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ACETYLENE

TWELFTH EDITION

COMPRESSED GAS ASSOCIATION, INC.

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Work Item 07-017
Acetylene Committee

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1 Introduction

This publication is one of a series compiled by the Compressed Gas Association, Inc. (CGA) to satisfy the demand for information relative to the production, transportation, handling, and storage of compressed gases. NFPA 51A, *Standard for Acetylene Cylinder Charging Plants,* provides information relative to the manufacture, handling, and storage of acetylene by cylinder charging plants [1].[1]

2 Scope

This publication presents general information on the characteristics of acetylene and its handling. Requests for specialized technical information should be directed to the manufacturers of this gas.

The following references may also be useful to acetylene users:

- NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Processes* [2];
- NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and other Hot Work* [3];
- ANSI/AWS Z49.1, *Safety in Welding and Cutting and Allied Processes* [4]; and
- CGA SB-4, *Handling Acetylene Cylinders in Fires* [5].

3 Acetylene

3.1 Composition

Acetylene is a compound of the elements carbon and hydrogen. Its composition is expressed by the chemical symbol C_2H_2. On a weight basis, the proportion of the elements in acetylene is approximately 12 parts of carbon to 1 part of hydrogen, or 92.3% to 7.7%, respectively.

3.2 Physical and chemical properties

At atmospheric temperatures and pressures, acetylene is a colorless gas that is slightly lighter than air. Acetylene of 100% purity is odorless, but acetylene of ordinary commercial purity has a distinctive, garlic-like odor. Some physical constants of acetylene are given in Table 1.

Acetylene burns in air with an intensely hot, luminous, and smoky flame. The ignition temperatures of acetylene and mixtures of acetylene with air or acetylene with oxygen will vary according to composition, pressure, water vapor content, and initial temperature. As a typical example, mixtures containing 30% acetylene by volume with air at atmospheric pressure can be ignited at approximately 581 °F (305 °C). The flammable limits of mixtures of acetylene with air and acetylene with oxygen will depend on the initial pressure, temperature, and water vapor content. In air at atmospheric pressure, the upper limit of flammability is approximately 82% acetylene in air. The lower limit is 2.5% acetylene in air.

Acetylene can be liquefied and solidified with relative ease, but both liquid and solid acetylene are unstable. Mixtures of gaseous acetylene with air or oxygen in certain proportions can explode if ignited. Gaseous acetylene under pressure may also decompose with explosive force under certain conditions at low pressure, but experience indicates that 15 psig (103 kPa) is generally acceptable as a safe pressure limit.[2] Generation, distribution through hose or pipe, or use of acetylene at pressures in excess of 15 psig (103 kPa) for welding and allied purposes is prohibited.

Pressure exceeding 15 psig (103 kPa) can be used with the use of special equipment. Where acetylene is used at pressures in excess of 15 psig (103 kPa) or transported through large diameter pipelines, means to prevent propagation if ignition occurs shall be used. Insulating large diameter pipes as a protection against exposure to

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

[2] kPa shall indicate gauge pressure unless otherwise noted as (kPa, abs) for absolute pressure and (kPa, differential) for differential pressure. All kPa values are rounded off per CGA P-11, *Metric Practice Guide for the Compressed Gas Industry* [6].

fires is recommended. More specific information on low and medium pressure acetylene piping is included in CGA G-1.2, *Acetylene Metering and Piping* [7].

Acetylene cylinders prevent the decomposition characteristics of the gas by providing a porous mass packing material with minute cellular spaces so no pockets of appreciable size remain where "free" acetylene in gaseous form can collect. This porous mass is saturated with acetone or other suitable solvent in which the gaseous acetylene actually dissolves. The combination of these two features—the porous filler and solvent—allows acetylene to be contained in cylinders at moderate pressure without danger of explosive decomposition. Maximum cylinder pressure is 250 psig at 70 °F (1720 kPa at 21.1 °C) with an approximate variation of 2.5 psi (18 kPa, differential) rise or fall in pressure for each degree Fahrenheit (0.56 °C) rise or fall in temperature. Typical acetylene cylinder shell constructions are shown in Figure 1.

