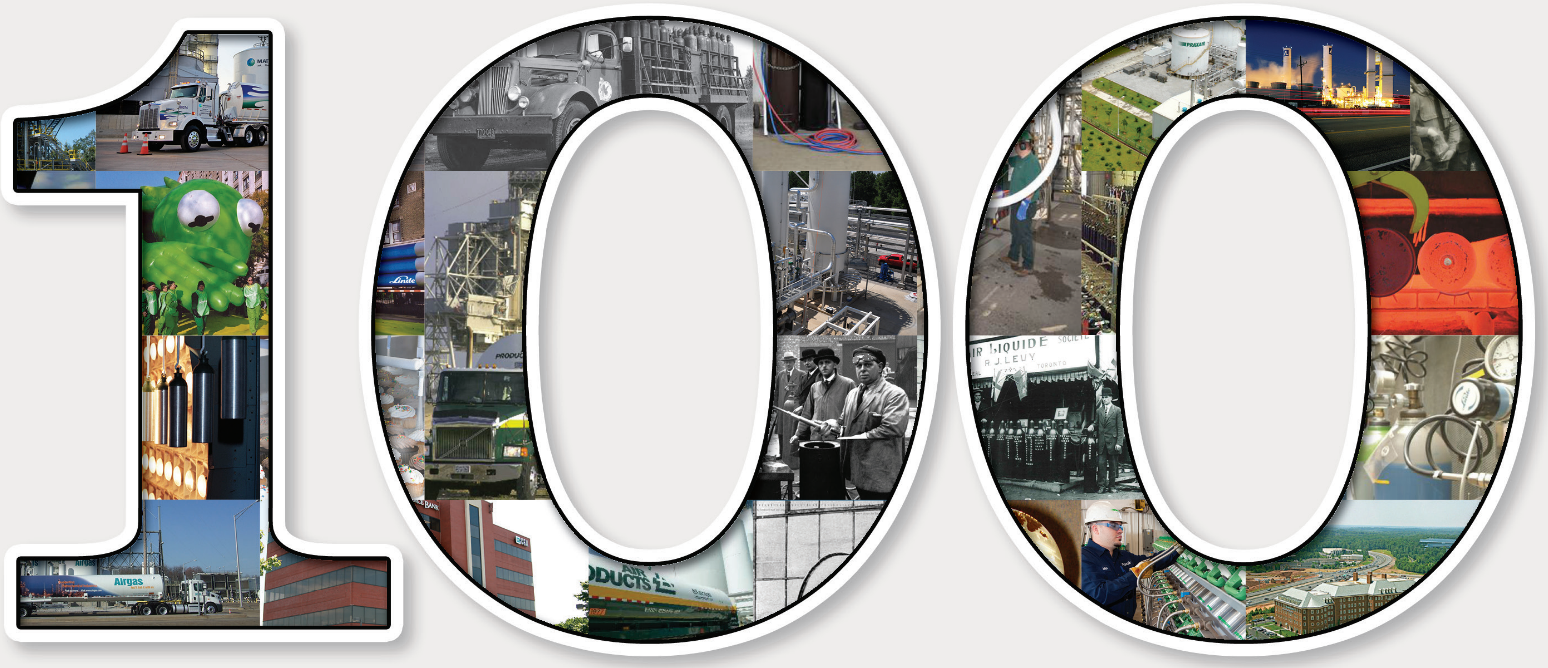


Celebrating 100 Years as The Standard for Safety: The Compressed Gas Association, Inc. 1913 – 2013

Dedication

Founded in 1913, the Compressed Gas Association is dedicated to promoting the ever-improving safe, secure, and environmentally responsible manufacture, transportation, storage, transfilling, and disposal of industrial and medical gases and their containers. Today, the scope of CGA activities includes the manufacture, transportation, storage, transfilling, and disposal of gases (liquefied, nonliquefied, dissolved, and cryogenic); and the containers and valves which hold compressed gases. The scope also includes related apparatus necessary for the safe dispensing or delivery of the gases in a commercial, industrial, research, or medical application. Additionally, the scope covers providing safety information or warnings about the chemical or physical properties of gases and their containers.

As an ANSI accredited standards development organization, CGA works to support this mission by developing, publishing, and globalizing industry technical and safety information in our positions and publications utilizing a committee consensus process. Currently, CGA has over three hundred publications. CGA works to harmonize these publications with other standards setting bodies nationally and internationally to aid in the development of an efficient, safe marketplace for our industry, employees, customers, and the public. Many publications have been adopted as regulatory requirements in the United States and Canada as a result of CGA's efforts cooperative relationships with regulatory agencies thereby improving safety and aiding the industry in proactive efforts to achieve self-regulation.

None of this would be possible without the dedication of CGA's members and volunteer committee participants. The development of these publications is a tremendous example of voluntary cooperation by the compressed gas industry to achieve safety through effective and appropriate regulations, and is made possible by the commitment of time, resources, and expertise by our members and their committee representatives. As CGA celebrates its centennial anniversary in 2013, it is readily apparent that the Association and its member companies take great pride in continuing the industry's outstanding safety record.

It is to those companies, and the men and women who have worked tirelessly to further CGA's safety mission, that this publication is proudly dedicated.

Michael B. Tiller
CGA President & Chief Executive Officer

Table of Contents

The Emergence of the Compressed Gas Industry

Early Uses of Compressed Gases

The compressed gas industry in the United States as we know it today dates back to the turn of the century when American companies began to be formed to produce acetylene and oxygen on a large scale. However, compressed gases such as carbon dioxide, oxygen, hydrogen, ammonia, nitrous oxide, chlorine, sulfur dioxide, and coal gas were already being used during the 19th century.

Gas for Food Production

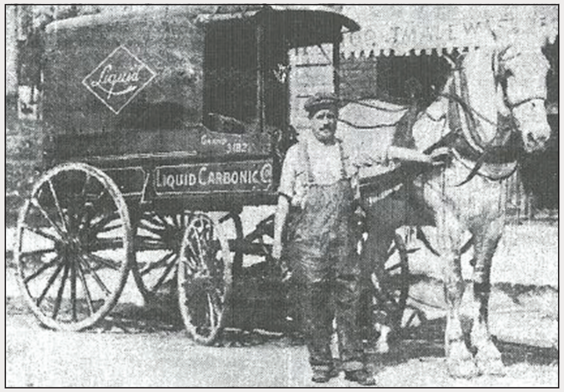
By far the largest use of compressed gas in the United State during the latter part of the 19th century was carbon dioxide, which was used for the "carbonation" of beverages. Carbon dioxide had been identified as a specific substance by Van Helmont as far back as 1608.

In 1767, Joseph Priestley, the discoverer of oxygen discovered that water could be carbonated by pouring it back and forth between two containers over fermenting grain. He devised a convenient method for carbonating water and published an article in 1772, which aroused public interest in the use of CO_2 in beverages.

As early as 1806, bottled carbonated water was being sold in New Haven, Connecticut using the crude generators of the day, and by 1859 there were some 123 bottlers offering carbonated beverages in the United States. The generator was usually a pressure vessel in which marble chips reacted with sulfuric acid to produce carbon dioxide, which was bubbled through the water to produce soda pop.

In 1884, a druggist in Terre Haute named Jacob Baur conceived of the idea of making carbon dioxide and storing it in cylinders for sale to the bottling trade. As a result, the Chicago Liquid Carbonic Acid Manufacturing Company (later Liquid Carbonic Corporation) was organized in 1888 and the first shipment of carbonic acid gas was made in 1889 from the company's Chicago plant.

This was the first time that carbon dioxide was manufactured and stored in liquid form on a commercial scale, a development, which also led to improved high-pressure cylinders for compressed and liquefied gases.



1890s Carbon Dioxide Delivery
(Courtesy of: Liquid Carbonic Industries Corporation)

The Fuel Gases

Gases that burn using air or oxygen to produce heat make up a family of gases called fuel gases. Fuel gases can be either non-liquefied gases such as hydrogen, liquefied gases such as butane, or dissolved gases such as acetylene. Liquefied gases are gases that are partially liquefied in their shipping containers under the vapor pressure of the gas.

Hydrogen

Hydrogen was first recognized as a discrete substance by Henry Cavendish, an English chemist, in 1766. In 1783, Antoine Lavoisier gave the element its name from the Greek 'hydro' meaning water and 'genes' meaning creator. It is the lightest of all gases and is the most common chemical element in the universe.

Throughout history, hydrogen has played an exciting role. In 1783, the first hydrogen balloon was developed by Jaques Charles. In 1806, a mixture of hydrogen and oxygen powered the first internal combustion engine. The first hydrogen filled airship took its maiden flight in 1900, and in 1919 the first nonstop transatlantic crossing was completed by a British hydrogen airship.

Pintsch Gas

In 1851, a German manufacturer and inventor named Julius Pintsch developed a product called Pintsch Gas, which was formed by cracking oil at high temperatures to form a long-burning oil gas which was compressed at 125 psi. Pintsch gas was used primarily in railroad car lights, but also in beacons and unmanned lighthouses. The gas was popular in these applications because it held its flame through vibration and rough usage. Pintsch gas was introduced to the United States in 1866 and was used for railroad car lights and stoves.

Liquefied Petroleum Gas

Liquefied petroleum gas was introduced in Britain during the 1870's by J.J. Coleman, who became the first to successfully liquefy petroleum gas. Coleman used pressure and low temperatures on gas formed from Scottish shale oil to produce his product. Early on, liquefied petroleum gas was used on a limited basis as a cooking fuel. Liquefied petroleum gas quickly evaporated in storage, thus hindering its use as a fuel gas. In 1911, American chemist Dr. Walter Snelling identified that propane and butane within gasoline caused its evaporation, and developed a practical method for removing these gases from stored gasoline.

Blaugas

In 1901, Hermann Blau, an engineer and chemist in Augsburg, Germany, invented a process of liquefying petroleum gas by decomposing mineral oils. Blaugas is a mixture of approximately 50% hydrogen, 40% carbon monoxide. While buoyant, it was not non-explosive. However, the foul smelling mixture of liquefied petroleum gases, permanent gases, and light fractions of gasoline was costly to produce and handle. Still, Blaugas was imported and later manufactured in the United States where it was used for heating and lighting before it was replaced by propane.

Gas for Medicinal Purposes

The use of compressed gases in medicine dates back as early as 1799 to the first uses of oxygen and nitrous oxide for respiratory therapy and dental anesthesia. Chlorine was used to some small extent for bleaching and sterilizing in the late 1800s, but this was limited to a few small pressurized containers. Nitrous oxide was first imported into the United States for use as a dental anesthetic in 1870.

Early Oxygen Therapy *(Courtesy of: Linde North America, Inc.)*

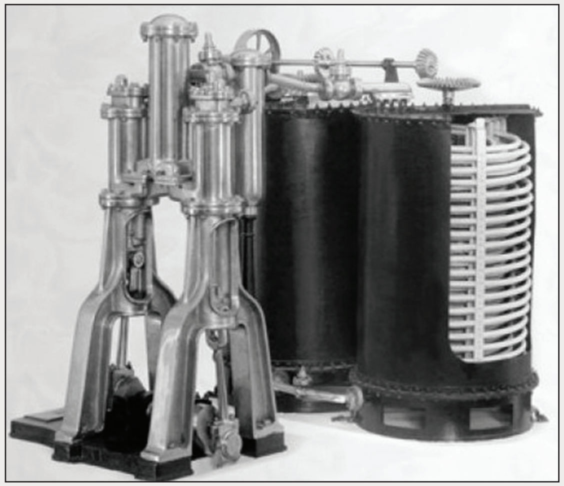
Mechanical Refrigeration

The first systems for mechanical refrigeration using vapor compression equipment emerged during the first part of the 19th century.

The first practical refrigeration system using the compression cycle is said to have been invented by Jacob Perkins in London in 1834, using ether as the refrigerant. In 1859, an ammonia absorption system was built by Ferdinand Carre and in 1873, Dr. Carl von Linde of Germany introduced an ammonia vapor compressor. In 1876, Raoul Pictet of France built a sulfur dioxide compressor, and the same year, methyl ether was used as a refrigerant in shipping meat from Argentina to France.

For the next few decades, attention was directed to improving in the mechanical design and operation of equipment, but one serious problem remained: All of the refrigerants in use at the time suffered from one or more hazardous properties.

The use of industrial gases in refrigeration ranks as one of the most important developments of modern civilization, making possible the storage and distribution of perishable foods, as well as air conditioning which permits us to live and work in comfort, even in adverse climates.



First Refrigeration Machine with Methyl Ether as the Refrigerant *(Courtesy of: Linde North America, Inc.)*

Discovery of Calcium Carbide and Acetylene

Acetylene was initially discovered using potassium carbide in 1836, by Edmund Davy, a professor of Chemistry to the Royal Dublin Society. Though Davy noted the new gas' potential for illumination, its discovery was to remain a laboratory curiosity for more than half a century. It wasn't until twenty-four years later that Marcel Berthelot would give acetylene its name.

In 1892, more than fifty years after Davy's discovery, James Turner Morehead and Thomas Willson organized the Willson Aluminum Company and built their first electric furnace in Spray, North Carolina. While experimenting in hopes of producing metallic calcium to be used as a catalyst in the production of aluminum, Morehead and Willson threw a quantity of coal tar and lime in the furnace, later collecting a solid residue from the furnace which proved not to be the metallic calcium they had hoped for, but a substance which gave off a rich, hydrocarbon gas when dipped into a pail of water.

One of the men took a burning piece of oil waste, fastened it to the end of a fishing pole, swung it over the bucket, and gas ignited with a luminous flame. On later analysis by William Rand Kenan, then a chemistry student at the University of North Carolina, and his mentor, Dr. F.P. Venable, the substance generated by Morehead and Willson proved to be calcium carbide, and the gas produced by immersing this substance in water was acetylene.

Quite by accident, Morehead and Willson had discovered an economical method of producing acetylene gas by the reaction of calcium carbide with water — the same process that is used today. A patent was issued on their process for production of calcium carbide in 1893 and five plants were established to manufacture calcium carbide. Backed by financiers from New York, Morehead and Willson established the Electro Gas Company to market calcium carbide and acetylene. In Niagara Falls, New York the Electro Gas Company established the Acetylene Light, Heat, and Power Company which, in 1898, became the Union Carbide Company.

Acetylene for Illumination

Because of the brilliant light given off by the acetylene flame, the first use of acetylene was for illumination of streets, homes, automobiles, and locomotives. A number of companies sprang up to produce acetylene generators for this purpose. The first use of acetylene for town lighting occurred in 1898 in New Milford, Connecticut.

At the time, no safe method had yet been found for storing acetylene, which is highly unstable as a compressed gas. But small acetylene generators could be used to generate the gas wherever it was needed for illumination, and even for cooking. Companies began to manufacture and market small acetylene generators to farmers in rural areas. They also manufactured acetylene hot-plates for cooking, and acetylene-fired side-arm heaters for making hot water.

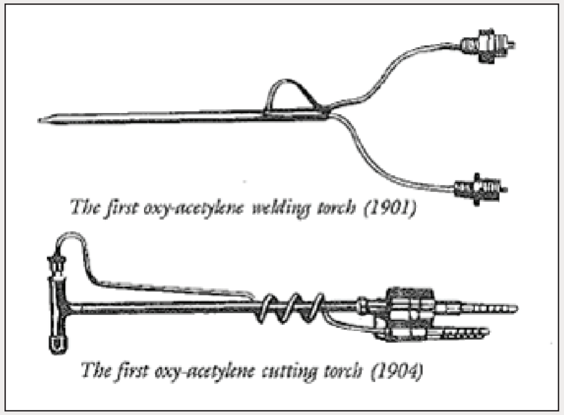
The use of acetylene for illumination and for cooking was short-lived, as electric arc lamps soon proved more practical for illumination, and liquefied petroleum gas soon took over the domestic cooking market. Reports indicate that there were still 100,000 such small acetylene generators in operation as late as 1938.

Calcium Carbide Bicycle Lamp

Acetylene for Welding and Cutting

In 1895, a French scientist, Henri Le Chatelier, discovered that the combustion of acetylene and oxygen produced a flame with a temperature higher than had previously been achieved. This allowed the use of acetylene for welding and cutting of metals, one of the most common uses of this gas.

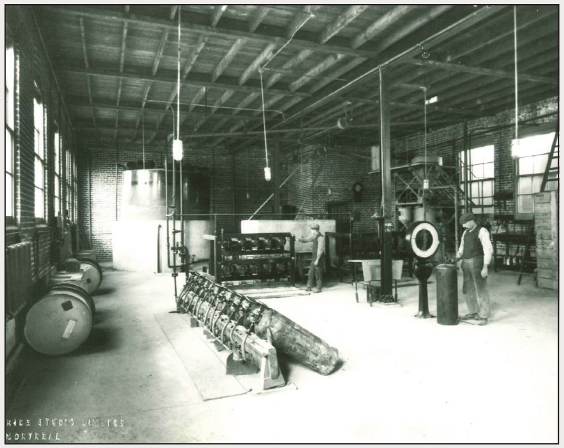
Shortly thereafter, in 1896, French scientists, George Claude and Albert Hess, invented a process for safely storing acetylene in a portable cylinder. This process consisted of dissolving the acetylene gas in acetone dispersed throughout a porous filler material contained in a steel cylinder. Under pressure, "free" acetylene is unstable and dangerous, but once dissolved in acetone, it is stable and safe to handle. Acetylene could now be safely and efficiently transported.



