AIR PRODUCTS

Safetygram-13

Acetylene

Acetylene

General

Pure acetylene is a colorless, highly flammable gas with an agreeable ethereal (ether-like) odor, but the odor of the commercial purity grade is distinctively garlic-like. Acetylene can be safely stored and used in cylinders filled with a porous material and containing a solvent (acetone) into which the acetylene has been dissolved.

Acetylene, when not dissolved in a solvent (free acetylene), can begin to dissociate (decompose) at pressures above 15 pounds per square inch gauge (psig). The products of dissociation are carbon, in the form of lampblack, and hydrogen. Considerable amounts of heat are generated by dissociation, which may produce explosions of great violence.

Steel and wrought iron are recommended for use in acetylene piping. Rolled, forged, or cast steel, or malleable iron fittings may be used. Cast iron is not permissible for fittings. Unalloyed copper, silver, or mercury should never be used in direct contact with acetylene since there is the possibility of forming explosive acetylides. Wet acetylene will produce explosive acetylides on copper, 70-30 brass, and aluminum-bronze. Weight (not pressure) is used to determine the amount of acetylene in a cylinder. The tare weight is subtracted from the actual weight, and the difference is multiplied by 14.7 to determine the amount of gas in standard cubic feet.

The molecular symbol for acetylene is C_2H_2.

Toxicity

Acetylene is a simple asphyxiant and anesthetic. Experiments have shown there to be no harmful effects from chronic exposure to acetylene at high concentrations.

Manufacture

Acetylene is manufactured by the reaction of water with calcium carbide. It is also manufactured by thermal cracking of hydrocarbons, or by partial combustion of methane with oxygen.

Uses

Approximately 80% of the annual acetylene production of the United States is used for chemical syntheses. Acetylene has become increasingly prominent as a raw material for a whole series of organic compounds, among them acetaldehyde, acetic acid, and acetic anhydride. The remaining 20% of the acetylene production is principally used for oxyacetylene cutting, heat treating, and welding.

Containers

Acetylene cylinders contain a filler material and a solvent in addition to the safety relief devices, valves, and protection caps normally supplied on standard-sized hollow steel cylinders for compressed gas service.

Shell

The shell is manufactured according to Department of Transportation DOT-8 or DOT-8AL specifications. It may have formed sides and a welded bottom, or be welded on the sides with a formed bottom. They are used at a service pressure of 250 psi at 70°F. The cylinders are initially hydrostatically tested to pressures two to three times the service pressure. DOT regulations require that the shell of all acetylene cylinders be inspected and requalified on a periodic basis. Typically, for a cylinder manufactured after 1991, the shell is requalified within 10 years of manufacture and every 10 years thereafter. Shells manufactured prior to 1991 must be requalified by 2001, and every 10 years thereafter.

Filler Material

Early cylinders were completely filled with a porous filler material consisting of diatomaceous earth (a porous calcium material formed from the accumulation of small organisms on ocean and lake beds millions of years ago), charcoal, asbestos, and cement.

Diatomaceous earth and charcoal are the porous elements, asbestos the strengthening material, and the cement is the binder. Present-day cylinders have a silica lime filler to which some manufacturers add asbestos, charcoal, and other materials to provide a lightweight filler with a higher porosity. The filler materials must be correctly proportioned to provide a homogenous mass in such a manner as to completely fill the shell within the maximum clearances specified by DOT to resist cracking of filler during rough handling of the cylinder, and to obtain the best acetylene charging and discharging capabilities. DOT-8 or DOT-8AL specifications define the requirement of the porosity of the filler material. DOT regu-

Properties

Molecular Weight	26.04
Specific Gravity, Gas (Air = 1) @ 68°F (20°C), 1 atm	0.906
Specific Gravity, Liquid @ –116°F (–82°C), 1 atm	0.621
Specific Volume @ 68°F (20°C), 1 atm	14.7 cu. ft./lb.
Flammable Limits @ 1 atm in air	2.5% – 100% (by volume)
Autoignition Temperature @ 1 atm	581°F (305°C)
Flash Point (Closed Cup)	0°F (–18°C)
Solubility in Acetone @ 59°F (15°C), 1 atm	20 cu. ft./cu. ft. acetone
Solubility in Acetone @ 59°F (15°C), 12 atm	240 cu. ft./cu. ft. acetone