Table 1—Physical constants of acetylene

	U.S. Units	**SI Units**
International symbol	C_2H_2	C_2H_2
Molecular weight	26.04	26.04
Vapor pressure at 70 °F (21.1 °C)	635 psig	4378 kPa
Density of the gas at 32 °F (0 °C) and 1 atm	0.07314 lb/ft^3	1.1716 kg/m^3
Specific gravity of the gas at 32 °F and 1 atm (air = 1)	0.906	0.906
Specific volume of the gas at 70 °F (21.1 °C) and 1 atm[1)]	14.7 ft^3/lb	0.918 m^3/kg
Specific gravity of liquid at –112 °F (–80 °C)	0.613	0.613
Density of liquid at 70 °F (21.1 °C)	24.0 lb/ft^3	384 kg/m^3
Boiling point at 10 psig[2)] (69 kPa)	–103.4 °F	–75.2 °C
Melting point at 10 psig[2)] (69 kPa)	–116 °F	–82.2 °C
Critical temperature	96.8 °F	36.0 °C
Critical pressure	907 psia	6254 kPa, abs
Critical density	14.4 lb/ft^3	231 kg/m^3
Triple point	–116 °F at 17.7 psia	–82.2 °C at 122 kPa, abs
Latent heat of vaporization at triple point	264 Btu/lb	614 kJ/kg
Latent heat of fusion at –114.7 °F (–81.5 °C)	41.56 Btu/lb	96.67 kJ/kg
Specific heat of gas at 60 °F (15.5 °C) and 1 atm		
C_p	0.383 Btu/(lb)(°F)	1.60 kJ/(kg)(°C)
C_v	0.304 Btu/(lb)(°F)	1.27 kJ/(kg)(°C)
Ratio of specific heats	1.26	1.26
Solubility in water, vol/vol at 32 °F (0 °C) and 1 atm	1.7	1.7
Solubility in water, vol/vol at 60 °F (15.6 °C)	1.1	1.1

1) Based on 1.171 g/L 32 °F (0 °C) and 1 atm (14.696 psia; 101.325 kPa, abs).

2) Reported at 10 psig (69 kPa) instead of at 1 atm because at 1 atm acetylene sublimes directly from the solid to the gaseous state without entering the liquid state. Its sublimation point at 1 atm (14.696 psia; 101.325 kPa) is –118 °F (–83.3 °C).