First Oxy-Acetylene Torches *(Courtesy of: Matheson)*

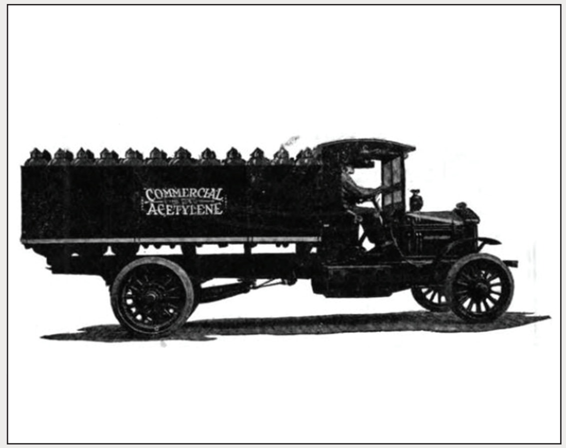
1915 Oxy-Acetylene Welding Demonstration
(Courtesy of: Air Liquide Canada, Inc.)

Mobile Welding Supply Store
(Courtesy of: Western International Gas and Cylinders, Inc.)



1915 Fill Plant in Montreal *(Courtesy of: Air Liquide Canada, Inc.)*

Modern Oxy Acetylene Welding Torch
(Courtesy of: Air Products and Chemicals, Inc.)



Early Acetylene Delivery Truck

Early Gas Production

The isolation and recognition of oxygen was one of the most important advances in chemistry. In 1774, Joseph Priestly heated red calx of mercury and found that the dephlogisticated air it gave off supported combustion and respiration. Soon after, Antoine Lavoisier showed that atmospheric air contained two gases. One of them supported combustion; he called it 'principe oxygine.'

The value of oxygen as a therapeutic agent has been appreciated since 1799, when Dr. Thomas Beddoes and Sir Humprey Davy administered it to patients at The Pneumatic Institute.

Oxygen Emerges as an Industrial Commodity

Before Linde invented the first method for liquefaction of air, a complex chemical method of extracting oxygen from barium oxide was developed by the French chemist Boussingault in the 1850's. Later refinements of Boussingault's process by Arthur Brin and Leon Quintin Brin in Britain between 1880 and 1885 lead to the formation of Brin's Oxygen Company Limited in 1886 (later British Oxygen Company, or BOC). By 1887, Brin's Oxygen Company produced 142,116 cubic feet of oxygen. Output was increased to 953,213 cubic feet in 1889. But Brin's process was soon to be replaced when Carl von Linde patented the commercial method for liquefaction of air.

Liquefaction of Air

In 1895, only three years after the discovery of calcium carbide and a cheap method of making acetylene gas, Dr. Carl von Linde of Germany invented the first process for the liquefaction of air, which made possible the economical production of large quantities of relatively pure oxygen from the atmosphere.

Although oxygen had been discovered as early as 1774 by Joseph Priestly and Antoine Lavoisier, and its therapeutic uses date back to 1799, oxygen was still a largely undeveloped resource before 1895.

Early Compressed Gas Containers

Portable metal cylinders have been used for the storage and transportation of compressed and liquefied gases from as far back as 1810. But the advent of high pressure compressed gas cylinders of the type used today did not occur until about 1890 when the first seamless steel high pressure cylinders were introduced by the Mannesmann Company in Germany. In 1900, inventor Paulus Heylandt built the first tank car for liquid oxygen, called the "Laubfrosch" or "Tree Frog".

In the United States, the first compressed gas cylinders were produced by the Harrisburg Pipe and Pipe Bending Company (now Harsco Corp.) in the late 1800's when the company fashioned its first "gas shipping drum" for anhydrous ammonia, a container that was "hammered, patched, and hand-welded" from a piece of steel pipe 55 inches long and 5 inches in diameter.

First Portable Tank for Liquid Oxygen
(Courtesy of: Linde North America, Inc.)

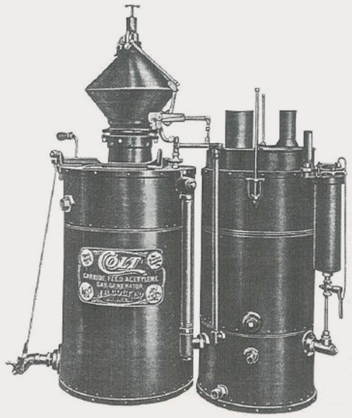
1901 – 1910: The Early Years

A Growth in Compressed Gas Use

Acetylene as a Practical Welding Tool

In 1901, two French engineers, C. Picard and E. Fouche developed the first practical oxy-acetylene welding torch. Picard went on to develop the oxy-acetylene cutting torch in 1904.

Oxy-acetylene welding and cutting of metals spawned a burgeoning new market for acetylene and oxygen, the first of the "industrial gases" and for the manufacture of equipment for the new trade. These new methods of cutting and fabricating steel soon replaced the slower, more labor intensive methods of hammer and chisel that had been used until that time.



Early Acetylene Generator,
Circa 1911
(Courtesy of: Union Carbide Corporation)

Air Separation Becomes a Reality

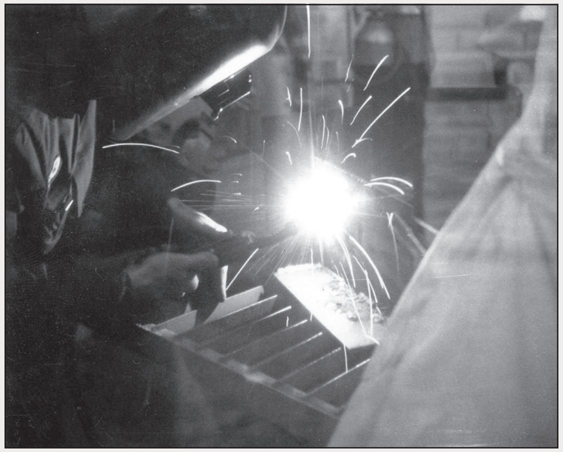
The Expansion Engine is Born

In 1902, the French scientist Georges Claude invented the expansion engine, a low pressure system for liquefying air on an industrial scale. Claude's method differed from the Linde cycle in that it operated at only 280 psi, a tremendous savings in energy over Linde's cycle.

Claude's invention of the expansion engine led to the formation of L'Air Liquide in November 1902 to exploit this new process. This was followed in 1905 by the invention of the double rectification column, which made it possible to produce oxygen of 93% purity.

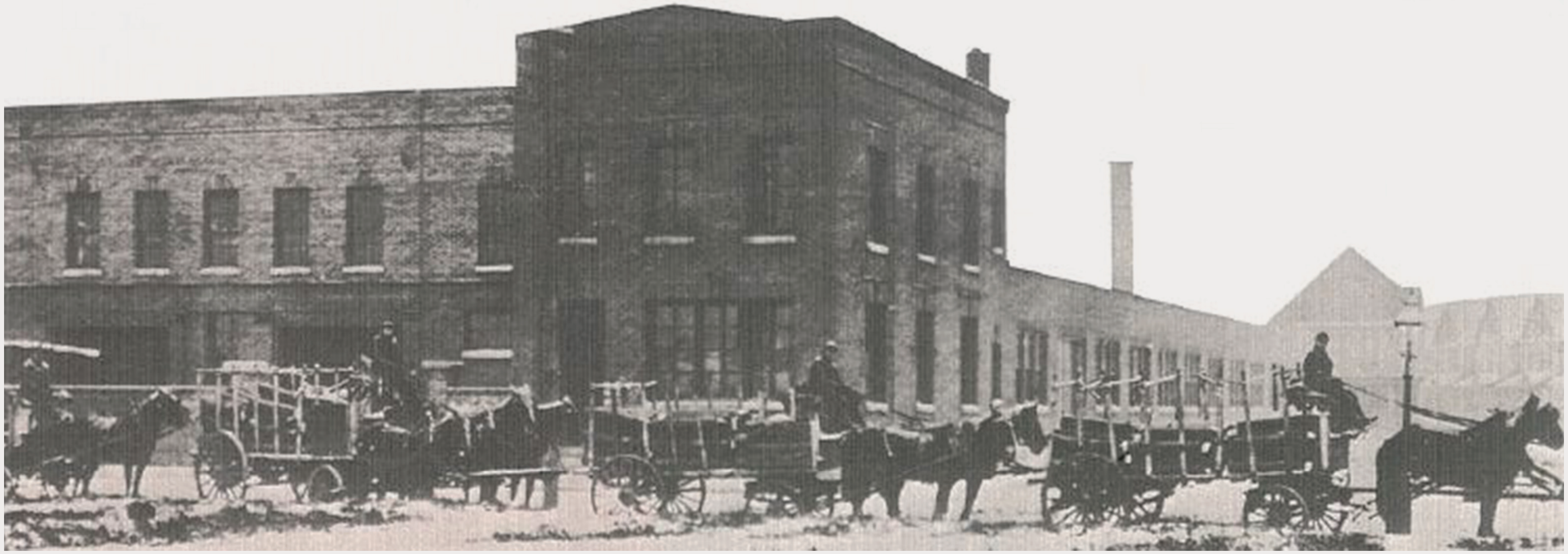
Claude's low pressure method of air separation would ultimately replace the high pressure cycle for the production of oxygen.

1920 Welding Demonstration
(Courtesy of: Air Liquide Canada, Inc.)

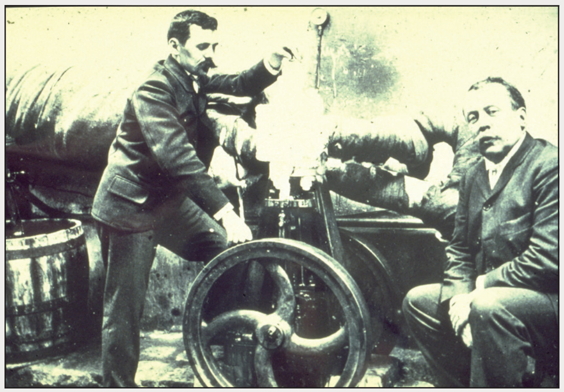


Welding Spark
(Courtesy of: Airgas Inc. and National Welders Supply Co., Inc.)

1918 Oxygen Gas Welding Apparatus
(Courtesy of: Western International Gas and Cylinders, Inc.)



First U.S. Air Separation Plant, Buffalo, New York, Circa 1907 *(Courtesy of: Union Carbide Corporation)*



Georges Claude with First ASU in 1910
(Courtesy of: American Air Liquide Holdings, Inc.)

First L'Air Liquide Plant, Located in Montreal Circa 1911
(Courtesy of: Air Liquide Canada, Inc.)

A number of oxygen plants using the Linde cycle were built in Europe between 1895 and 1906. The first U.S. air separation plant built in Buffalo, New York in 1907 by the Linde Air Products Company used the Linde cycle.

The Cylinder Industry Comes to the United States

Emergence of High Pressure Containers

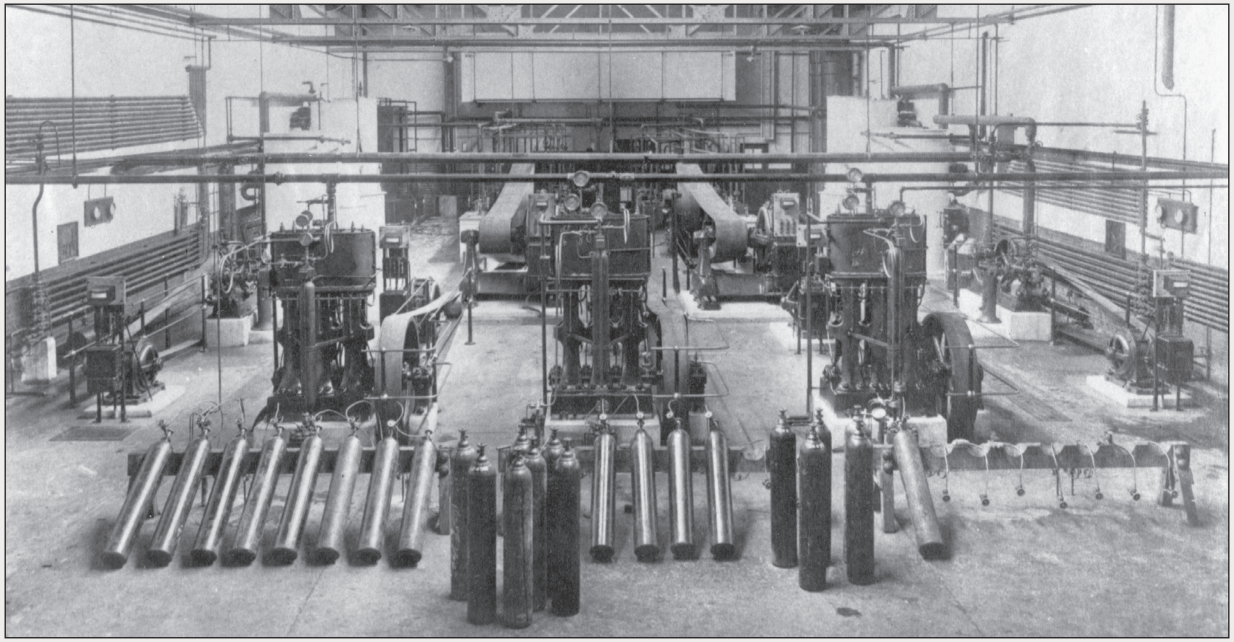
By 1888, with the emergence of the trade in liquefied carbon dioxide, there emerged a need for high pressure cylinders.

At first, Harrisburg decided that 20 lbs. of carbon dioxide could be compressed into the hand-welded "gas shipping drum", which had been used for ammonia. But it was soon discovered that the tightly compressed carbon dioxide often ruptured the cylinder at the hand-welded seam.

The first solution to the problem was to test each cylinder before shipping, and a pump was built that would bring the pressure up to 3700 psi. When the final test pressure was reached, a bell went off, and the pressure was held for a time to determine if the welds would hold. Poor welds ruptured; reliable welds withstood the test.

At the same time, however, seamless steel high pressure cylinders were already being imported from Germany. As a result, Harrisburg constructed the first U.S. seamless cylinder plant, which went into production in 1902.

These first American-made seamless high pressure cylinders were tested using the 3700 lb. pump, and were the same dimensions as the previous hand-welded cylinders (55 in. by 5 in.). Soon afterward, Harrisburg began selling the new high pressure cylinders for storing of carbon dioxide, as well as for compressed air, which was beginning to be used by saloons for dispensing of beer.



1926 Cylinder Filling Operation in Buffalo, New York *(Courtesy of: Praxair, Inc.)*

Oxygen Cylinders

With the advent of the first air separation plants starting in 1907, and the rapid growth of oxy-acetylene welding, there came a need for high pressure oxygen cylinders. Up to this time, oxygen had been shipped in low pressure cylinders containing only about 100 cubic feet of gas. Harrisburg started making high pressure oxygen cylinders in 1908, along with its only U.S. competitor at the time, National Tube Company. The new oxygen cylinders required higher pressures than carbon dioxide cylinders, and soon resulted in improved methods for cylinder manufacture and testing.

Lecture Bottle
(Courtesy of: Matheson)

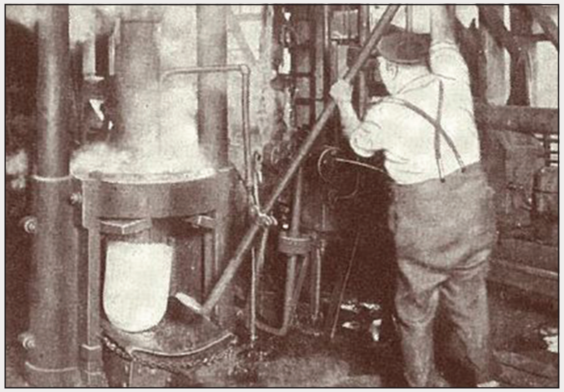
Salesman with Early Cylinders, Circa 1915
(Courtesy of: Air Liquide Canada, Inc.)

Lighter Weight Cylinders

The weight of compressed gas cylinders, which contributed to high transportation costs, and difficulty in handling, was always a problem. While American companies began making high pressure steel cylinders during the first decade of the century, they met with only limited success.

This was due, in part, to the fact that the U.S. Congress lowered the import tariff on imported compressed gas cylinders in 1910, making it possible to ship German-made cylinders as far as California for $2.00 less per cylinder than American-made cylinders.