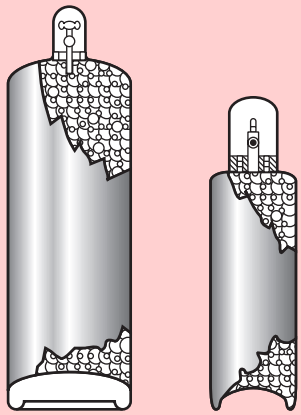
Cylinder Specifications

Size	Nominal Dimension w/o valve	Empty Wt. (lbs.)	Full Wt. (lbs.)	Full Capacity (cu. ft.) Std. Press.
MC	4" x 12"	7 1/2	8 1/2	10
B	6" x 19"	22 1/2	25 1/2	40
1	7" x 25"	47	52 1/2	75
2	8" x 30"	70	79	130
3	10" x 30"	100	113	190
4	12" x 36"	175	197 3/4	330
5	12" x 39"	185	209 3/4	360

lations require that the filler of all acetylene cylinders undergo a one-time inspection and requalification. Cylinders manufactured after 1991 will be requalified at least 3 years after but before 20 years of the date of manufacture. Cylinders manufactured before 1991 will be requalified before 2001. The construction of acetylene cylinders is shown by the cutaway views: Figure 1, the large, and Figure 2, the small-type cylinder.

Requalification of cylinder shell and filler material can only be performed by a facility that has been authorized by and registered with DOT.

Figures 1 and 2



Valves

The Compressed Gas Association (CGA) and the American National Standards Institute have adopted a thread size of 0.885 inch I.D.—14 threads per inch. It is left-hand with internal threads, accepting a bullet-shaped nipple. It is designated as Valve Outlet No. 510 and shown in Figure 3. Figure 4 shows the alternate CGA standard valve outlet used on some acetylene cylinders. The valve outlet has a thread size of 0.825 inch O.D.—14 threads per inch with external right-hand threads.

Figure 3

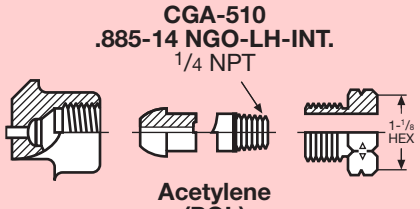
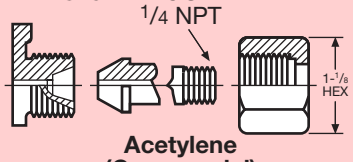


Figure 4

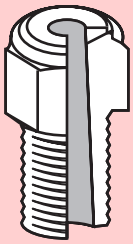


Safety Devices

Protection against excessive temperatures is provided in part by plugs filled with fusible metal which melt at about 212°F. Smaller cylinders may have a small passage in the valve body filled with fusible metal. A fusible plug is illustrated in Figure 5.

Never attempt to stop a fusible plug leak by any means. Notify supplier immediately.

Figure 5



Acetone

Acetone is charged into the cylinder and completely fills the pores of the filler material. Acetone is the solvent which will dissolve the acetylene gas charged into the cylinder. DOT regulations control the amount of acetone and acetylene allowed in each size cylinder.

Identification

Each cylinder is identified by:

1. DOT-8 or DOT-8AL, the specifications controlling the manufacture of the cylinder.
2. The serial number, manufacturer's symbol, and owner's symbol.
3. The date of test.
4. The tare weight, expressed in pounds and ounces. The tare weight includes the cylinder, filler, acetone, valve, saturation gas and plugs, but not the cylinder cap.
5. Retest markings that indicate the shell or filler was requalified.

Sizes of Cylinders

The table, Cylinder Specifications, lists some of the physical specifications of some of the more common sizes of acetylene cylinders in service.

Shipment of Acetylene Cylinders

Shipments of acetylene cylinders by highway transportation must conform to Department of Transportation regulations as set forth in the Code of Federal Regulations, Title 49, which describes the labeling and identification required. A DOT 4" x 4" flammable gas label or tag is required for common carrier shipments. Figure 6 illustrates the label that is required.