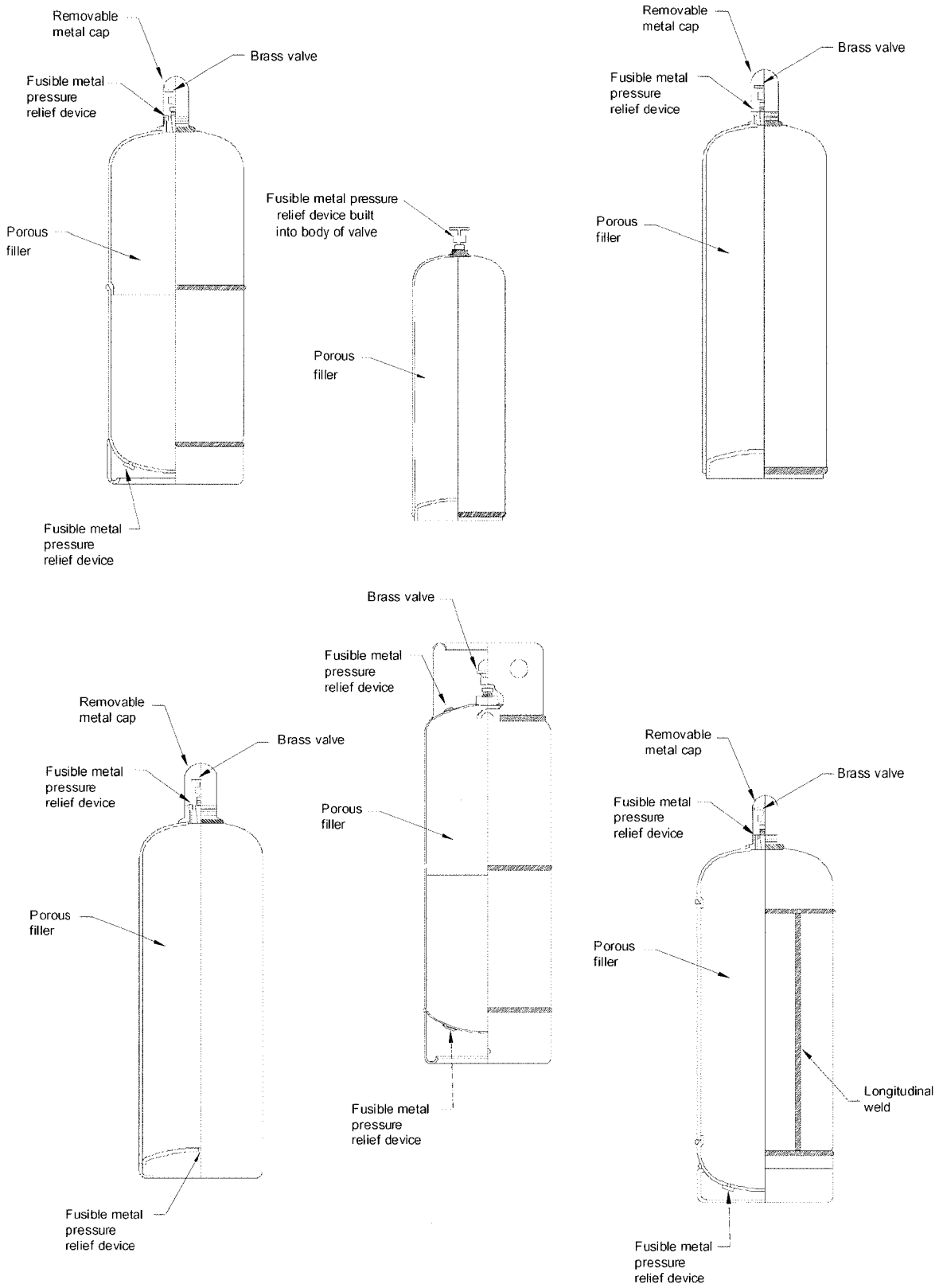


Figure 1—Typical acetylene cylinder shell constructions

3.3 Physiological effects

Commercial acetylene is generally considered a nontoxic gas that has been shown in experiments to have no chronic harmful effects even in high concentrations. In fact, it has been used as an anesthetic. Like most other gases, acetylene is a simple asphyxiant if present in such high concentrations that the lungs are deprived of their required supply of oxygen. In such cases, asphyxiation will result. It should be noted, however, that the lower flammable limit of acetylene in air will be reached well before asphyxiation can occur, and the danger of explosion is reached before any other health hazard is present.

3.4 Manufacture

Acetylene is usually manufactured by reacting calcium carbide and water to produce acetylene with calcium hydroxide [$Ca(OH)_2$] as a coproduct. For additional information refer to CGA G-1.5, *Carbide Lime—Its Value and Uses* [8]. Acetylene may also be manufactured by the thermal or arc cracking of hydrocarbons or by a process using the partial combustion of methane with oxygen.

Acetylene manufactured from calcium carbide made in the United States and Canada normally contains less than 0.4% impurities other than water vapor. Apart from water, the chief impurity is air at concentrations of 0.2% to 0.4%. The remainder consists of trace quantities of phosphine, ammonia, hydrogen sulfide, and in some instances, small amounts of carbon dioxide, hydrogen, methane, carbon monoxide, organic sulfur compounds, silicon hydrides, and arsine. Purified cylinder acetylene is substantially free from phosphine, ammonia, hydrogen sulfide, organic sulfur compounds, and arsine. The other impurities are nearly the same as in the original gas. Refer to CGA G-1.1, *Commodity Specification for Acetylene* [9].

3.5 Pipeline use of acetylene

Pipeline acetylene is used in the United States for chemical synthesis and for manufacturing carbon black. Acetylene is used in the manufacture of a variety of specialty chemicals and monomers that are used for organic synthesis, as solvents, and to make polymers used for plastics and synthetic rubber. The earlier uses for acetylene in the manufacture of commodity chemicals such as acetone, acetic acid, and acetaldehyde have been replaced by alternative raw materials.

3.6 Cylinder use

The remaining acetylene production is principally used for oxy-acetylene welding, cutting, and heat treating.

4 Acetylene cylinders

4.1 General

Acetylene is classified by the U.S. Department of Transportation (DOT) as a flammable compressed gas and it shall be shipped in steel cylinders manufactured to Specification DOT-8, DOT-8AL, ICC-8, ICC-8AL, DOT E-6517, DOT E-7542, or DOT E-10320 [10]. In Canada, acetylene is also classified by Transport Canada (TC) as a flammable compressed gas, and it shall be shipped in steel cylinders manufactured to Specification CTC-8, CTC-8AL, CTC-8WC, TC-8WM or TC-8WAM [10, 11].

Specifications DOT-8, DOT-8AL, ICC-8, ICC-8AL, DOT E-6517, DOT E-7542, and DOT E-10320 require that the steel used in cylinders meet certain chemical and physical requirements. These specifications also require that cylinder shells pass hydrostatic pressure tests, possess fillers of 92% or less porosity charged with a specified amount of solvent, and be protected by adequate pressure relief devices. Specifications and regulations governing the transportation of acetylene and other compressed gases are promulgated in the United States by DOT, which has federal authority for enforcement. In Canada, the requirements are specified in standards published by the Canadian Standards Association (CSA) and adopted into the *Transportation of Dangerous Goods Regulations* by TC [12].