To meet this challenge, Harrisburg developed the first quenched and drawn heat treated high pressure cylinder. This reduced the weight of a standard 220 cubic foot cylinder by one-third, making the handling of a standard cylinder a one-man operation instead of requiring two men as before. At first, supporters of the heavier German cylinders denounced the new, light-weight cylinder as an inferior product. But eventually, the critics were discredited, and the lighter-weight American cylinders gained acceptance in the U.S. market.

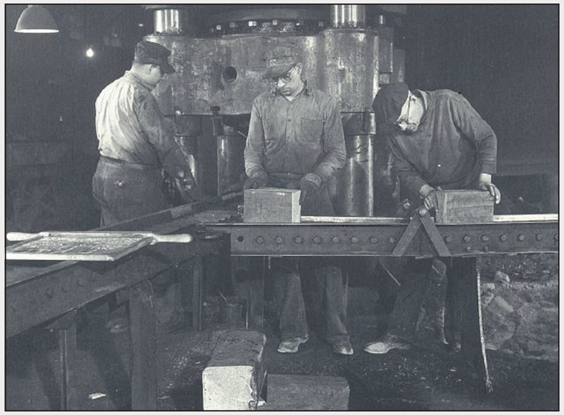


Forming a Cylinder *(Courtesy of: Taylor-Wharton International, LLC)*

Cylinder Tests

In the early 1900s, Harrisburg built an improvised testing apparatus known today as the "Water Jacket Leveling Burette Testing Method." This early test apparatus was made from a piece of scrap pipe, and used a glass burette borrowed from the laboratory, which was suspended by a cord and pulley. Expansion measurements were made as the cylinder was placed under increased pressure, while the burette was raised and lowered to take readings at the same level.

By 1911, the new "Water Jacket Test" for compressed gas cylinders would be included in proposed government regulations being drafted by the Bureau of Explosives (BOE).



Steel Billets for Cylinder Manufacture
(Courtesy of: Taylor-Wharton International, LLC)

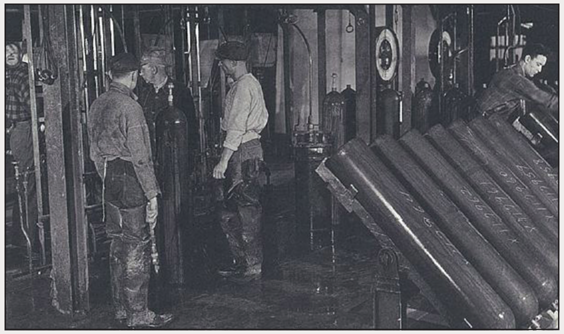
Analyzing Cylinders at Toronto Facility, 1920 *(Courtesy of: Air Liquide Canada, Inc.)*

The Initiation of Regulations

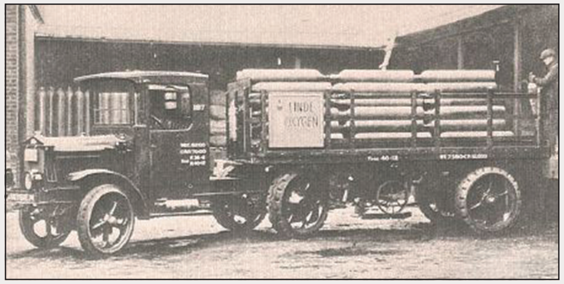
By 1907, with the compressed gas industry growing rapidly, the United States government had begun to recognize the need for regulation of compressed gases in interstate transport. As a result of a growing number of accidents involving explosives, which raised the cost of transporting explosives to the railroads, the Bureau of Explosives was created under the American Railway Association (ARA), predecessor of the Association of American Railroads whose rules extended to more than explosives.

In 1908, in order to reduce the number of accidents, Congress granted the Interstate Commerce Commission (ICC) power to regulate the transportation of explosives. Even though the Congressional mandate was to regulate explosives, the ICC promptly adopted the Bureau of Explosives (BOE) rules, which extended beyond explosives to include other hazardous materials. As the Bureau refined its rules, the ICC routinely adopted them and these procedures sharply reduced accidents despite rapid growth in shipments of hazardous materials. Through the adoption of BOE rules, the ICC promulgated regulations for the safe transport of compressed gases.

Later regulations developed by the BOE and promulgated by the ICC would address shipments of compressed and liquefied gases via railroad tank cars, which began with the first recorded shipment of chlorine in 1909.



Water-Jacket Leveling Burette Test
(Courtesy of: Taylor-Wharton International, LLC)



First Tractor-Trailer Cylinder Truck, Circa 1914
(Courtesy of: Union Carbide Corporation)

Early Cylinder Truck *(Courtesy of: Airgas, Inc. and National Welders Supply Co., Inc.)*

1911 – 1920: A Need for an Industry Voice

The Compressed Gas Manufacturers' Association is Formed

Early Compressed Gas Regulations

In 1911, the ICC proposed the first compressed gas regulations, which addressed the specifications for the manufacture and testing of low pressure compressed gas cylinders. It was these proposed regulations that prompted about a dozen compressed gas manufacturers to work cooperatively to see that reasonable and uniform regulations were adopted.

The group hired Robert King of Philbin, Beekman, Menken, & Griscom to represent their interests with the BOE and ICC. This early effort culminated in 1912 with the publication of the first ICC regulations regarding the transportation of compressed gases. It soon became evident to the small group of companies, however, that a national association of compressed gas manufacturers was needed to promote uniform, safe, and reasonable regulations for the industry.

Finding an Industry Voice

On January 16, 1913, Robert King sent a letter to the seventy-five known manufacturers of compressed gases in the United States inviting them to attend a meeting in New York for the purpose of organizing a new industry association.

King identified several matters of vital and common interest to be considered by the proposed association, including:

- better control of cylinders;
- proper classification of cylinders;
- trade reports to prevent bad accounts;
- careful investigation of accidents to cylinders in transportation or otherwise, for the purpose of preventing accidents;
- standardization of cylinders and their connections;
- bureau of investigation to extend the gas industry by ascertaining new fields in which gases might be used; and
- mutual cooperation by manufacturers to report lost cylinders.

CGMA Organizational Meeting

Twenty nine of the seventy-five companies invited were represented at the organizational meeting held March 21, 1913 in New York. Another sixteen, although not represented, had already signified their approval.

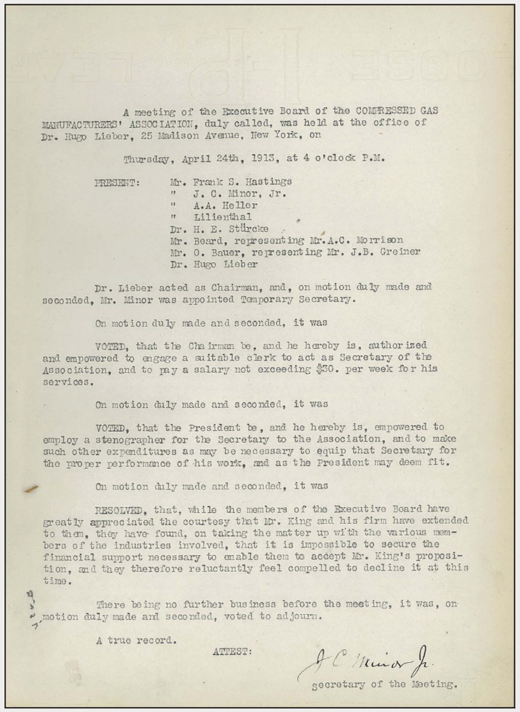
Dr. Hugo Lieber of the Blaugas Company of America was elected President of the new Compressed Gas Manufacturers' Association (CGMA). J.B. Greiner of the Liquid Carbonic Company was elected First Vice President, and A. Cressy Morrison of Linde Air Products Company was elected Second Vice President.

Members of the Executive Board were:

- Dr. Hugo Lieber, Blaugas Company of America, President
- J.B. Greiner, Liquid Carbonic Co., First Vice President
- A. Cressy Morrison, Linde Air Products Co., Second Vice PResident
- Frank S. Hastings, Commercial Acetylene Co.
- George S. Haydock, Standard Carbonic Co.
- A.A. Heller, International Oxygen Co.
- W.W Johnston, S.S. White Dental Manufacturing Co.
- Otto S. King, Standard Oxygen Co.
- J.C. Minor, General Carbonic Co.
- Justin G. Sholes, Ohio Chemical & Manufacturing Co.
- Dr. H.E. Sturcke, Crescent Chemical Manufacturing Co.

Thus, the Compressed Gas Manufacturers Association (CGMA) was organized on March 21, 1913, and the first official meeting was held April 24, 1913. Soon after, the Association moved into offices at 25 Madison Avenue in New York, which were on loan from a member company to save expenses. The first annual meeting of the CGMA was held in New York on January 29, 1914. A year after its organization, on April 2, 1914, the Association was incorporated as a not-for-profit organization under the laws of the State of New York. By this time the Association numbered 77 U.S. members and 5 Canadian members. In 1914, the CGMA Executive Board authorized "Associate Memberships" for interested parties who were not eligible for full membership under the current rules of the Association.

First CGMA Annual Meeting, New York, January 29, 1914
(Courtesy of: Compressed Gas Association, Inc.)



A meeting of the Executive Board of the COMPRESSED GAS MANUFACTURERS' ASSOCIATION, duly called, was held at the office of Dr. Hugo Lieber, 25 Madison Avenue, New York, on

Thursday, April 24th, 1913, at 4 o'clock P.M.

PRESENT: Mr. Frank S. Hastings
" J. C. Minor, Jr.
" A.A. Heller
" Lilienthal
Dr. H. E. Stürcke
Mr. Beard, representing Mr. A.C. Morrison
Mr. O. Bauer, representing Mr. J.B. Greiner
Dr. Hugo Lieber

Dr. Lieber acted as Chairman, and, on motion duly made and seconded, Mr. Minor was appointed Temporary Secretary.

On motion duly made and seconded, it was

VOTED, that the Chairman be, and he hereby is, authorized and empowered to engage a suitable clerk to act as Secretary of the Association, and to pay a salary not exceeding $30. per week for his services.

On motion duly made and seconded, it was

VOTED, that the President be, and he hereby is, empowered to employ a stenographer for the Secretary to the Association, and to make such other expenditures as may be necessary to equip that Secretary for the proper performance of his work, and as the President may deem fit.

On motion duly made and seconded, it was

RESOLVED, that, while the members of the Executive Board have greatly appreciated the courtesy that Mr. King and his firm have extended to them, they have found, on taking the matter up with the various members of the industries involved, that it is impossible to secure the financial support necessary to enable them to accept Mr. King's proposition, and they therefore reluctantly feel compelled to decline it at this time.

There being no further business before the meeting, it was, on motion duly made and seconded, voted to adjourn.

A true record.

ATTEST: J C Minor Jr.
Secretary of the Meeting.

First CGMA Meeting Minutes, 1913
(Courtesy of: Compressed Gas Association, Inc.)

Original CGMA Logo *(Courtesy of: Compressed Gas Association, Inc.)*

Established as a Technical Association

The distinction between CGMA as a "technical association" as opposed to a marketing-oriented "trade association" was a matter of concern to the founding fathers of the CGMA from the beginning.

Thus, while Robert King's first letter to prospective members indicated that one of the matters of interest to the new association would be the establishment of a "bureau of investigation to extend the gas industry by ascertaining the new fields in which gases might be used," neither the bureau nor any standing committee was ever established to promote new markets for compressed gases.

Instead, CGMA focused its attention on the development of industry standards, the pursuit of uniform government regulations, and on technical and safety matters, a philosophy that has been largely responsible for the acceptance of CGMA recommendations and proposed standards among government regulatory agencies throughout the United States and Canada.

A Growing Membership

By 1915, CGMA had grown to 82 members. These included:

- 32 manufacturers of oxygen and nitrous oxide
- 21 manufacturers of carbon dioxide
- 12 manufacturers of Blaugas and Pinsch gas
- 9 manufacturers of anhydrous ammonia
- 5 manufacturers of acetylene
- 2 manufacturers of chlorine
- 1 manufacturer of sulfur dioxide

By 1918, the CGMA membership was reported as close to 100% of the compressed gas industry.

Early Regulatory Efforts

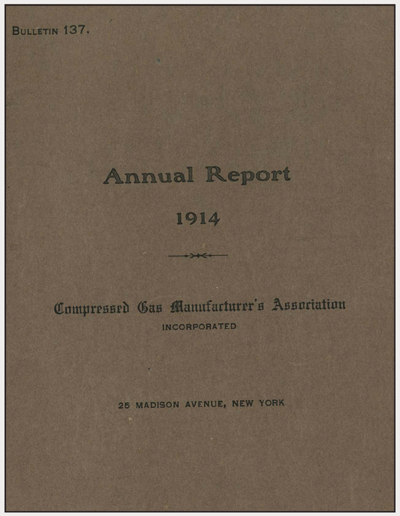
In 1913, CGMA worked with the BOE to investigate several incidents related to the use of lap-welded cylinders in carbon dioxide service. As a result of the testing, CGMA made recommendations that members submit welded cylinders for etching tests by CGMA, that at least 1 in 500 (or 1 in 1,000 for lots larger than 2,000) cylinders from a lot be tested, that butt welded cylinders be sent to a third party for testing and hydraulically tested at 500 lb. intervals up to 2,500 lbs. using a hammer test to strike welds, and that rings from burst cylinders be cut and etched.

Later in 1913, CGMA recommended that changes be made to the ICC Regulations regarding fill limits, requiring that cylinders be filled on scales by weight and not by pressure, establishing a re-testing period for cylinders, recommending that cylinders be weighed before they are filled, noting that any cylinder showing signs of surface corrosion should be re-tested, recommending that any cylinder returned with 10 lbs. or more of water in it be re-tested, and recommending that the hammer test be applied to any series of cylinders that may show an unusually large number of failures during the regular testing. CGMA also began to prepare recommendations for the standardization of cylinder tests, purchasing a

Lane Stretch Pump to perform inspection and testing on donated cylinders. By 1914, all cylinders offered for interstate shipment were required to have been tested and marked. In 1919, CGMA requested that the BOE organize a department responsible for the inspection and qualification of cylinders, both during and after manufacture.

In early 1914, CGMA completed an investigation of the use of safety disks and safety plugs of a fusible nature, and recommended that they were feasible to use in the compressed gas industry. An effort was initiated to standardize these devices.

CGMA's first regulatory efforts in Canada started in 1915, with participation in the Canadian Railway Commission to begin discussions regarding railway regulations for the transport of hazardous articles. A CGMA representative was also appointed as a special delegate to the Chamber of Commerce of Canada for the purpose of discussing the adoption of the U.S. ICC Regulations in Canada.


Bulletin 137.

Annual Report

1914

Compressed Gas Manufacturer's Association

INCORPORATED

25 MADISON AVENUE, NEW YORK

1914 CGMA Annual Report
(Courtesy of: Compressed Gas Association, Inc.)

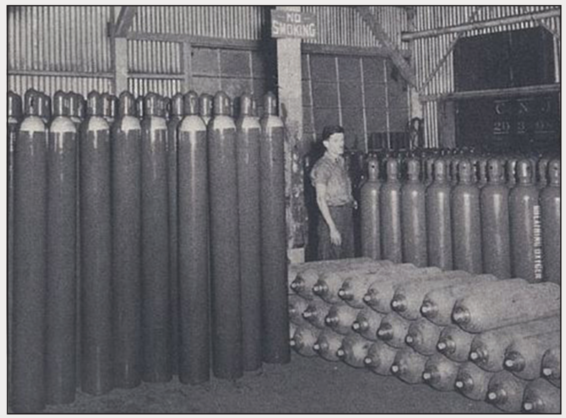
The First World War

By 1915, work to support World War I was a primary concern for CGMA. Throughout 1916, committees worked with the BOE to prepare specifications for chlorine and sulphurous acid containers, recommendations for cylinder annealing practices, and safe handling requirements for various gases. At the request of the BOE, CGMA also conducted testing to determine what pressure increase, if any, would result from shock to liquid gas containers.

In 1916, the Association formed a Transportation Committee. Its primary goal was to facilitate the prompt return of cylinders. Working with the U.S. Railroad Administration, the CGMA was successful in getting the government to promulgate regulations to ensure the return of cylinders. In a September 10, 1918 letter to the War Industries Board, the CGMA made suggestions to facilitate the movement of oxygen and other gases to aid in the war effort. The Board responded by issuing an order on October 11, 1918 requiring that each cylinder be labeled "RUSH. This cylinder is in war service. To avoid delay or stoppage of war work, the United States Government directs prompt movement. FILL, SHIP, USE, and RETURN at once." The order also provided for a rental charge on cylinders at the rate of 50 cents per week on each cylinder retained by any user beyond the free-allowance period, and the CGMA was made the clearing house to determine the ownership of cylinders not carrying the owners' names.