Shipments by air must conform with Title 49 Code of Federal Regulations (FAA Regulations). 49 CFR is the official publication of the Department of Transportation concerning transport of hazardous materials by any mode. These regulations are also found in the Civil Aeronautics Board No. 82 Restricted Articles Tariff No. 6-D, but the designation of this tariff may change from time to time. The weight limitations for passenger and cargo aircraft remain the same.

Figure 6

Safety Considerations

Figure 7 shows the damage that can be done to regulating equipment when the basic safety rules governing the handling and use of acetylene and acetylene cylinders are violated.

Users of acetylene should know and understand the construction of the cylinders and the properties of acetylene. The following basic safety rules are a guide to storage, handling, and use of acetylene cylinders.

1. Always store and use acetylene cylinders in an upright position to prevent loss of acetone which reduces the cylinder's ability to hold dissolved acetylene.
2. Do not handle cylinders roughly or carelessly to prevent damage to the cylinder or the filler. Dropping cylinders can cause leaks to develop at fuse plugs. Sharp dents in the cylinder can break up the filler in the area of the dent and cause voids where free acetylene can accumulate and decompose at cylinder pressures.
3. Keep cylinders away from external sources of heat. Cylinders are not designed for temperatures in excess of 125°F (52°C).
4. Protect the bottom heads of acetylene cylinders from damp ground.
5. Separate flammable gas cylinders from oxygen and other oxidizing gas cylinders during storage. Separate full acetylene cylinders from empty cylinders. Provide a means of preventing cylinders from falling if accidentally bumped.
6. Use regulators and pressure relief devices when connecting cylinders to circuits having lower pressure service ratings.
7. Always soap-test all regulator, torch, hose, and cylinder connections before placing acetylene equipment in service. Leaks in a confined area can cause acetylene to collect and readily attain concentrations above the lower flammability limit of 2.5 percent acetylene in the air.
8. Do not use acetylene at pressures above 15 psig, the pressure where decomposition can begin, to avoid explosion and fire hazard.
9. Remove leaking acetylene cylinders to an open area and tag them indicating the danger. Never attempt to stop a fuse plug leak. Notify your supplier immediately.
10. In most cases, it is best to allow a burning acetylene cylinder to burn itself out. The exception is small fires at fitting connections which can effectively be extinguished by applying a wet rag, wet asbestos, or similar types of material. Caution must be exercised because the heat from a small flame can melt the fuse plugs and cause a rapid discharge of acetylene which can produce a large fire. Water may be effectively used to prevent involvement of additional cylinders and to protect equipment and property adjacent to burning acetylene cylinders. Adequate distance must be maintained between personnel and burning cylinders because cylinders may rupture.
11. Keep valves closed when cylinders are not in service or empty. At the end of the shift or work day, close the cylinder valve and bleed the pressure off the regulator and torch equipment. Keep cylinder caps on the cylinders provided with threaded spuds when in storage or being moved.
12. If an acetylene cylinder receives a sharp or deep dent, the metal is gouged, or any other mechanical defect, circle the defect with a marking pen to alert the supplier of the defect. Federal Law prohibits persons, other than cylinder manufacturers, from repairing acetylene cylinders. Disposal of unserviceable cylinders should only be attempted by experienced personnel.

Figure 7

13. An acetylene cylinder valve should not be opened more than approximately 1 1/2 turns.
14. To minimize the withdrawal of liquid solvent, acetylene should be withdrawn from the cylinder at a rate not to exceed 1/10 (one-tenth) of the capacity of the cylinder per hour during intermittent use. For full withdrawal of the contents of the cylinder on a continuous basis, the flow rate should be no more than 1/15 (one-fifteenth) of the capacity of the cylinder per hour.
15. If a cylinder protective cap is extremely difficult to remove, do not apply excessive force or pry the cap loose with a bar inserted into the ventilation openings. Attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier.
16. Wrenches should not be used on valves equipped with a handwheel. If the valve is faulty, attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier.
17. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases.
18. Shipment of a compressed gas cylinder filled without the consent of the owner is a violation of Federal Law.

Personnel Equipment

Safety glasses, safety shoes, and ordinary work gloves are recommended for cylinder handling. Welder's gloves, welder's goggles, leather sleeves, a leather apron, and other standard protective equipment must be worn for cutting and welding operations.