Hazardous materials regulations of the DOT including specifications for shipping containers are published in Title 49 of the U.S. *Code of Federal Regulations* (49 CFR) [10].

Acetylene in its free state under pressure can decompose violently with the evolution of heat. The decomposition can be initiated by shock, temperature, or reactive substances, and oxygen is not required either to initiate

or sustain decomposition. The higher the pressure, the smaller the initial energy input required to cause decomposition. To minimize the hazards of storing and transporting acetylene, it can only be compressed into specially constructed DOT and TC approved cylinders packed with a porous, inert absorptive solid material that is saturated with a solvent. Cylinders used with all other compressed gases are unsuitable for charging with acetylene, and other gases shall not be charged into acetylene cylinders. Acetylene mixed with any other gas shall not be charged into an acetylene cylinder.

Acetylene is generally available in cylinders having capacities from 10 ft^3 to 420 ft^3 (0.3 m^3 to 11.9 m^3).

4.2 Valves

Detailed, dimensioned drawings of standard and limited standard acetylene cylinder valve outlets are published in CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections* [13].

4.3 Pressure relief devices

Acetylene cylinders are fitted with fusible metal pressure relief devices that will release the acetylene in the event of an abnormally high temperature, as in a fire. In cylinders manufactured for use in the United States and Canada, these pressure relief devices contain a fusible metal that melts at approximately 212 °F (100 °C), which is the temperature of boiling water at atmospheric pressure. In large cylinders, the devices usually take the form of replaceable plugs that have a core of fusible metal and are installed in the top and bottom heads of the cylinder. Small cylinders may not have such devices, but have passages in a valve or other cylinder accessory that are filled with the fusible metal. See CGA S-1.1, *Pressure Relief Device Standards—Part 1—Cylinders for Compressed Gases* [14].

While fusible metal relief devices will melt in a fire, they can also melt from other sources of heat such as weld spatters and cutting or burning slag. Avoid exposing any part of your body to the line of discharge of a fusible metal pressure relief device, which can release in a fire, or acetylene venting from a melted device, which can be burning or ignite at any moment.

4.4 Filling limits

Because of the characteristic of any gas or liquid confined in a closed container to increase in pressure with rising temperature, the possibility always exists that a cylinder charged with gas at a safe pressure at normal temperatures would reach a dangerously high pressure at high temperatures. To prevent this from happening during normal use, DOT and TC have regulations that limit the amount of solvent and acetylene that may be charged into a cylinder. These regulations provide that the internal pressure of a cylinder when filled may not exceed 250 psig (1720 kPa) at 70 °F (21.1 °C).

4.5 Marking and labeling

The following marks are required by DOT or TC to be plainly stamped on or near the shoulder or top head of all acetylene cylinders:

- cylinder specification (example: DOT-8, DOT-8AL, ICC-8, ICC-8AL, DOT E-6517, DOT E-7542, DOT E-10320, CTC-8, CTC-8AL, CTC-8WC, TC-8WM or TC-8WAM);
- serial number and the manufacturer's identifying symbol, which shall be registered with DOT or TC;
- date the cylinder was tested by the manufacturer; and
- tare weight.

The tare weight of the acetylene cylinder consists of the combined weights of the following:

- cylinder shell;
- porous mass;
- fusible metal pressure relief devices;
- solvent;

- saturation gas; and
- valve.

If at any time the valve is removed for replacement, extreme care shall be taken to ensure that the new valve has the identical weight so the tare weight stamped on the cylinder remains correct. If the new valve weight is heavier or lighter by 1 oz (28.4 g) on cylinders of 75 ft^3 (2.1 m^3) capacity or less, or by 2 oz (56.8 g) on cylinders of more than 75 ft^3 (2.1 m^3) capacity, then the tare weight stamped on the cylinder shall be changed to reflect the new weight. This change can only be made in accordance with DOT or TC requirements.

The required markings on cylinders shall not be changed except as provided by DOT or TC regulations. Markings on cylinders shall be kept in a legible condition.

Acetylene cylinders shall be legibly marked with the proper shipping name and identification number:

ACETYLENE

UN1001

Such markings:

- shall be made by means of stenciling, stamping, or labeling;
- shall not be readily removable; and
- shall be in accordance with CGA C-7, *Guide to Preparation of Precautionary Labeling and Marking of Compressed Gas Containers* [15].