The entrance of the United States into World War I in 1917 introduced a significant growth in activity for compressed gas manufacturing. CGMA worked tirelessly to augment cylinder owner labeling requirements in order to expedite the return of cylinders. During the War, many industries reported a significant increase in workplace incidents due to a focus on supplying the demand for materials, but the compressed gas industry successfully maintained its exemplary safety record. CGMA also supported war time activities by advertising Liberty Bonds, recruiting for the Gas and Flame and Balloon Divisions, and requesting the services of welders and chemists to aid the BOE. The 1917 CGMA Annual Meeting was significantly scaled back; no alcohol or rationed foods were served. The funds not used for the meeting were donated to the American Red Cross.

Immediately following World War I in 1918, CGMA initiated efforts to develop standards for compressed gas cylinder valve connections in response to the difficulties encountered by the industry and the military. Many problems were encountered during filling and usage of compressed gas containers due to the multiplicity of connections in use. This was a particular issue due to the danger of using the same connections for incompatible gases. At the end of the year, CGMA received a letter from Major J.C. Minor, thanking members for their quick support when help was sought by the U.S. government and military, and noting the impact of the development of new gases and supply of needed gases on the outcome of the war.



Cylinders for WWI
(Courtesy of: Taylor-Wharton International, LLC)

Women Welding Cylinders for World War I
(Courtesy of: Air Liquide Canada, Inc.)

Growth of the Compressed Gas Industry

Nitrogen Use in the War

Nitrogen was initially discovered in the early 1700's, but not named until 1790 by French chemist Jean Antoine Claude Chaptal. Nitrogen experienced a boom in popularity in 1905, when German chemist Fritz Haber discovered that nitrogen and hydrogen would combine if they were heated to high temperatures with high pressures when promoted by a metal catalyst. This discovery was used to develop the nitrogen compound ammonia, which was used by many farmers as a synthetic crop fertilizer and as a foundation material to develop nitrates for explosives used in World War I.

The Beginning of the Liquefied Petroleum Gas Industry

The beginning of the liquefied petroleum gas industry in the United States is attributed to Walter O. Snelling, who was a chemist and explosives expert with the U.S. Bureau of Mines, and who developed a way to "bottle" wet gas in 1910 for use in heating and lighting. Two years later, in 1912, Frank Peterson created and patented the use of compression to produce liquefied petroleum gas and Snelling created the American Gasol Company to market propane. A year later, Snelling sold his propane patent to one of the founders of what would eventually become Conoco Phillips. From 1915 to 1917, liquefied petroleum gas was also used as an economical alternative to acetylene for cutting metals, and as early as 1929 it was used as an automotive fuel.

In 1920, Carbide and Carbon Chemicals Corp. (a subsidiary of Union Carbide Corporation) began selling propane for cooking under the name "Pyrofax," becoming the first major manufacturer of liquefied petroleum gas. The year saw the first recorded production of liquefied petroleum gas totaling 223,000 U.S. gallons, which would nearly double three years later. In 1921, the same company developed the first "fractionation" process using a column still known as the "stabilizer," a technology which made possible economical high-volume production, and a more uniform and stable liquefied petroleum gas product.

Advances in Air Reduction

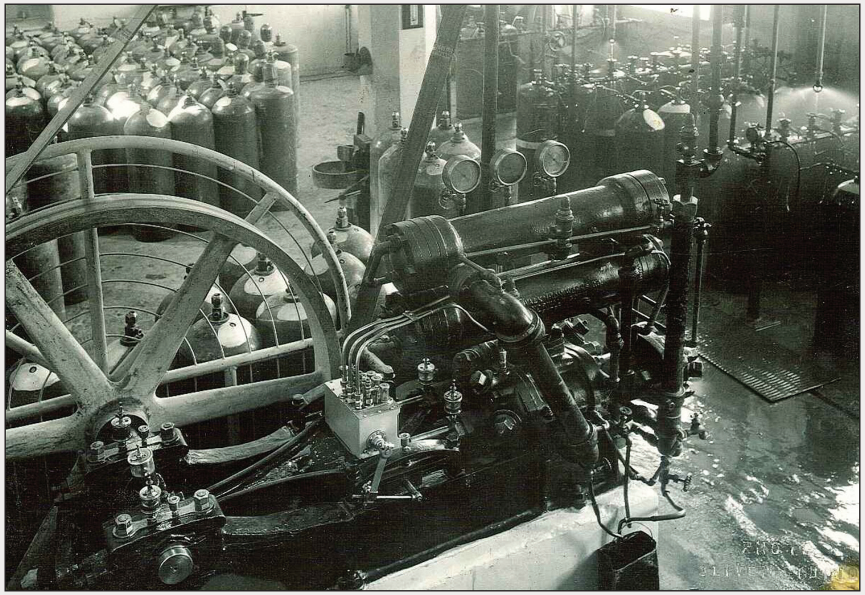
Oxygen Production Grows

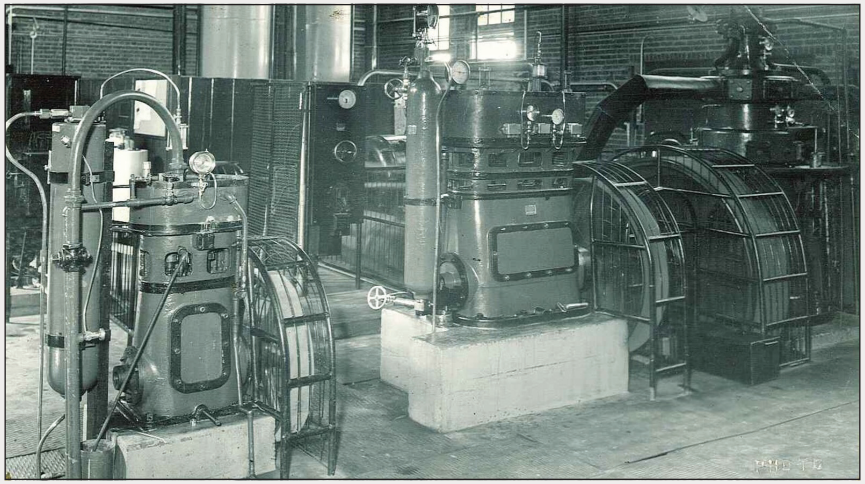
In 1912, the Linde Air Products Company was selling 34.6 million cubic feet of oxygen per year. By 1916, when the first monograph on the compressed gas industry was developed for the Encyclopedia Americana, twenty-five U.S. companies were producing 358 million cubic feet of oxygen per year. Of these, only the three largest (Linde Air Products Company, Air Reduction Company, and Superior Oxygen Company) were producing oxygen by the liquefaction of air. They accounted for approximately 325 million cubic feet per year or 91%of total U.S. oxygen production.

In Linde's process, the refrigeration produced by the expansion of air is repeated and intensified until it reaches the point at which the air becomes liquid at atmospheric pressure. Subsequent fractional vaporization made it possible to "draw off" very pure oxygen in gaseous form and to store this gas in high pressure cylinders.

While similar discoveries were made in Britain by Dr. William Hampson, and in America by Charles E. Tripler, the culminating patent triumph went to von Linde.

Linde's process sparked a revolution in the production of oxygen, and soon, plants were being built in Europe using this process. However, the Linde cycle had its drawbacks. First, the process could only recover 66% of the oxygen in the air; second, it was a high pressure process. Still oxygen produced by the Linde process was far more economical than Brin's barium oxide process.





1920s Calgary Plant *(Courtesy of: Air Liquide Canada, Inc.)*

Electrolytic Oxygen Production

In 1916, twenty-two U.S. companies were producing oxygen using the electrolytic process. Together, they produced approximately 33 million cubic feet of oxygen per year, or about 9% of the total U.S. production.

The electrolytic process was inefficient, however, and proved slower and more costly than other air separation methods. It was phased out when a method for the production, storage, and transport of oxygen in liquid form was developed.

Cylinder Protection Mechanisms

As early as 1913 and 1914, CGMA's Test and Specification Committee was studying the efficacy of frangible disks and fusible plugs as means to relieve excess pressure in compressed gas cylinders.

A frangible disc is a metal disc, usually contained in the cylinder valve, which is designed to rupture if internal pressure in the cylinder exceeds a safe level, thereby providing a controlled release of excess pressure.

Another common pressure relief device is the fusible plug. The fusible plug may be installed in the valve, or in the cylinder itself, and is designed to weaken or "melt" when exposed to excessive heat. If a compressed gas cylinder is exposed to a fire, the fusible plug melts, creating an opening that vents the cylinder's contents, thereby preventing rupture of the container.

1921 – 1930: The Industry Grows

CGMA: A Growing Organization

CGMA Establishes Canadian Division

While there was only one Canadian company among the founding companies, there were five in the 1914 membership. This reflected not only a growing compressed gas industry in Canada, but an early recognition among Americans and Canadians alike that uniformity of specifications and regulations in the United States and Canada was in the best interests of all concerned.

In succeeding years, the continuing strong participation of Canadian companies in the work of the CGMA was to lead to the formation of a Canadian Section with its own secretary and Board of Directors, which held its first annual meeting in Montreal in 1921.

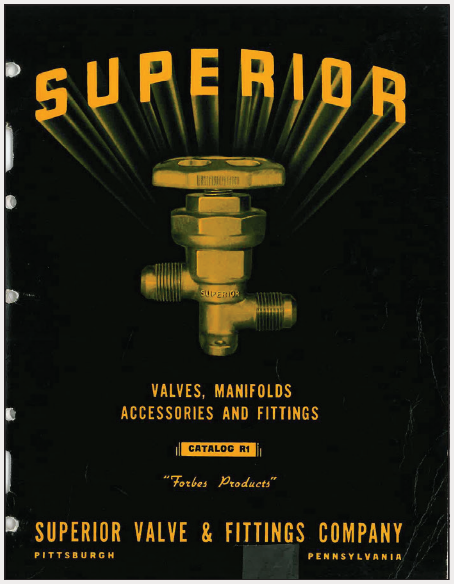
Continued Regulatory Efforts

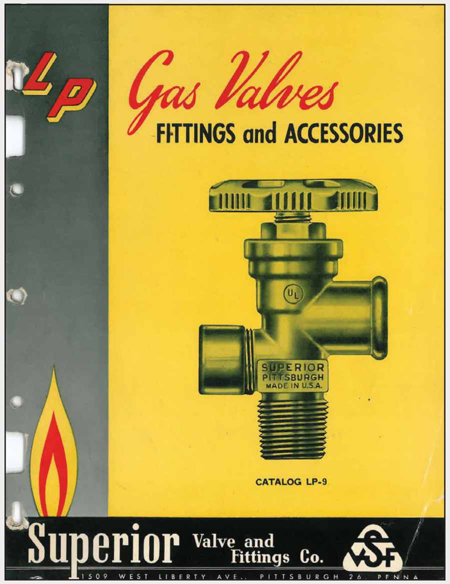
As World War I came to a close, CGMA returned from matters related to the war effort to technical and safety matters. CGMA cooperated with the BOE in establishing the nation's first cylinder ownership symbol registration program, a program that was taken over by CGMA more than sixty years later when the U.S. Department of Transportation relieved the BOE of this responsibility.

During the 1920's, the Association continued to cooperate with the ICC and the BOE in a great many standardization projects, including:

- revised methods for calculating the wall thickness of Class V railroad tank cars for propane, ammonia, sulfur dioxide, and chlorine;
- the first schedule of compressed gas container pressure relief devices;
- standard cylinder valve outlet threads for oxygen and nitrous oxide;
- agreement on reporting of accidents;
- adoption of specifications for steel cylinders having 20 lbs. water capacity for use with refrigerant gases sulfur dioxide, methyl chloride, ethyl chloride, propane, butane, and isobutene; and
- establishment of valve outlet standards for carbon dioxide, Liquefied petroleum gas, nitrous oxide, and methyl chloride.

In succeeding years, the CGMA Transportation and Connection Standards committees were involved in the development of specifications for containers and connections used in the transport of gases in cryogenic liquid form, and the Association has continued to work closely with the BOE, the ICC, and later the DOT, in updating federal regulations to reflect improvements in the design of cryogenic transport vehicles.





Early Valve & Fittings Catalogs *(Courtesy of: Sherwood Valve, LLC)*

A common industry problem was addressed in 1930, when CGMA established a special committee to standardize valve threads. Prior to this work, refilling cylinders was a challenge due to the number of cylinder and valve combinations. After investigating a number of incidents, CGMA and its members formed a plan to standardize valve threads in order to reduce the likelihood of a poor fitting valve being ejected from a cylinder.

Superior Valves & Fittings Company Building, Pittsburgh, Pennsylvania *(Courtesy of: Sherwood Valve, LLC)*

CGMA's Early Publications

In 1924, CGMA issued its first publication, titled *Safe Handling of Compressed Gases*. The publication was intended to convey best practices used by CGMA members to the public and military. It was also intended to serve as a cornerstone for CGMA's regulatory efforts, as it was hoped to be adopted by regulators seeking information on safe handling practices.

CGMA began advocating the standard practice of stenciling, stamping, or labeling each cylinder with the name of the gas contained through letters to the membership and regulators in 1925. CGMA would later develop publications regarding standard cylinder labeling practices, which would be adopted by the American Standards Association in 1942.

In order to develop a comprehensive guide of compressed gas properties and safety information, the CGMA Executive Board endorsed the creation of the industry's first handbook of compressed gases in 1926. The work effort to develop the handbook was sustained over 40 years, and the first edition of the *CGA Handbook of Compressed Gases* was published in 1966.

The Industry Advances

The Rare Gases

Until 1918, the rare gases of the atmosphere were considered a scientific curiosity. By the early 1920's, however, new and important uses began to emerge for these rare gases.

Krypton

Krypton was discovered in 1898 by Sir William Ramsay and Morris Travers, and is estimated to be concentrated in the atmosphere at 1 part per million. By the mid-1920s, krypton was frequently used in a mixture with argon as the fill gas of fluorescent lamps, and used to fill incandescent light bulbs.

Neon

Neon was discovered a few weeks after krypton by Sir William Ramsay and Morris Travers. In 1910, Georges Claude demonstrated modern neon lighting based on a sealed tube of neon. However, neon did not gain popularity in the U.S. until 1923, when the first neon signs were introduced at a Los Angeles Packard car dealership. The use of neon as a light source for signs continued to grow over the next several decades. By the 1950's, New York City's Times Square was dominated by neon signs.

Helium

Helium was first observed in the late 1800s, but considered to be a rare phenomenon on Earth. In 1903, an oil drilling operation in Dexter, Kansas produced a gas geyser that would not burn; samples of the gas showed that it was 1.84% helium. This led to the discovery that helium was concentrated in large quantities under the American Great Plains, where it could be extracted as a by-product of natural gas.

The U.S. Navy sponsored three small helium plants during World War I; during this time, it was discovered that helium could be used to fly balloons and aircraft. On December 1, 1921, the world's first helium-filled airship, a U.S. Navy C-7, flew its maiden voyage from Hampton Roads, Virginia to Washington, D.C. In 1925, the U.S. government set up the National Helium Reserve in Amarillo, Texas with the goal of providing helium for defense, research, and medical purposes.

Exploration of New Uses for Carbon Dioxide

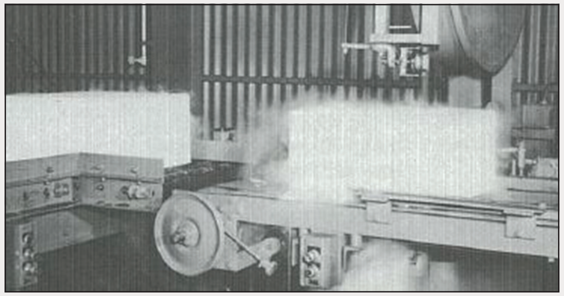
Only once in its history did the Association authorize funds for a study to expand a particular market. This occurred in 1922 when the CMGA funded a fellowship at the Mellon Institute to explore new uses for carbon dioxide. The research later resulted in the widespread use of carbon dioxide as a fire suppressant, as well as many other modern-day applications.

The following year, the Executive Board reaffirmed the Association's mission as a technical and safety association, and no further funding was authorized.

Advances in Refrigeration

Use of Carbon Dioxide as a Refrigerant

The commercial use of solid carbon dioxide or "dry ice" dates back to about 1927 when it was first introduced in a talk before the CGMA by J. W Martin of the Dry Ice Corporation of America. The use of dry ice made possible the distribution of ice cream and other perishable foods.



Dry Ice Production
(Courtesy of: Liquid Carbonic Industries Corporation)

Fluorocarbon Refrigerants

Then, in 1928, C.F. Kettering, a vice president at General Motors, decided the refrigeration industry needed a new refrigerant. As a result, he asked Thomas Midgley, a local researcher in Detroit, to see if he could find one. Three days after getting this assignment, Midgley and his associates had synthesized dichlorodifluoromethane, a liquefied refrigerant gas which not only had the necessary properties as an excellent refrigerant, but also demonstrated low toxicity and nonflammability.