First Aid

Persons who have become incapacitated or comatose through the anesthetic action of acetylene or oxygen deprivation should be moved promptly to fresh air. If breathing has stopped or is ineffective, assisted respiration is essential. Give oxygen if available. Seek medical assistance.

Fire Fighting

Since acetylene is a flammable gas, caution should be taken in extinguishing the fire until the source of acetylene gas can be stopped. It is important to prevent acetylene gas from collecting in a confined area because the gas may reignite and explode.

In all cases of acetylene cylinder fires, the area should be evacuated as quickly as possible. Someone knowledgeable in handling acetylene fires should be left in charge. If possible, first stop the flow of acetylene gas by closing the valve and then cool all materials in the area below the ignition temperature.

The fusible metal plugs at the top and bottom of the cylinder will melt at 212°F. If the fusible metal plugs relieve, flames can be projected approximately 15 feet from the top and bottom of the cylinder. Dry powder or carbon dioxide fire extinguishers can be used to extinguish small acetylene flames. If an acetylene cylinder fire could involve additional acetylene cylinders, it is very important to spray a large quantity of water on adjacent cylinders to cool the cylinder and prevent the fusible metal plugs on the adjacent cylinders from becoming heated, melting, and discharging additional acetylene.

Air Products and Chemicals, Inc.
7201 Hamilton Boulevard
Allentown, PA 18195-1501
Telephone: (610) 481-4911
Fax: (610) 481-5900

Reference Sources

Air Products Material Safety Data Sheets
Air Products and Chemicals, Inc.
Allentown, PA 18195-1501
800-752-1597

Handbook of Compressed Gases, Third Edition
Compressed Gas Association, Inc.
Arlington, VA 22202
412-979-0900

Hazardous Materials Response Book
National Fire Protection Association
Quincy, MA 02269-9101

NIOSH Pocket Guide to Chemical Hazards
Lab Safety Supply Co.
Janesville, WI 53547-1368

Compressed Gas Association Pamphlet P-1, Safe Handling of Compressed Gases in Containers
Compressed Gas Association, Inc.
Arlington, VA 22202
412-979-0900

Compressed Gas Association Pamphlet G-1, Acetylene
Compressed Gas Association, Inc.
Arlington, VA 22202
412-979-0900

Additional Safetygrams From Air Products

Safetygram-1 Oxygen
Safetygram-2 Nitrogen
Safetygram-3 Argon
Safetygram-4 Hydrogen
Safetygram-5 Helium
Safetygram-6 Liquid Oxygen
Safetygram-7 Liquid Nitrogen
Safetygram-8 Liquid Argon
Safetygram-9 Liquid Hydrogen
Safetygram-10 Handling, Storage, and Use of Compressed Gas Cylinders
Safetygram-11 Emergency Action in Handling Leaking Compressed Gas Cylinders
Safetygram-12 Safe Handling and Use of Air Products Compressed Gases and Equipment
Safetygram-13 Acetylene
Safetygram-14 Don't Turn a Cylinder Into a Rocket
Safetygram-15 Cylinder Safety Devices
Safetygram-16 Safe Handling of Cryogenic Liquids
Safetygram-17 Dangers of Oxygen-Deficient Atmospheres
Safetygram-18 Carbon Dioxide
Safetygram-19 Carbon Monoxide
Safetygram-20 Nitrous Oxide
Safetygram-21 Safe Handling Procedures for Medical Oxygen Cylinders and the Use of Regulating Equipment
Safetygram-22 Liquid Helium
Safetygram-23 Cylinder Valves
Safetygram-24 Hydrogen Chloride
Safetygram-25 20% Fluorine/Nitrogen
Safetygram-26 Silane

Additional Information

For additional technical or safety information, please call 800-752-1697.

Emergency Response Guidebook
J. J. Keller & Associates
Neenah, WI 54956
800-558-5011

Fire Protection Guide to Hazardous Materials
National Fire Protection Association
Quincy, MA 02269-9101
617-770-3000

EMERGENCY PHONE NUMBERS

800-523-9374 .... Continental U.S.
610-481-7711 ..... Outside U.S.

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