DOT regulations require that in addition to marking of the proper shipping name and identification number on a cylinder, a 100 mm (3.9-in) diamond (square-on-point) red label (designating a flammable gas) having the number 2 in the lower corner be attached to each cylinder containing acetylene when offered for transportation. This includes rail, common, contract, or private motor carriers.

Alternately, DOT regulations allow the use of 30 mm (1.25-in) square-on-point labels as long as the cylinder(s) are not overpacked and are durably and legibly marked in accordance with CGA C-7, Appendix A. See 49 CFR 172.400a [10].

In Canada, the general requirement is for each side of a label to be at least 100 mm in length with a line running 5 mm inside the edge. However, if that size label, together with the shipping name, technical name, and UN number, cannot be displayed because of the irregular shape or size of the small means of containment, each side of the label may be reduced in length by the same amount to the point where the label, together with the shipping name, technical name, and UN number, will fit that small means of containment, but must not be reduced to less than 30 mm [12]. In Canada, hazard class wording is not allowed on labels; whereas, in the United States it is optional.

4.6 Refilling

United States and Canadian regulations forbid the shipment of cylinders containing acetylene unless they were charged by or with the consent of the owner. In addition, cylinders may be charged only by a person or company having possession of complete information on the nature of the porous filler, the kind and quantity of the solvent in the cylinders, and the meaning of the markings on the cylinders.

5 Storing acetylene cylinders at user's premises

5.1 General

When storing acetylene cylinders, the user shall comply with all local, state, federal, provincial, and municipal regulations, and with the standards of the National Fire Protection Association (NFPA) and the International Code Council (ICC). See NFPA 51, the I-Codes, and 29 CFR Part 1910.253 [2, 16, 17]. In addition, the user should also consult and follow the practices described in CGA P-1, *Safe Handling of Compressed Gases in Containers* [18].

5.2 Rules for storing acetylene cylinders

The following are rules for storing acetylene cylinders:

- For the sake of safety and orderliness, cylinders should always be stored in an assigned location bearing in mind that acetylene is a flammable gas stored under pressure;
- Acetylene cylinders should be stored in a dry and well-ventilated location;
- Because of the rapid rise of pressure in the cylinder with increasing temperature, cylinders shall not be stored at temperatures exceeding 125 °F (51.7 °C) and shall not be used at temperatures above 120 °F (48.9 °C). Acetylene cylinders should not be stored near sources of heat such as radiators and furnaces, or potential sources of heat such as highly combustible materials like gasoline, oil, waste, etc.;
- Acetylene cylinders should not be stored near elevators, gangways, or in locations where heavy moving objects may strike or fall against them. Dropping a cylinder or subjecting it to abnormal mechanical shock is likely to damage the cylinder, valve, or fusible metal pressure relief device;
- Acetylene cylinders should not be stored in close proximity to oxygen cylinders. Unless separated by a minimum distance of 20 ft (6.1 m), a noncombustible partition 5 ft (1.5 m) high having a fire-resistive rating of at least 1 hr should be between stored acetylene cylinders and oxygen cylinders;

  NOTE—Single cylinders of acetylene and oxygen may be stored secured on a cart or used adjacent to each other without a partition. Additionally, single cylinders of acetylene and oxygen located at a work station (e.g. chained to a wall or building column or secured on a cart) shall be considered "in service".

- Acetylene cylinders stored inside a building shall be limited to a total capacity of 2500 ft^3 (70.8 m^3) of acetylene exclusive of cylinders in use or attached for use. Quantities exceeding this total shall be stored in a special building or in a separate room as required by NFPA 51 [2]. In buildings and rooms housing acetylene operations, ventilation shall be provided and no open flames for heating or lighting shall be permitted;
- Storage should be planned so cylinders are used in the order in which they are received from the supplier;
- Valve protection caps, when provided for in the cylinder design, shall be mechanically attached except when cylinders are in actual use;
- Conspicuous signs should be posted in the storage area forbidding smoking or the carrying of open flame;
- Empty cylinders should be stored separately from full cylinders. Empty cylinders should be marked with the letters MT or EMPTY to avoid confusion;
- Valves shall be closed on all cylinders when not in use and when the cylinders are empty;
- Cylinders should be stored and used in a vertical position. Use in a secured vertical position enhances safety by providing for easy access to the valve and regulator assembly;
- When storing acetylene cylinders outdoors, they should be protected from the ground to prevent bottom corrosion. During the winter, cylinders stored in the open should be protected against accumulations of ice or snow. In summer, charged cylinders stored in the open should be screened against the direct rays of the sun in those localities where extreme temperatures prevail;
- Stored cylinders should be protected from individuals without authorized access; and
- Do not store acetylene cylinders, particularly small cylinders used for soldering, in confined spaces such as drawers, closets, unventilated cabinets, automobile trunks, or toolboxes. Acetylene cylinders should not be stored or transported in automobiles or any enclosed vehicle.