In 1929, E.I. duPont de Nemours & Co., Inc. was asked to help in developing a practical commercial process for manufacturing the new refrigerant, and shortly thereafter, General Motors and DuPont formed a joint venture company, Kinetic Chemicals, Inc. to manufacture and market the new fluorocarbon refrigerant. The resulting product, "Freon 12," introduced in 1931, was the first member of what was to become a large family of fluorocarbon refrigerants marketed under the DuPont trade name. With this development, and improvements in the mechanical compressors, safe refrigeration for home use became a reality, and mechanical air conditioning was soon to follow.

Growth in Fuel Gases

By 1927, sales of liquefied petroleum gas exceeded one million gallons for the first time. By 1929, liquefied petroleum gas was widely used as an automotive fuel.

CGMA completed the first connection standard for liquefied petroleum gas in 1928. This achievement was followed in 1931, by the completion of the first draft specification for liquefied petroleum gas storage containers, which was submitted to the

American Society for Testing and Materials (ASTM), the American Petroleum Institute (API), and the National Fire Protection Association (NFPA). Adopted by the NFPA in May 1932, this CGMA-developed standard became NFPA Pamphlet 58, which is still in use today. Over the years, the CGA has continued to cooperate with NFPA in updating this important standard for liquefied petroleum gas containers.

The Introduction of Cryogenic Production

Emergence of Cryogenic Liquids

While Linde and Claude had found methods to reduce air to its liquid form, and distillation into its constituent gases, the gases produced by the first air separation plants were vaporized back into gases and stored in compressed gas cylinders.

The emergence of cryogenic liquids was not only to make possible the high volume uses of oxygen, which were soon to emerge, but to create new markets for the other atmospheric gases such as nitrogen, argon, neon, and helium, all of which would later be produced, stored, transported, and often used in their liquid form.

Now Praxair, this photo shows the company's cryogenic tanker in 1949. *(Courtesy of Praxair, Inc.)*

Early Liquid Transport

As new uses for large quantities of oxygen and other industrial gases began to emerge, costs for cylinders and transportation became a stumbling block to further expansion.

This problem was solved shortly after the First World War by C.W. Heylandt in Germany. During the 1920's, Heylandt built the first specially-insulated storage vessels and tank trucks, which would allow the extremely cold cryogenic liquid products of the air separation plants to be drawn off as liquids, stored in insulated tanks or vehicles, and transported to market in bulk form.

Early Liquefied Gas Dewars
(Courtesy of: Taylor-Wharton International, LLC)

First U.S. Liquid Oxygen Plant

The first Heylandt system was introduced into the United States at the Union Carbide Corporation's Linde Division in Buffalo, New York in 1927, and two years later, in 1929, Linde began the first liquid oxygen production. Distribution of liquid oxygen in specially-made insulated tank trucks began in 1932.

Early Liquid Oxygen Trailer
(Courtesy of: Air Products and Chemicals, Inc.)

One of the chief difficulties to overcome in the handling of liquid oxygen was the highly reactive nature of oxygen and hydrocarbon lubricants. New nonflammable lubricants had to be found that would not react with oxygen. A multilayer packing of asbestos and graphite was developed by Linde that made pumping of liquid oxygen possible.

Another obstacle was the poor insulation of the day, which permitted heat to leak into the liquid oxygen tanks. The first Heylandt tanks used a magnesium insulation, which had a very high heat leak resulting in a rapid loss of product due to vaporization.

1931 – 1940: The Cryogenic Age

CGMA Continues Advancing Industry Safety

During the 1930s, the Association continued to grow. The work to further develop CGMA as comprehensive resource for the industry, provide safety notices and positions on important issues, and establish industry positions as a form of self-regulation was tremendous.

In 1938, CGMA celebrated its 25th Anniversary; only a year later, World War II began and severely limited the Association's resources. In order to conserve resources and consolidate war support efforts, CGMA formed an agreement with the Liquefied Petroleum Gas Association in 1939 to share office space and some staff while continuing to operate as separate entities.

Early Safety Notices

As the industry continued to grow, CGMA maintained a focus on providing safety information in a timely manner not only to members, but to members of the public and the U.S. and Canadian governments.

In 1935, CGMA issued its first formal Safety Bulletin, noting the safety hazards of relying on a warm water bath to raise the temperature of cylinders for filling. Later in the year, CGMA would discover that many cylinders intentionally disabled and sold for scrap had been poorly repaired and sold back into service, creating a potential danger for compressed gas users. CGMA issued a notice to members regarding the problem, and recommending that any cylinders intended for scrap be destroyed by crushing to ensure that they could not be re-used. After a series of incidents in hospitals, CGMA issued a position strongly recommending that medical facilities immediately cease the practice of transferring high pressure gas from one cylinder to another.

Continued Regulatory Activity

As the use of liquefied petroleum gas as a common fuel increased, CGMA worked with NFPA to develop standards for liquefied petroleum gas systems, liquefied petroleum gas as a motor fuel, and gas systems for welding and cutting. Later, both groups would work cooperatively with the ICC Bureau of Motor Carriers to establish requirements for safety valves on petroleum gas tanks.

In 1937, the Canadian Fire Marshals indicated that they would begin work to develop draft regulations for compressed gases. The CGMA Canadian Section offered a tremendous amount of support to develop the initial drafts and ultimately the finalized requirements. The Canadian Section also worked to draft new requirements for electrical installations in acetylene plants for the Canadian Electric Code.

At the request of the Food and Drug Administration, the CGMA Medical Gases Committee worked to draft uniform label requirements for medical gas cylinders in 1939. In 1940, CGMA worked to support an American Hospital Association recommendation that small cylinders containing medical gases be color-coded to indicate the contents. After many years of work on this issue, the Association would publish the first standard for color coding of compressed gas cylinders intended for medical use in 1973.

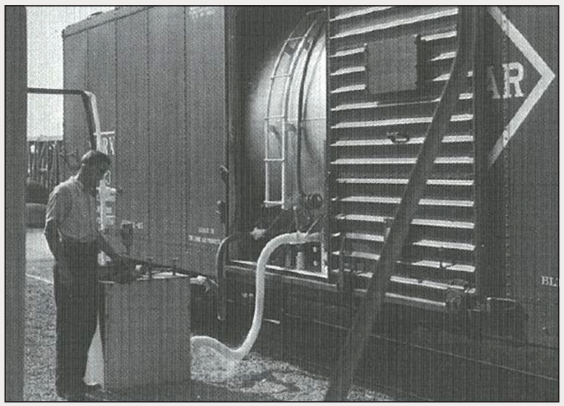
During the mid-1930s, the threat of war in Europe placed an increased focus on ensuring the availability of materials to support wartime activities. CGMA offered the U.S. Navy Department the services of the Association in the formulation of suitable cylinder acceptance tests and cylinder specifications. The technical staff and committees of CGMA also worked with the BOE to determine the yield point of steel cylinders in compressed gas service. By 1939, CGMA formed an advisory committee to support the U.S. Munitions Board; the committee worked to compile data related to compressed gases and answer general inquiries related to safe handling practices.

The Age of Cryogenic Gases

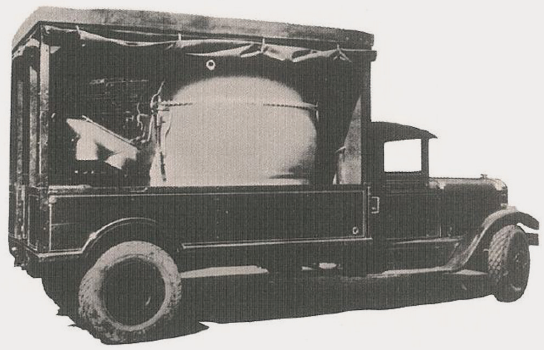
The 1930's saw a tremendous growth in the compressed gas industry as markets for compressed gases continued to expand, but the most significant development was systems for the production, storage, and distribution of gases in liquid form. In 1931, the first vacuum-insulated-motor trucks and railroad tank cars were built to carry gases in their refrigerated liquefied state at extremely low cryogenic temperatures.

In 1933, the ICC announced regulations for the transport of compressed gases by motor truck. CGMA supported these new regulations and agreed to work with the ICC to submit improvements to the regulations as technology advanced.

Vintage Cryogenic Truck
(Courtesy of: Airgas, Inc. and National Welders Supply Company, Inc.)



1930s Liquid Oxygen Railroad Tanker
(Courtesy of: Union Carbide Corporation)

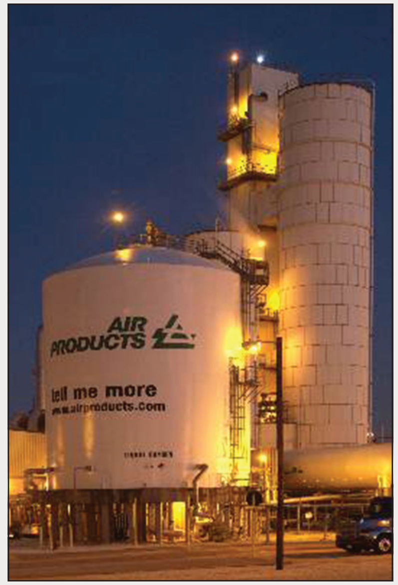


First Linde Liquid Oxygen Truck, Circa 1931
(Courtesy of: Union Carbide Corporation)

By 1936, Linde and others began developing a powder insulation, which reduced heat leak in vacuum-insulated container by twenty times, greatly reducing product loss and lengthening the time that product could be stored. In 1939, Union Carbide's Linde Division shipped the first railroad tank car of liquid oxygen.

Storage and transportation of oxygen in liquid form during the 1930's and thereafter revolutionized the industry, for a volume of 862 cubic feet of oxygen could now be reduced to only one cubic foot of liquid. This greatly facilitated the transportation of oxygen to large users, and lowered transportation costs.

Soon, new double-walled cryogenic vessels with improved multi-layer insulation would make possible longer storage of cryogenic liquids in bulk storage tanks, portable cryogenic cylinders, tank trucks, railroad tankers, and barges, which are used today for a wide variety of cryogenic liquid products.



Modern Liquid Bulk Storage Equipment
(Courtesy of: Air Products and Chemicals, Inc.)

New Uses for Compressed Gases

Acetylene and the Manufacture of Industrial Chemicals

The most recent use discovered for acetylene was in 1930 when Julius Reppe developed a method for using high pressure and temperature to convert acetylene into chemicals such as acetone, ethylene, and butadiene. However, working with acetylene under high pressures was dangerous and in many countries illegal. Reppe created special test tubes called "Reppe glasses" which were stainless steel spheres allowing high pressure experiments. Using acetylene, Reppe synthesized a large number of vinyl compounds to be used in the field of plastics. These acetylene experiments resulted in new chemical compounds with diverse applications in medicine, cosmetics, and industrial production. Acetylene is still used to manufacture some industrial chemicals.

Cylinder Fill Lines
(Courtesy of: Western International Gas and Cylinders, Inc.)

Acetylene Generator
(Courtesy of: Western International Gas and Cylinders, Inc.)

Carbon Dioxide as a Fire Suppressant

By 1932, carbon dioxide fire extinguishers were being introduced by the Walter Kidde Company, and soon scores of other uses were found for this versatile gas. The first of the compressed gases to be produced and distributed on a commercial scale, carbon dioxide remains today one of the important products of the compressed gas industry.

Equipment Advances

Spring-Loaded Pressure Relief Devices

In the early 1930's, CGMA approached the Bastion-Blessing Company of Chicago (now RegO Company) and asked them to design a spring-loaded pressure relief valve for compressed gas cylinders.

This spring-loaded pressure relief device would automatically open at a pre-determined pressure, venting excess pressure within the container. Once excess pressure was relieved, the device would reclose, preventing unnecessary release of product.

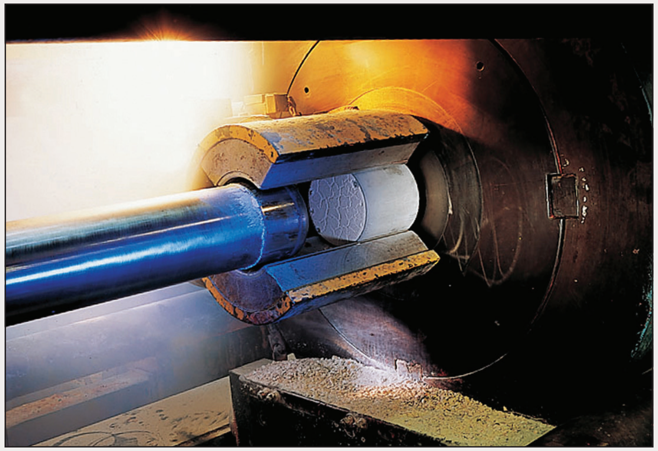
In 1932, CGMA sponsored a series of fire tests in Pontiac, Michigan to test the efficacy of the new spring-loaded pressure relief devices. These first fire tests were witnessed by representatives from the ICC, BOE, NFPA, API, Factory Mutual Laboratories, Underwriters Laboratories (UL), the National Board of Fire Underwriters, and the American Gas Association (AGA).

Based upon these tests, the ICC and the BOE approved the use of spring-loaded pressure relief devices on compressed gas cylinders.

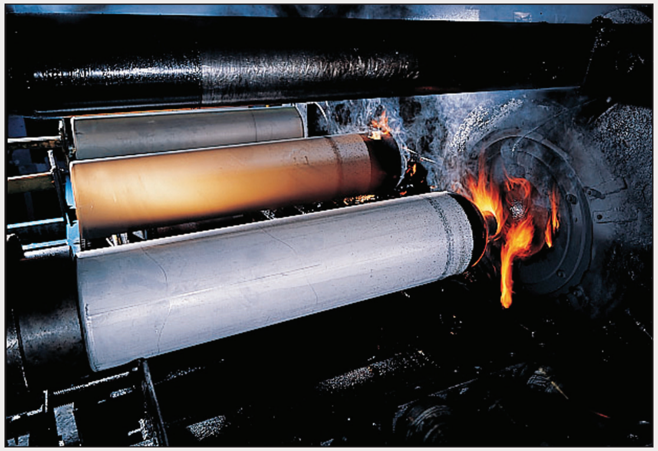
Later, spring-loaded pressure relief devices with metal-to-metal seats were designed and approved for use on tank cars carrying liquefied compressed gases.

Aluminum Alloy Cylinders Introduced

Aluminum alloy compressed gas cylinders, first introduced in 1932, and later designs with fiber wrapping, also gained popularity in some applications due to their lighter weight.



Aluminum Cylinder Extrusion
(Courtesy of: Luxfer Gas Cylinders USA)



Aluminum Cylinder Neck Formation
(Courtesy of: Luxfer Gas Cylinders USA)

Aluminum Cylinder Painting
(Courtesy of: Luxfer Gas Cylinders USA)

Aluminum Cylinder Testing
(Courtesy of: Luxfer Gas Cylinders USA)

1941 – 1950: The War Years

CGMA Becomes the Compressed Gas Association

CGMA faced many resource strains resulting from World War II. Both the CGMA and the CGMA Canadian Section general secretaries were granted leaves of absence to serve in the U.S. Army as experts on compressed gases. The Association worked to conduct testing and formulate responses to the U.S. Army regarding hardness of cylinders, effects of hydrostatic testing, use of safety devices in environments with high ambient temperatures, and the safe use of aluminum cylinders of a welded or brazed design.

Despite the strain, CGMA remained focused on providing services to members and expanded to include compressed gas equipment manufacturers. The Association also worked to organize the administration of committees, particularly the tracking of items of interest to the members. The first docket numbers were introduced in CGMA committee notes in 1946.

The name of the Association was changed to the "Compressed Gas Association" (CGA) in 1948 when the board of directors decided that membership should include not only manufacturers of compressed gases, but manufacturers of cylinders, regulators, valves, and other equipment used in the industry.

New CGA Logo, 1948 – 1968
(Courtesy of: Compressed Gas Association, Inc.)

Cylinder Plant, World War II
(Courtesy of: Taylor-Wharton International, LLC)

War Time Regulations

Over the course of the war, the Office of Defense Transportation (ODT) issued several orders meant to ensure the effective movement of war supplies, troops, and essential civilians. The first orders, issued in 1942, increased the minimum freight rates, allowed government control of buses and other large transport vehicles, eliminated the shipment of less-than-capacity truck loads, stopped local delivery services, and granted the ODT control of the movement of tank cars and grain shipments. Subsequent orders issued in 1943 altered the requirements for loading of hazardous goods, limited motor truck mileage, and mandated tank car unloading within 24 hours after arrival at a destination.

CGMA proposed an exemption to the ODT orders, which would provide for the expedited return of empty cylinders, which were not being returned fast enough to be refilled for the war.

