DOT Spec	MFG	Date of MFG	Corro- sion & pitting	Dents	Cuts, digs & gouges	Unauth orized repairs	Stencil changes	Torch or arc burns	Fire damage	Bulges	Neck dents	Attach- ments	Mono- lithic	Non- mono- lithic	Filler cond- ition	Head clear- ance	Disposi -tion code	Date insp.	Inspec- tors initials
001	•	8	ABC	1958	✓	✓	✓	✓	✓	✓	✓	C							C		
002	O	8	EFG	1923	✓	✓	C												C		
003	N	8AL	XYZ	1924	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		

Disposition code:
✓ = OK, return to service
C = Condemn and Scrap
R = Remove from service

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Compressed Gas Association
14501 George Carter Way, Suite 103
Chantilly VA 20151-2923
703-788-2700
www.cganet.com