6 Handling and using acetylene cylinders

The following are general handling rules for users of acetylene cylinders:

- Call acetylene by its proper name, acetylene. Acetylene should not be referred to merely by the word "gas";

- In the United States, use only cylinders marked DOT-8, ICC-8, DOT-8AL, ICC-8AL, DOT E-6517, DOT E-7542 or DOT E-10320; in Canada equivalent cylinders are marked CTC-8, CTC-8AL, CTC-8WC, TC-8WM or TC-8WAM. These markings certify compliance with the manufacturing and testing regulations of DOT or TC;
- Required markings stamped on the cylinder shall not be changed except where allowed by DOT or TC. Such changes should be made only by cylinder fillers and people knowledgeable with DOT/TC requirement;
- Never use manifolds for acetylene cylinders unless constructed and installed under the supervision of qualified persons familiar with the proper practices for their construction and use. Manifolds should comply with the standards of a recognized safety authority such as Underwriters Laboratories, Inc. (UL) [19]. It is best to purchase manifolds from a reliable manufacturer familiar with the standards that apply and the reasons for these standards. Do not supply acetylene by a system of shop piping without consulting your acetylene supplier for recommendations;
- Users should never attempt to repair or alter cylinders or valves. If a cylinder is leaking, follow the recommendations in 6.5 and contact your supplier;
- Never tamper with fusible metal pressure relief devices in valves or cylinders. Keep sparks and flames away from acetylene cylinders and under no circumstances allow a torch flame to come in contact with fusible metal pressure relief devices. Should the valve outlet of an acetylene cylinder become clogged by ice, thaw with warm (not boiling) water;
- Never attempt to transfer acetylene from one cylinder to another, to refill acetylene cylinders, or to mix any other gas with acetylene in a cylinder;
- In welding shops and industrial plants using both oxy-acetylene and electric welding apparatus, care should be taken to avoid handling electric welding equipment in a manner that may permit acetylene cylinders to come in contact with the electric welding apparatus or electrical circuits;
- Where valve protection caps are provided for in the cylinder design, such caps shall be mechanically connected except when the cylinders are in use; and
- Never use acetylene cylinders as rollers, supports, or for any purpose other than as acetylene cylinders.

6.1 Moving cylinders

When moving acetylene cylinders, as in storing them, it is important to remember that they should not be subjected to abnormal mechanical shocks that might damage the cylinders, the valve, or the fusible metal pressure relief devices. This is especially important on those small cylinders not equipped with protection caps. Care shall be exercised to ensure that cylinders are not dropped or permitted to strike each other violently. They are sturdy containers but shall not be abused.

Cylinders should not be dropped while being unloaded or loaded from a truck or dock. Trucks with elevator tailgates provide a very good means of unloading or loading cylinders safely.

It is sometimes necessary to transport cylinders by crane or derrick. Lifting magnets, slings, rope or chain, or any other device in which the cylinders themselves form a part of the carrier should never be used for hoisting acetylene cylinders. Instead, when a crane is used, a platform, cage, or cradle should be provided, which will protect the cylinders from being damaged by slamming against obstructions and keep them from falling out.

Movement of cylinders is easily accomplished by the use of a hand truck or cylinder pallet. An acceptable method such as chaining should be used in securing cylinders standing upright. Cylinders shall not be transported lying horizontally with the valve unprotected in a position that would allow it to collide with stationary objects. Cylinders should never be dragged from place to place.

Valves shall always be closed before cylinders are moved. Unless cylinders are moved while secured in an upright position to a suitable hand truck, pressure regulators should be removed and valve protection caps, if provided for in the cylinder design, should be attached.

Cylinders should not be dropped or handled in a manner that would allow the bottom fusible metal pressure relief device to strike an object resulting in leakage of acetylene from the device.

6.2 Withdrawing acetylene from cylinders

Never use acetylene through torches or other devices equipped with shut-off valves on the acetylene supply connections without reducing the pressure through a suitable acetylene regulator attached to the cylinder valve.

Acetylene should not be used at a pressure exceeding 15 psig (103 kPa).