New Regulations for Transportation

The "cryogenic revolution" brought with it the need for many new standards for equipment and safe operating procedures, and spawned the development of new ICC regulations for highway and rail transportation of gases in refrigerated liquid form. CGMA and its member companies participated in efforts to promote safety in the use of the new liquid technology.

In 1945, the Senate proposed a draft bill, S-1290, which provided the ICC with enforcement authority for all violations of transport of dangerous articles by common, contract, and private carriers; gave ICC permission to engage in unannounced inspections of facilities producing dangerous articles; terminated the services of the BOE and the Committee on Tank Cars; expanded the regulatory requirements to all interstate and intrastate transport; and allowed the development of rules, regulations, and exemptions without hearing or notice. CGMA was wholly opposed to the bill and was authorized to hire legal counsel to negotiate more reasonable requirements for the industry.

Later, CGMA funded a $12,000 study of the ICC Regulations, employing additional staff to complete a thorough review of the regulations and oversee the committees' development of proposals for new or revised regulations.

1962 Tube Trailer *(Courtesy of: Air Products and Chemicals, Inc.)*

Modern Tube Trailer *(Courtesy of: Matheson)*

Publication Library Established

While many industry positions and papers were published in CGA's early years, CGMA began work to establish a full publication library in 1949, with the development of C-1, *Methods for Hydrostatic Testing Compressed Gas Cylinders*, G-1, *Acetylene*, P-1, *Safe Handling of Compressed Gases*, and P-2, *Characteristics and Safe Handling of Medical Gases*.

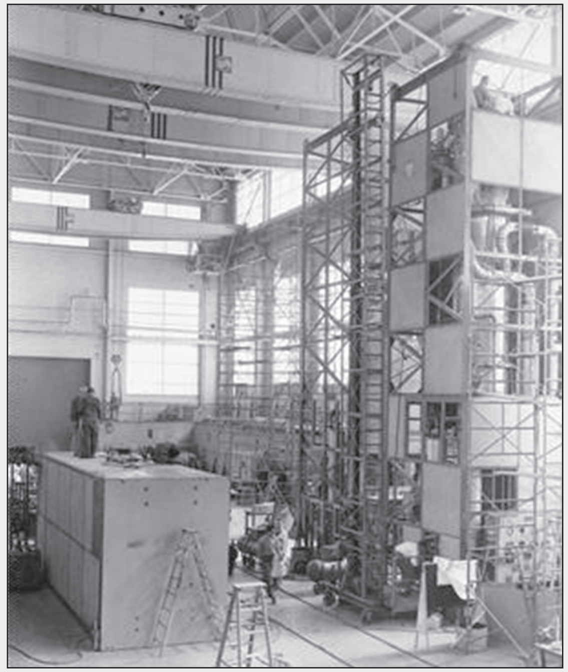
CGA's publications are a cornerstone of the Association; serving to provide safety information to anyone handling compressed gases or compressed gas equipment. These publications also represent the industry's positions to regulators and code developers, supporting the industry's goal of supplying technically sound information to promote self-regulation.

The publication library has continued to grow, and now holds over 300 publications, position statements, safety alerts, safety bulletins, technical bulletins, videos, and other items.

A Major Production Breakthrough: On-Site Production of Liquid Oxygen

In 1940, a new company called Air Products, Inc., entered the industrial gas business and helped to bring about a significant transformation in the traditional method of transporting industrial gases to market.

Prior to this time, the major industrial gas producers manufactured gases at large, centralized plants. From there, the products were distributed to customers by highway or rail.



75 Ton Per Day Plant Construction, Circa 1956
(Air Products, 1956)

Leonard Parker Pool, a salesman for a major industrial gas producer, decided there had to be a better way.

Recognizing that the costs of packaging and transportation exceeded the cost of the product itself, Pool founded Air Products in 1940 with the aim of manufacturing a relatively small and inexpensive oxygen generator that could be constructed adjacent to a user's facility, eliminating the high costs of packaging and transportation.

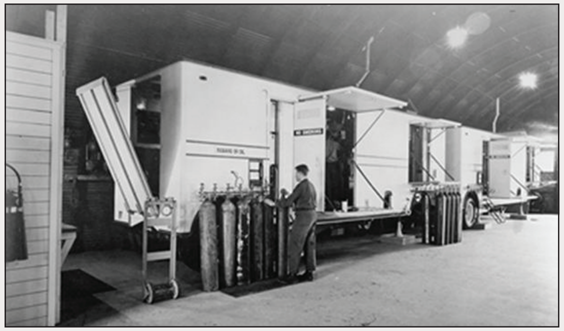
The key to making his idea work was to design a new low pressure liquid oxygen pump. This was soon developed, and the company installed its first on-site plant at the Rotary Electric Steel Company in Detroit, Michigan in 1942, only months after the United States entered World War II.

The timing of Air Products' development of on-site oxygen production technology was fortuitous, for the company was soon to receive contracts from the government for trailer-mounted oxygen plants, which could be used in the war efforts in Europe and the South Pacific, a business that lead to the production of 240 mobile oxygen and nitrogen plants for the military during World War II.

Compressed Gases: Everyday Use

Propane as a Cooking Fuel

Annual propane sales exceeded the billion gallon mark by 1945 when post World War II industrial development brought about propane's golden age. Two years later, 62 percent of all U.S. homes were equipped with either natural gas or propane for cooking and the first propane transport tanker was launched.



Mobile Oxygen Generators Used by the U.S. Navy to Fill Cylinders *(Courtesy of: Air Products and Chemicals, Inc.)*

Oxygen Units for Corps of Engineers, Circa 1957
(Courtesy of: Air Products and Chemicals, Inc.)

1955 Mobile Oxygen and Nitrogen Semi-Trailer
(Courtesy of: Air Products and Chemicals, Inc.)

The Transistor Fuels the use of Specialty Gases

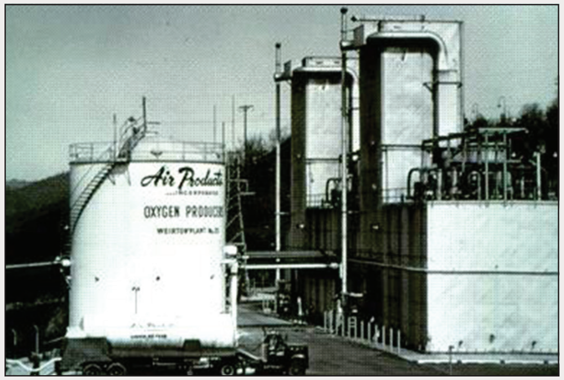
In 1947, one of the most important electronic inventions of the modern era, the point-contact transistor and semiconductors, became a critical part of modern electronic devices. Specialty gases saw a surge in growth, as they are critical to the process of semiconductor manufacturing. Producing an integrated circuit requires over 30 different process gases for etching, deposition, oxidation, doping, and inerting applications. Transistors made the development of many of the smaller and cost effective devices like radios, calculators, and computers. The range of gases used in the electronics segment is broader than in virtually any other industry.

Increase in Steel Production

As American steel companies worked to increase their production efficiency, they began to use oxygen to blow through molten pig iron to lower the carbon content of the resulting steel. This change reduced capital costs of the steel plants, lowered the time of smelting, and increased labor productivity. Furnaces using an open hearth design produced steel from 350 tons of iron in 10 – 12 hours; those using oxygen furnaces could convert the same amount to steel in less than 40 minutes.

By the late 1940s, larger capacity air separation plants became common place to serve the needs of steel companies. Modern air separation plants can range from very small (1 to 5 tons of product per day) to very large tonnage plants (exceeding 4000 tons of product per day).

After the war, American steel companies began increasing their use of oxygen to increase production efficiency, and in 1947, Air Products received a contract from National Steel Corporation for a 400-ton-per-day oxygen plant at the company's Weirton Steel facility. It was not to be long before other U.S. companies began using the new onsite production technology.



First Oxygen on Site Plant at Weirton Steel in 1951
(Courtesy of: Air Products and Chemicals, Inc.)

During the decades that followed, steel and other industries rapidly increased their use of onsite plants to supply ever larger quantities of oxygen, nitrogen, hydrogen, carbon monoxide, and other industrial gases.

In the early 1950s, CGA published G-4, *Oxygen*, which provided information about the properties, manufacture, usage, storage, and handling of oxygen.

Improvements to Compressed Gas Equipment

Standardization of Cylinder Valves

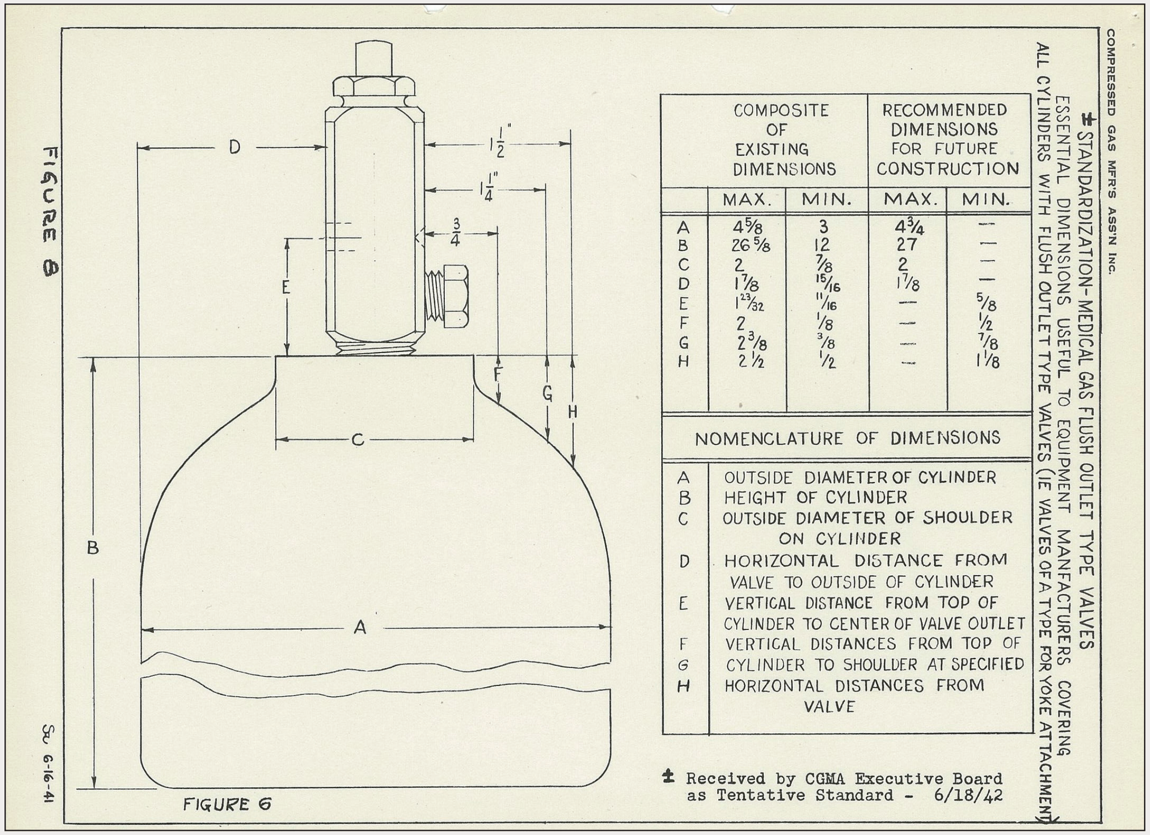
Through the activity of the Gas Cylinder Valve Thread Committee of CGMA, substantial progress was made through the years that followed and, when the United States became involved in World War II, the gas industry materially improved this situation. The compressed gas industry achieved virtual standardization at tremendous cost for replacement of valve equipment. Their standards, however, were not completely formalized nor fully coordinated with other related standards. Much of the progress between World War I and World War II was the result of interest in this problem by the Federal Specifications Board.

The circumstances surrounding industrial and military users of compressed gases during World War II brought into clear focus the need for acceleration of the standardization project for cylinder valve needs. They created not only the necessity but also an opportunity for the compressed gas industry, the military services, and other federal agencies to study cooperatively the standardization problems of valve outlet threads. These studies resulted in closer definition and appreciation of each valve outlet and a more balanced relationship between the many types and sizes.

When the standards associations representing Great Britain, Canada, and the United States met in Ottawa in October 1945 to consider unification of screw threads, a fairly well-developed plan for standardization of compressed gas cylinder valve threads was presented to the Conference by the Valve Standardization Committee of CGMA. These proposed standards represented the experience and knowledge of compressed gas manufacturers and the needs and requirements of varied users of gas cylinder valves, including the military services and other federal agencies. Approval of these standards to the extent to which they were then developed was given by the U.S. Department of Commerce, the U.S. Army, and the U.S. Navy through the Interdepartmental Screw Thread Committee following a joint meeting with the representatives of CGMA in July 1945. Much progress was made later in that year at the Canadian Section Meeting of CGMA, unifying United States and Canadian practices. During January 1946, through conference between representatives of the CGMA Valve Thread Standardization Committee and the Interdepartmental Screw Thread Committee in Washington, agreements were reached that resulted in final approval of considerable additional gas cylinder valve thread data for inclusion in the National Bureau of Standards Handbook H-28.

From January 1946 and February 1949, the CGMA Valve Thread Standardization Committee developed its standards sufficiently to present them to the American Standards Association and the Canadian Standards Association (CSA). They were accepted as National Standards for Canada and the United States in 1949, accomplishing an objective established some 30 years before. Since that date, additional connections have been developed and have been included in subsequent editions of the standard. In January 1949, the Valve Thread Standardization Committee became the Valve Standards Committee.

Cylinder Valve *(Courtesy of: Sherwood Valve, LLC)*



1942 CGMA Standard for Medical Gas Valves *(Courtesy of: Compressed Gas Association, Inc.)*

Underwater Breathing Apparatus

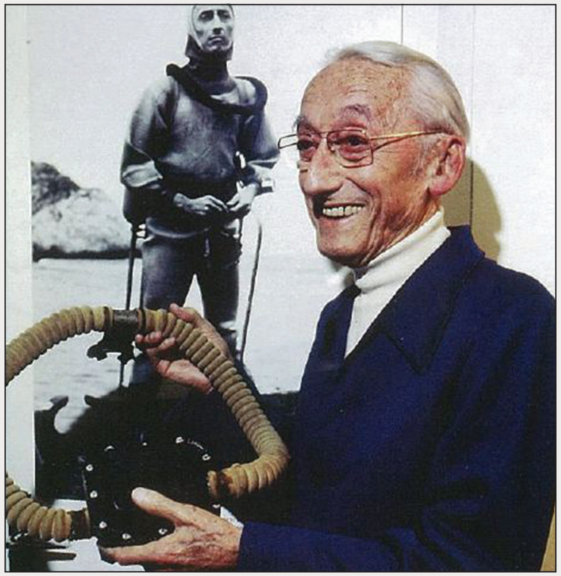
Jacques-Yves Cousteau, Jean Delorme, and Emile Gagnan perfected the demand regulator in 1943, which automatically adjusted the pressure of the air delivered to the diver to match the ambient pressure of the water. As the diver descended, the pressure of air delivered by the regulator automatically increased, and decreased again as the diver ascended. When the prototype was built, Cousteau immediately tested it in a bathtub in Air Liquide's Quai d'Orsay office. In 1946, Air Liquide developed Spirotechnique, which made it possible to breathe safely under water and was later marketed as the Aqua-Lung. The self-contained underwater breathing apparatus (SCUBA) allowed divers to explore the ocean and promoted a new age of underwater discovery.

1958 Aqua-Lung Advertisement
(Courtesy of: American Air Liquide Holdings, Inc.)

Standardization of Cylinder Filling

In 1945, CGMA's Executive Board approved working in cooperation with the United Nations Standards Coordinating Committee to work towards international standards for gas cylinder filling pressures and filling densities. In support of this work, CGMA also initiated a project to develop improved cylinder testing to reveal brittleness or other weakness, and to evaluate protecting cylinders in some gas service with pressure relief devices.

In 1949, the International Organization for Standardization (ISO) formed Technical Committee (TC) 58, Gas Cylinders, to standardize gas cylinders, their fittings, and characteristics related to their manufacture and use. CGA has coordinated the U.S. response to ISO TC 58 since the committee was organized.



Jacques Cousteau with Demand Regulator in 1943
(Courtesy of: American Air Liquide Holdings, Inc.)

Lighter Weight Cylinders

As the use of aircraft increased toward the end of WWI, there was an urgent need for small, lightweight oxygen cylinders for oxygen breathing equipment. Harrisburg Pipe and Pipe Bending Company developed a 208 cubic inch chrome-steel cylinder that withstood a 4000 lb. pressure test and weighed only seven pounds. It was the first alloy steel cylinder ever made.

In 1945, CGMA worked to develop a specification and prototype for single trip non-refillable containers limited to 1 lb. of gas capacity for medical use.