Observe the following precautions when connecting and using acetylene cylinders:

- It is always preferable to use acetylene cylinders in a secured upright position. Use in a horizontal position does not make the acetylene less stable, but it does prevent ease of access to the valve and regulator assembly;
- Never use wrenches or other tools for opening or closing cylinder valves except those provided by the valve or acetylene manufacturer;
- Visually examine the CGA connection on the cylinder and remove any visible contamination before connecting the regulator. Clean out the contaminant using nitrogen, air, or a clean rag. Avoid opening an acetylene cylinder valve without a suitable regulator and flow restrictor such as a torch attached;
- Regulators and pressure gauges provided for use with a particular gas or gases shall not be used on cylinders containing any other gas. To prevent interchanging of equipment, be sure that the threads on regulators or other unions correspond to those on cylinder valve outlets;
- After attaching the regulator and before the cylinder valve is opened, check that the pressure adjusting screw of the regulator is released or backed out;
- Be sure that all connections are gas-tight and that the connected hose is in good condition and does not have any leaks;
- Always open the acetylene cylinder valve slowly. Never use a hammer or mallet in attempting to open or close a valve;
- An acetylene cylinder valve should be opened the minimum amount required to deliver acceptable flow so it can be closed as quickly as possible in an emergency situation. One and one-half turns is usually sufficient to provide adequate flow;
- Do not pile hose, tools, or other objects on top of an acetylene cylinder since this might interfere with quick closing of the valve;
- The wrench used for opening the cylinder valve should always be kept on the valve spindle when the cylinder is in use;
- Always close the cylinder valve when the work is finished. Be sure the cylinder valve is closed and all gas released from the regulator before removing the regulator from a cylinder;
- Never apply a torch to the side of a cylinder to raise the pressure (serious accidents have occurred due to violation of this precaution);
- Experience has shown that for welding, cutting, and allied processes, a withdrawal rate of 1/7 of the cylinder capacity per hour is generally acceptable;
- To minimize the withdrawal of liquid solvent in applications that are more sensitive to solvent carry-over, acetylene should be withdrawn from the cylinder at a rate not to exceed 1/10 of the capacity of the cylinder per hour during intermittent use, and for withdrawal of the contents of the cylinder on a continuous basis, the flow rate should be no more than 1/15 of the capacity of the cylinder per hour; and
- Never open a valve without proper attachments (regulator and torch or regulator and flow restriction of some type such as a flowmeter). Opening the cylinder valve without proper attachments can cause a cylinder to spit acetone and can cause an acetylene fire.

6.3 Determining cylinder contents

Because acetylene gas is dissolved in solution in a solvent, the contents of an acetylene cylinder cannot be determined accurately by pressure gauge readings. A pressure gauge attached to the cylinder indicates what is known as "solution pressure" in the cylinder. This pressure is greatly affected by changes in cylinder temperature, and these variations are particularly noticeable at the temperature extremes experienced in summer and winter. For example, the gauge pressure of a cylinder may be 250 psig (1720 kPa) when the temperature is 70 °F (21.1 °C); if this same cylinder is allowed to cool to 0 °F (–17.8 °C), the pressure will drop to less than 100 psig (690 kPa) without any acetylene having been withdrawn from the cylinder. Therefore, the contents of an acetylene cylinder, unlike oxygen or nitrogen cylinders, cannot be determined accurately by pressure gauge readings. However, acetylene cylinder contents can be accurately measured by weight, and it is on this basis that cylinder charging operations are conducted. Weight of acetylene can be converted to cubic feet of acetylene by the factor of 14.7 ft^3/lb (0.918 m^3/kg).

6.4 Returning empty cylinders

Close the cylinder valve and replace the valve protection cap, if there is provision for one. Return empty cylinders promptly to the supplier in accordance with the supplier's instructions.

6.5 Handling leaking cylinders

Because acetylene and air mixtures in almost all proportions are flammable and explosive, care should be taken to prevent acetylene leakage. Connections should be kept tight and hoses maintained in good condition. Points of suspected leakage should be tested by brushing or spraying with soapy water or leak detection solution. A leak will be indicated by bubbles of escaping acetylene passing through the soap film. *NEVER TEST FOR LEAKS WITH AN OPEN FLAME.* While fusible metal pressure relief devices will melt in a fire, they can melt from other sources of excessive heat. Avoid exposing any part of your body to the line of discharge of a fusible metal pressure relief device, which can release in a fire, or the venting acetylene, which can be burning or may ignite at any moment.

If acetylene leaks around the valve spindle on packed-type valves when the valve is open, close the valve and tighten the gland nut. This compresses the packing around the spindle. If this does not stop the leak, reclose the valve and attach to the cylinder a tag stating that the valve is unserviceable. Notify the gas supplier and follow the supplier's instructions for the cylinder's return.