Over the years, improvements were made to reduce the weight of compressed gas cylinders by adopting higher strength steels, and annealing or heat treating, which allowed for higher storage pressures and thinner walled containers. The mild steels used in the first high pressure cylinders were soon replaced by high carbon steels. These were later replaced by manganese steels and chrome molybdenum steels.

1960 Large Extrusion Press, England *(Courtesy of: Luxfer Gas Cylinders USA)*

1951 – 1960: The Storage and Transportation Revolution

Incident Prevention: CGA Publishes Cylinder Connection Safety Systems

Pin Index Safety System

The first Pin Index Safety System for noninterchangeable "yoke-type" medical gas cylinder connections was developed and incorporated into CGA Standard V-I in 1953.

The Pin Index Safety System uses geometric features on the yoke to ensure that connections between a gas cylinder and a machine that uses pressurized gases are not connected to the wrong gas yoke. Each gas cylinder has a unique pin configuration to fit its respective gas yoke.

Diameter Index Safety System

First published in 1959, CGA V-5, the Diameter Index Safety System was developed by CGA to meet the need for a standard for noninterchangeable connections where removable exposed threaded connections are employed in conjunction with individual gas lines of medical gas administering equipment at pressures of 200 psi or less.

This system provided for the first time an industry-wide design standard for low pressure medical gas connections to outlets of medical gas regulators, and connections for anesthesia, resuscitation and therapy apparatus. For all medical gases and suction connections (except oxygen), noninterchangeable indexing is achieved by a series of increasing and decreasing diameters. This standard, as first published in 1959, allowed for 12 noninterchangeable connections. It was revised in 1978 to include eight new connections.

The Space Race and The Cold War: Influence on Compressed Gases

The Helium Resurgence

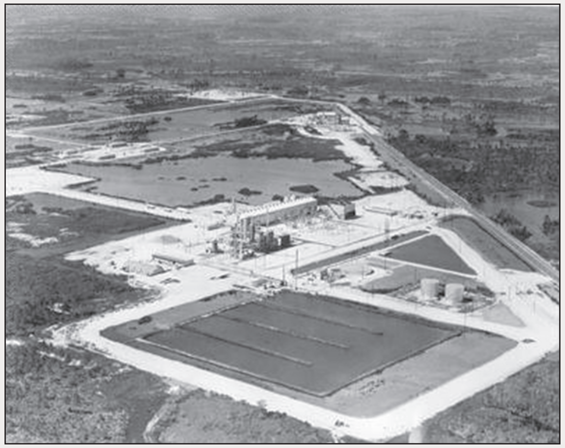
In the 1950's, after a decline in use following World War II, helium again regained popularity as a coolant to create oxygen/hydrogen rocket fuel for the Space Race and the Cold War.

The U.S. Bureau of Mines passed the Helium Act Amendments of 1960, which arranged for a helium conservation program and allowed 5 private plants to recover helium. The Bureau built a pipeline to connect those plants with the government's partially depleted field near the Federal Helium Reserve. Some of this helium was used for NASA's space program and other research opportunities; the rest was injected into the Federal Helium Reserve.

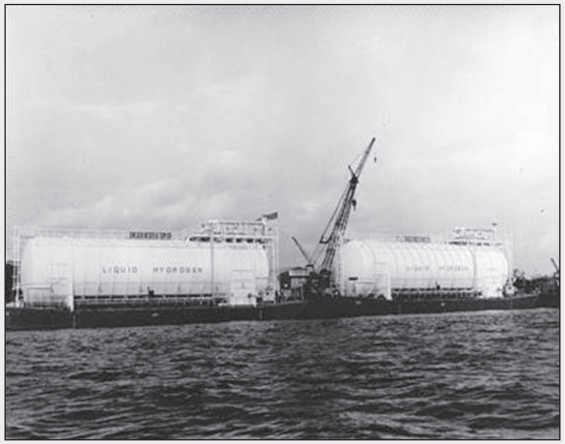
Liquid Hydrogen Advances

At the end of the 1950's, Air Products built the first commercial-sized plant for the production of liquid hydrogen to serve the fuel needs of the U.S. space program, and trailers were needed to transport the product at -423 degrees Fahrenheit. By 1960, the company had designed, built, and shipped the first four 7,000 gallon liquid hydrogen trailers to the U.S. Air Force. Later trailers would be capable of transporting up to 14,000 gallons of liquid hydrogen. To further meet the needs of the U.S. space program, special ocean-going barges with capacities as high as 250,000 gallons of liquefied gas were designed to transport liquid oxygen and liquid hydrogen along the Intra-Coastal Waterway.

1965 Liquid Hydrogen Delivery to US Army Marshall Flight Center *(Courtesy of: Air Products and Chemicals, Inc.)*



1960 Air Force Liquid Hydrogen Plant
(Courtesy of: Air Products and Chemicals, Inc.)



Barges with Liquid Hydrogen for NASA Delivery
(Courtesy of: Air Products and Chemicals, Inc.)

NASA Space Shuttle Hydrogen Delivery
(Courtesy of: Air Products and Chemicals, Inc.)

Growth of the Food Freezing Industry

The 1950s saw significant growth in the restaurant industry, particularly in the areas of fast food and other franchised restaurants. As restaurant chains began to expand throughout the U.S., and even overseas, maintaining consistency became a priority. Many of these restaurants began to produce processed foods in order to develop a consistent product for the customer, which resulted in the significant growth of food freezing practices.

The compressed gas industry worked to develop specific freezing methods and equipment in response to the new market growth. Nitrogen use surged, and continued to grow for the decades to come.

Hamburger Freezing
(Courtesy of: American Air Liquide Holdings, Inc.)

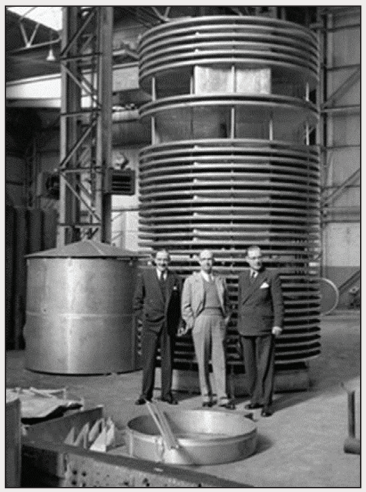
Strawberries Exiting Tunnel Freezer
(Courtesy of: Air Products and Chemicals, Inc.)

A New Method for Air Separation

For decades, air separation relied on cryogenic technology, and advancements focused on the storage, transport, and production of cryogenic product. In the 1950s, Praxair introduced new non-cryogenic air separation methods. These systems carried out air separation at ambient temperatures using pressure swing adsorption (PSA) and membranes for nitrogen production, vacuum swing adsorption (VSA) for oxygen production, and catalyst-based oxygen removal systems for nitrogen purification.

Non-cryogenic air separation would not become popular until the 1980s, when Air Liquide, British Oxygen, Linde, and Air Products all began to develop non-cryogenic technologies, realizing the value of these small units that could produce small quantities of gas more cheaply than air separation plants.

Air Separation Plant *(Courtesy of: Praxair, Inc.)*



Column Trays Built by Hughes and Lancaster, August 1956
(Courtesy of: Air Products and Chemicals, Inc.)

New Transportation Opportunities

Industrial Gas Pipelines Emerge

During the 1950's and 60's, the steelmaking, chemical, petroleum, petrochemical, electronics, and aerospace industries were rapidly increasing their demands for industrial gases. As these industries were often grouped together geographically, industrial gas suppliers began constructing major gas-producing facilities and distributing gases to multiple customers by pipeline network.

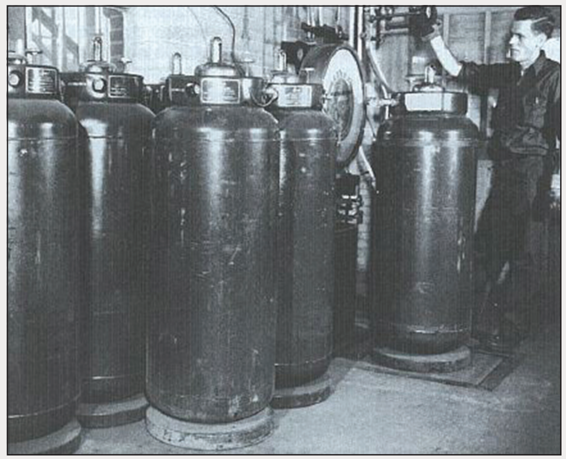
The first such pipeline was built by Union Carbide's Linde Division and went into service in 1950 linking the company's East Chicago, Indiana complex with Inland Steel's facility at Indiana Harbor. These oxygen and nitrogen pipelines would later link three Union Carbide plants to a half dozen steel mills, and a number of metal fabricating plants, chemical plants, and refineries.

Pipeline distribution of industrial gases in the Southwest was pioneered by Harry K. Smith, Big Three Industries, with a four-mile pipeline serving a dozen customers in the Houston area in 1952. This was followed by a major pipeline constructed along the Houston Ship Channel in 1969. By 1986 when L'Air Liquide purchased Big Three Industries, the company had become the fifth largest industrial gas manufacturer in the U.S., with more than 1,000 miles of industrial gas pipelines.

Gulf Coast Pipeline Facility *(Courtesy of: Praxair, Inc.)*

First Cryogenic Cylinders

One of the most significant developments during the 1950's was the introduction of the first vacuum/powder-insulated "cryogenic" cylinders, which permitted the delivery of liquefied oxygen and other industrial gases within local markets. The first of these was the LINDE LC-3 liquid oxygen cylinder, developed in the mid-1950's, which made it possible to store in liquid form the volume equivalent of twelve "K" size gas cylinders.



Linde LC-3 Cylinders *(Courtesy of: Union Carbide Corporation)*

1961 – 1970: A New Era of Regulation

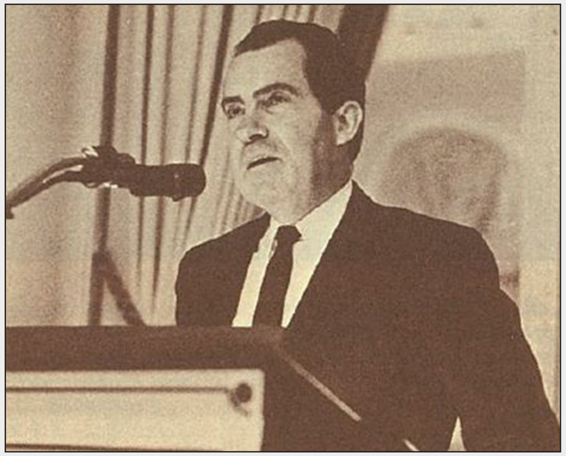
CGA: Advancing with the Industry

As member companies worked to meet increasing production demands for liquid helium, hydrogen, nitrogen, and oxygen to supply gases for use in government missile and space exploration programs, CGA also began to grow and change with technology.

In 1961, CGA sponsored a panel discussion at the Annual Meeting regarding the use of electronic computers to control processes. In 1963, CGA would collect available safety training videos from members to establish the first video library, allowing other members to rent training videos for a fee.

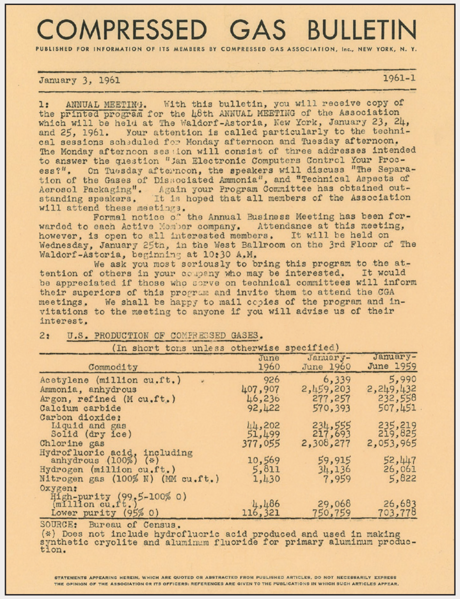
Early in the 1960s, CGA's office moved to 500 Fifth Avenue, New York, New York, a space with larger conference areas in order to accommodate the growing committees. In 1962, CGA was reorganized into divisions of specific technical subjects. The CGA Canadian Section was reformed as a division rather than a fully separate section. A year later, the International Acetylene Association was consolidated into CGA. In 1967, committee members were classified as "voting" or "corresponding" for the first time in order to determine who on a committee held the right to approve or disprove changes to CGA positions. By the end of the decade, individual publications were assigned to specific committees so they could be reviewed and revised more regularly.

In honor of the Association's 50th Anniversary, CGA also launched a marketing campaign, featuring a brochure titled "Compressed Gas Association, Inc.: Past, Present, Future", followed by the development of a new tagline "Strength in Industry is in Unity." The marketing efforts were used to increase regulatory agency awareness of the CGA and its efforts, culminating in a keynote speech from former Vice President of the United States, Mr. Richard M. Nixon, at the 1966 CGA Annual Meeting. In 1968, CGA would release a new logo, which would remain as the symbol of the Association for the next 45 years.



Vice President Nixon Speaks at 1966 CGA Annual Meeting
(Courtesy of: Compressed Gas Association, Inc.)

CGA Logo 1968 – 2013
(Courtesy of: Compressed Gas Association, Inc.)



COMPRESSED GAS BULLETIN

PUBLISHED FOR INFORMATION OF ITS MEMBERS BY COMPRESSED GAS ASSOCIATION, Inc., NEW YORK, N. Y.

January 3, 1961 — 1961-1

1: ANNUAL MEETING. With this bulletin, you will receive copy of the printed program for the 48th ANNUAL MEETING of the Association which will be held at The Waldorf-Astoria, New York, January 23, 24, and 25, 1961. Your attention is called particularly to the technical sessions scheduled for Monday afternoon and Tuesday afternoon. The Monday afternoon session will consist of three addresses intended to answer the question "Can Electronic Computers Control Your Process?". On Tuesday afternoon, the speakers will discuss "The Separation of the Gases of Dissociated Ammonia", and "Technical Aspects of Aerosol Packaging". Again your Program Committee has obtained outstanding speakers. It is hoped that all members of the Association will attend these meetings.

Formal notice of the Annual Business Meeting has been forwarded to each Active Member company. Attendance at this meeting, however, is open to all interested members. It will be held on Wednesday, January 25th, in the West Ballroom on the 3rd Floor of The Waldorf-Astoria, beginning at 10:30 A.M.

We ask you most seriously to bring this program to the attention of others in your company who may be interested. It would be appreciated if those who serve on technical committees will inform their superiors of this program and invite them to attend the CGA meetings. We shall be happy to mail copies of the program and invitations to the meeting to anyone if you will advise us of their interest.

2: U.S. PRODUCTION OF COMPRESSED GASES.

(In short tons unless otherwise specified)

Commodity	June 1960	January-June 1960	January-June 1959
Acetylene (million cu.ft.)	926	6,339	5,990
Ammonia, anhydrous	407,907	2,459,203	2,249,432
Argon, refined (M cu.ft.)	46,236	277,257	232,558
Calcium carbide	92,422	570,393	507,451
Carbon dioxide:			
Liquid and gas	44,202	234,555	235,219
Solid (dry ice)	51,499	217,693	219,825
Chlorine gas	377,055	2,308,277	2,053,965
Hydrofluoric acid, including anhydrous (100%) (*)	10,569	59,915	52,447
Hydrogen (million cu.ft.)	5,811	34,136	26,061
Nitrogen gas (100% N) (MM cu.ft.)	1,430	7,959	5,822
Oxygen:			
High-purity (99.5-100% O) (million cu.ft.)	4,486	29,068	26,683
Lower purity (95% O)	116,321	750,759	703,778

SOURCE: Bureau of Census.
(*) Does not include hydrofluoric acid produced and used in making synthetic cryolite and aluminum fluoride for primary aluminum production.

STATEMENTS APPEARING HEREIN, WHICH ARE QUOTED OR ABSTRACTED FROM PUBLISHED ARTICLES, DO NOT NECESSARILY EXPRESS THE OPINION OF THE ASSOCIATION OR ITS OFFICERS; REFERENCES ARE GIVEN TO THE PUBLICATIONS IN WHICH SUCH ARTICLES APPEAR.

1961 Compressed Gas Bulletin
(Courtesy of: Compressed Gas Association, Inc.)

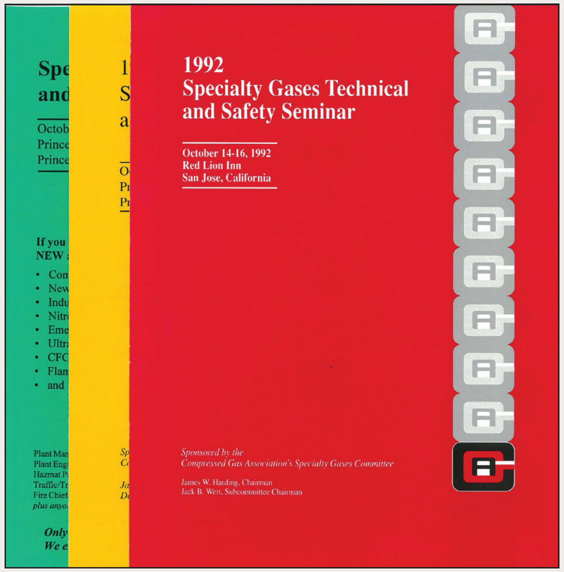
CGA Introduces Safety Seminars

Early CGA Annual Meetings featured a symposium of papers on a given topic, and were a precursor to more extensive CGA Safety Seminars. Since the 1960s, CGA has hosted a number of safety seminars, where members provided presentations of technology advances, industry incidents, test results, and general safety information.