If acetylene leaks from the valve even when the valve is closed, or if rough handling causes any fusible metal pressure relief device to leak, move the cylinder outdoors away from any possible source of ignition and plainly tag the cylinder as having an unserviceable valve or fusible plug relief device. Place a sign in close proximity to the cylinder warning persons against approaching the cylinder with cigarettes or other open flames. Notify the supplier immediately giving the particulars of the defect, as far as known, and follow their instructions. In no case should you attempt to correct a leaking fuse plug or valve thread by tightening it while the cylinder is under pressure.

6.6 Prevention of fire

Carelessness in the use of oxy-acetylene equipment can lead to fires from sparks and molten metal. Because of the general information in this publication, no attempt has been made to address problems of this nature. NFPA 51B provides information on fire prevention around welding operations [3]. Also see CGA SB-4 [5].

7 Piping, fittings, and equipment

Acetylene users should consult their supplier and recognized safety authorities such as NFPA and UL for recommendations on acetylene manifolds and shop piping [2, 19].

Only steel and wrought iron pipe should be used for acetylene. Joints may be welded or made of threaded or flanged fittings. Rolled, forged, or cast steel or malleable iron fittings may also be used. The use of cast iron fittings is not permissible.

Under certain conditions, acetylene forms readily explosive compounds with copper, silver, and mercury. For this reason, contact between acetylene and these metals, their salts, compounds, and high concentration alloys

containing these metals is to be avoided. It is generally accepted that brass containing less than 65% copper in the alloy and certain nickel alloys are suitable for use in acetylene service under normal conditions. In normal service, conditions involving contact with highly caustic salts or solutions, or contact with other materials corrosive to copper or copper alloys, can render the above generally acceptable alloys unsatisfactory for this service. The presence of moisture and certain acids or alkaline materials tend to enhance the formation of copper acetylides. For further information on this subject, refer to NFPA 51 [2].

8 References

Unless otherwise specified, the latest edition shall apply.

[1] NFPA 51A, *Standard for Acetylene Cylinder Charging Plants,* National Fire Protection Association, Inc., 1 Batterymarch Park, Quincy, MA 02269. www.nfpa.org

[2] NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Processes,* National Fire Protection Association, Inc., 1 Batterymarch Park, Quincy, MA 02269. www.nfpa.org

[3] NFPA 51B, *Standard for Fire Prevention During Welding, Cutting and Other Hot Work,* National Fire Protection Association, Inc., 1 Batterymarch Park, Quincy, MA 02269. www.nfpa.org

[4] ANSI/AWS Z49.1, *Safety in Welding and Cutting and Allied Processes,* American Welding Society, Box 351040, 550 N.W. Le Jeune Rd., Miami, FL 33126. www.aws.org

[5] CGA SB-4, *Handling Acetylene Cylinders in Fires,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[6] CGA P-11, *Metric Practice Guide for the Compressed Gas Industry,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[7] CGA G-1.2, *Acetylene Metering and Piping,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[8] CGA G-1.5, *Carbide Lime—Its Value and Uses,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[9] CGA G-1.1, *Commodity Specification for Acetylene,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[10] *Code of Federal Regulations,* Title 49 (Transportation) Parts 100-180, Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. www.gpoaccess.gov

[11] CSA B339, *Cylinders, Spheres, and Tubes for the Transportation of Dangerous Goods,* Canadian Standards Association, 5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada. www.csa.ca

[12] *Transportation of Dangerous Goods Regulations,* (Transport Canada), Canadian Government Publishing, Public Works and Government Services Canada, Ottawa, ON K1A 0S9, Canada. www.tc.gc.ca

[13] CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[14] CGA S-1.1, *Pressure Relief Device Standards—Part 1—Cylinders for Compressed Gases,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

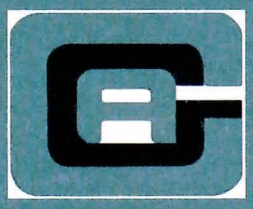
[15] CGA C-7, *Guide to Preparation of Precautionary Labeling and Marking of Compressed Gas Containers,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[16] I-Codes, International Code Council Headquarters, 5203 Leesburg Pike, Suite 600, Falls Church, VA 22041. www.iccsafe.org.

[17] *Code of Federal Regulations*, Title 29 (Labor), Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. www.gpoaccess.gov

[18] CGA P-1, *Safe Handling of Compressed Gases in Containers,* Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[19] UL 407, *Standard for Manifolds for Compressed Gases,* Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062. www.ul.com



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