The first CGA safety seminar, the Air Separation Plant Safety Symposium, was held on October 16 – 17, 1962 with over 100 participants. Early seminars covered distributor safety and air separation plants. Throughout the 1970s, the seminar roster was expanded to include a joint distributor safety seminar between CGA and NWSA, oxygen compressors and pumps symposium, and a specialty gases technical information and safety seminar. In later years, CGA committees added the industrial gases and related products seminar, a symposium on driver safety and operations, an acetylene safety and industrial gases apparatus seminar, a cylinder fill plant safety seminar, and a hydrogen safety seminar were added.

Today's seminars include:

- the Acetylene and Liquefied Petroleum Gas Safety Seminar, produced by the Acetylene Committee and the Liquefied Petroleum Gas Committee;
- the Safety and Reliability of Industrial Gases, Equipment, and Facilities Seminar, produced by the Atmospheric Gases and Equipment Committee;
- the Specialty Gases Technical and Safety Seminar, produced by the Specialty Gases Committee; and
- the Cylinder Requalification Operations Seminar, produced by the Cylinder Specifications Committee.



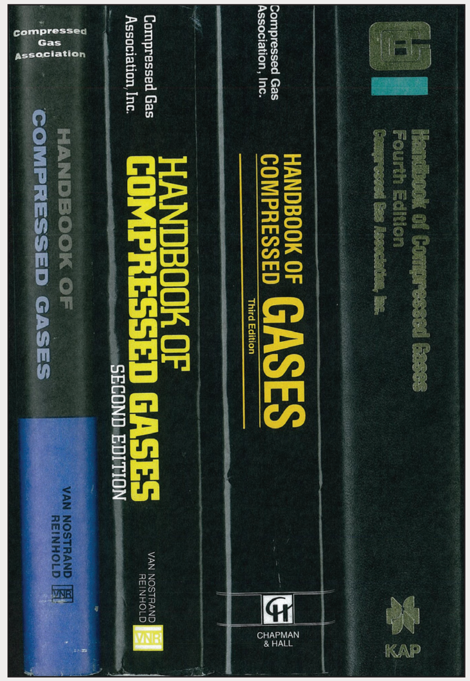
1990's CGA Specialty Gases Seminar Programs
(Courtesy of: Compressed Gas Association, Inc.)

2010 Acetylene and Liquefied Petroleum Gas Safety Seminar
(Courtesy of: Compressed Gas Association, Inc.)

CGA's Handbook of Compressed Gases

More than forty years of work by CGA technical committees went into the first edition of the *Handbook of Compressed Gases*, which was published in 1966, offering for the first time comprehensive information on compressed gases, as well as equipment specifications, and procedures for the safe handling, storage, transportation, and use of these products.

After extensive review and revision efforts by CGA's committees, the fifth edition of the *CGA Handbook of Compressed Gases* will be published in 2013. For the first time, the Handbook will be made available in an electronic format as well as via hardcopy to members and customers.



CGA Handbooks *(Courtesy of: Compressed Gas Association, Inc.)*

A Regulatory Shift

Enhancements to Transportation Regulations

Early in 1961, the ICC issued a notice announcing changes to regulations for the transportation of explosives and other dangerous articles. The proposed changes to the regulations were developed through the cooperative efforts of the American Petroleum Institute, the Liquefied Petroleum Gas Association, the Manufacturing Chemists' Association, the National Tank Truck Carriers, Inc., and CGA. These recommendations were accepted with some modifications in June 1961.

Later in the year, the Board of Transport Commissioners for Canada issued regulations pertaining to the piggy-back transportation of dangerous commodities in cargo tanks, which included some requirements for the transport of compressed gases developed by CGA.

In 1962, CGA worked with the U.S. National Bureau of Standards to develop a specification for insulated portable tanks intended for the shipment of low temperature liquid argon, nitrogen, and hydrogen. This work was followed by an effort to develop new regulations for the transportation of bulk dangerous cargo by water, which were completed in cooperation with the U.S. Coast Guard in 1965.

CGA worked jointly with the Railway Progress Institute and the Association of American Railroads to establish and fund the Tank Car Research Committee in 1970. The Committee was responsible for reviewing many aspects of tank and appurtenance design, and providing recommendations for regulatory updates when needed.

In addition, CGA worked with the National Liquefied Petroleum Gas Association, the Agricultural Nitrogen Institute, and the National Tank Truck Carriers to promulgate research and data collection to support industry regulatory requests related to various transportation issues.

A New Regulatory Body

On October 15, 1966, the U.S. Department of Transportation (DOT) was established by Congress to ensure a fast, safe, efficient, accessible, and convenient transportation system that meets the vital national interests and enhances the quality of life of the American people.

In the next year, all BOE dockets related to CGA work efforts were transferred to the DOT. Over the next 15 years the transportation regulations were substantially rewritten and expanded, which required a sustained effort by CGA to ensure that the regulations were feasible for the industry and consistent with other regulatory requirements.

Railcar *(Courtesy of: Chart Industries, Inc.)*

Medical Gases as a Separate Drug Item

In 1967, CGA initiated a program of cooperation with the United States Pharmacopoeia (USP) to develop medical product specifications. The first prepared was the Nitrous Oxide Specification, which was submitted to the USP as a sample in hope that similar specifications could be developed and used for compressed gases.

Research and Informative Efforts

In order to evaluate porous filling material for use in acetylene cylinders, CGA completed testing and data collection in both the U.S. and Canada. The resulting recommendations were forwarded to the BOE, where they were approved and sent for inclusion in the ICC regulations.

The Association also worked with the Cryogenic Data Center of the National Bureau of Standards to publish a compilation of standard density data for atmospheric gases and hydrogen.

In 1968, CGA entered a joint sponsorship with the National Bureau of Standards to conduct research in the field of cryogenic fluid flow measurement.

Early Oxygen Walker
(Courtesy of: Praxair, Inc.)

New Delivery Mechanisms

Medical Gases on the Move

Developed in 1960 by Union Carbide for use in combat aircraft, the "Linde Oxygen Walker" and similar portable oxygen systems were available from a number of medical gases suppliers. The widespread use of portable liquid oxygen systems for the treatment of respiratory and cardiac patients permitted many patients to resume normal activities which would otherwise be impossible.

Continued Advancement in Liquid Transport

The use of helium grew rapidly in the 1960s and 70s. As a result, transport vehicles had to be designed that could maintain the liquid helium at -452 degrees Fahrenheit. The first such transport, with a capacity of 5,000 gallons, was built by Union Carbide's Linde Division in 1958. In 1960, Air Products delivered to the U.S. Navy what was then the world's largest helium liquefier.

In 1968, the first liquid nitrogen-shielded bulk container for overseas shipment of liquid helium was built by Cryenco and delivered to Airco for service in Japan. This container had a capacity of 8,500 gallons of liquid helium (equivalent to 850,000 cubic feet of helium gas), and was capable of maintaining the liquid helium at -452 degrees Fahrenheit for thirty days. Air Products and Chemicals, Inc. began making bulk containers for shipment of liquid helium to Europe and Japan in 1970.

First Liquid Helium Shipment to Japan, 1970
(Courtesy of: Air Products and Chemicals, Inc.)

Development of the FTSC Code

With the growth of the electronic, chemical, and other high technology industries within the past 15-20 years where new gases were developed, the need to classify all gases became a reality. In the 1960s, the FTSC Code was developed, which categorized the fire potential, toxicity, state of the gas, and corrosiveness of each gas. New connections were designed to fit into the existing system of noninterchangeable connections. These were tested and then assigned to the new gases or other various groups of gases as needed. A goal of only one standard valve outlet connection for each gas was established. All of these changes appeared in the 1977 edition of V-1.

1971 – 1980: Standardization Becomes a Priority

CGA Efforts to Enhance Safety

Establishing the Leonard Parker Pool Safety Awards

In 1978, CGA established an awards program to recognize improvements in employee safety throughout the industry. Today, several awards are given in continual recognition of employee safety, fleet safety, environmental awareness, and our committee members' dedication to CGA.

Sponsored by Air Products and Chemicals, Inc., and created in 1978, the Leonard Parker Pool Safety Awards were the first such recognition given by CGA. The awards are in memory of Leonard Parker Pool, the founder and former chief executive of Air Products and Chemicals, Inc. The awards are presented annually to the participating CGA member companies that have recorded the greatest improvement in safety performance during the previous two years, and are based upon the total recordable case incidence rates as defined by the Occupational Safety and Health Administration. There are three divisions of the award based on employee exposure hours.

Leonard Parker Pool Award Presentation
(Courtesy of: Compressed Gas Association, Inc.)

The CGA Video Program

In 1978, CGA began the production of several important audiovisual safety training programs. The first of these were published in 1979, including AV-1, *Safe Storage and Handling of Compressed Gases*, and AV-2, *Pre-Trip Inspection of Compressed Gas Tank Cars*. AV-1 debuted at the 1979 Summer Meeting, where it was such an overwhelming success that all 200 copies were sold by the end of the summer.

Today's CGA library contains 8 videos:

- AV-1, Safe Handling and Storage of Compressed Gases;
- AV-5, Safe Handling of Liquefied Nitrogen and Argon;
- AV-7, Characteristics and Safe Handling of Carbon Dioxide;
- AV-8, Characteristics and Safe Handling of Cryogenic Liquid and Gaseous Oxygen;
- AV-9, Handling Acetylene Cylinders in Fire Situations;
- AV-10, Safe Handling and Use of Medical Equipment and Gases in a Homecare Environment; and
- AV-12, Avoiding Medical Gas Mix-ups.

New Training for Committee Leaders

In 1978, CGA held its first Chairman's Meeting with over 50 attendees. The meeting allowed committee chairs to receive training from CGA staff and discuss committee work efforts and common problems.

Today, the CGA Committee Leadership Seminar is held on a bi-annual basis to provide training and discussion opportunities for CGA committee chairs, vice chairs, and participants.

Leonard Parker Pool Safety Award Winners

Year	Group 1	Group 2	Group 3
2011	Air Products and Chemicals, Inc.	Jack B. Kelley, Inc.	ACME Cryogenics, Inc.
2010	American Air Liquide Holdings, Inc.	INO Therapeutics, Inc.	Voltaix, Inc.
2009	Praxair, Inc.	Luxfer Gas Cylinders USA	Acme Cryogenics, Inc.
2008	American Air Liquide Holdings, Inc.	Matheson Tri-Gas	Roberts Oxygen Company, Inc.
2007	Praxair, Inc.	No Winner	Air Liquide America Specialty Gases
2006	BOC North America	Matheson Tri-Gas	Acme Cryogenics, Inc.
2005	American Air Liquide	No Winner	No Winner
2004	Praxair, Inc.	Matheson Tri-Gas	Western International Gas & Cylinders, Inc.
2003	Air Products and Chemicals Inc.	Holox Ltd.	INO Therapeutics
2002	Air Liquide America	No Winner	Western International Gas & Cylinders, Inc.
2001	BOC Gases	Scott Specialty Gases	No Winner
2000	Holox Ltd.	Messer Canada	AMKO Service Company
1999	Praxair, Inc.	No Winner	Matheson Gas Products Canada
1998	MG Industries	Scott Specialty Gases Inc.	Rexarc International Inc.
1997	Air Products and Chemicals, Inc.	National Welders Supply Co. Inc.	Solkatronic Chemicals, Inc.
1996	Air Liquide America Corp.	Holox, Ltd.	Matheson Gas Products Canada
1995	MG Industries	Luxfer, Inc.	SCI Inc.-Taylor Wharton
1994	AGA Gas	Holox, Ltd.	Pressed Steel Tank Co
1993	Airco/BOC Gases	Minnesota Valley Engineering, Inc.	Matheson Gas Products Canada
1992	Praxair Canada, Inc.	Canadian Oxygen Limited	Welsco, Inc.
1991	Liquid Carbonic	AMKO Service Co.	Hydro-Flex, Inc.
1990	Union Carbide Canada Limited Linde	Superior Valve Company	Rexarc International, Inc.
1989	The BOC Group/Airco	Canadian Oxygen Ltd.	AMKO Service Company
1988	Big Three Industries, Inc.	Scott Specialty Gases	Rexarc International, Inc.
1987	Liquid Air Corporation	Canadian Oxygen Limited	Matheson Gas Products Canada Inc.
1986	E.I. Du Pont de Nemours & Co.	Minnesota Valley Engineering, Inc.	Welsco, Inc.
1985	Air Products and Chemicals, Co.	Canadian Cylinders Ltd.	
1984	S.A. White Martins	Air Products DIV. SCL	
1983	E. I. Du Pont de Nemours & Co.	Minnesota Valley Engineering, Inc.	
1982	Airco, Inc.	Sherwood Selpac Corp.	
1981	Air Products and Chemicals	Marison Co.	
1980	Allied Chemical Div. Of Allied Corp.	Virginia Chemical Inc.	
1979	USS Agri-Chemicals	Union Carbide Canada, Ltd.	
1978	Airco, Inc.	Airweld, Inc.	

A New Regulatory Landscape

The Environment Becomes a New Focus

The U.S. Environmental Protection Agency (EPA) was established on December 2, 1970 to consolidate a variety of federal research, monitoring, standard-setting, and enforcement activities to ensure environmental protection. As a result, several regulations were passed in the 1970s and 80s, impacting compressed gas manufacture, transport, and disposal activities:

- The Clean Air Act (CAA) - Enacted in 1970, established ambient air quality standards for specific pollutants, permitting requirements for sources of air pollutants, requirements for programs/plans to prevent and respond to hazardous material emergencies, reporting of greenhouse gas emissions, and an overall reduction and management program for ozone-depleting substances (ODSs).

- The Clean Water Act (CWA) - Created in 1972 and amended in 1977 with the objective to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The three major areas the CWA covers that affect industrial gas facilities are discharges to U.S. waters, pretreatment programs for discharges to public works, and stormwater discharges.
- Safe Drinking Water Act (SDWA) – Originally passed in 1974, the SDWA protects the quality of drinking water in the United States. This law focuses on all waters actually or potentially designed for drinking use, whether from aboveground or underground sources.
- Resource Conservation and Recovery Act (RCRA) –Passed in 1976, amended in 1980, and amended again in 1984 with passage of the Hazardous and Solid Waste Amendments. Portions of RCRA that often apply to the locations of industrial gas companies include: Subtitle C of RCRA, which creates "cradle to grave" responsibility for the generation, transportation, treatment, storage, and disposal of hazardous waste; Subtitle D, which addresses nonhazardous waste management practices; and Subtitle I, which governs underground storage tanks.
- Toxic Substances Control Act (TSCA) –Passed in 1976, establishes a system for identifying and evaluating environmental and health effects of existing chemicals and any new substances entering the U.S. market.
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - Also commonly referred to as Superfund, was enacted in 1980 primarily to provide funding and enforcement authority for cleaning up thousands of hazardous waste sites created in the past and for responding to hazardous substances spills.
- Emergency Planning and Community Right-to-Know Act (EPRCRA) or Superfund Amendments and Reauthorization Act (SARA) Title III - Enacted in 1986, it established numerous reporting requirements for use, storage, and releases of hazardous substances.

New Transportation Regulations

In the 1970s, CGA worked to review and respond to nearly 100 regulatory notices issued by the newly formed DOT. This was a tremendous resource strain for the Association and its committees, and nearly all of the work through the decade was related to various transportation rulemakings.

Among these efforts was the evaluation of a proposal for a completely new Hazard Information System, which would substantially revise labeling, placarding, classification, and paperwork requirements for many hazardous materials. CGA submitted a great number of comments to the initial proposal, and worked cooperatively with the DOT to modify the proposal in a way that was more feasible for the compressed gas industry.

For the next decade, CGA would work to address many more topics relevant to the industry, including:

- extending service life of some cylinders;
- modified specifications for DOT cylinders;
- use of safety relief devices on cylinders and tank cars;
- tank car head shields;
- cargo tank requirements;
- revisions to exemption (special permit) procedures;
- prevention of stress corrosion cracking;
- restrictions to the transport of hazardous materials;
- cylinder qualification requirements; and
- cylinder standardization.

The Transportation Act of 1974 expanded the regulatory authority of DOT and created a new Materials Transportation Bureau (MTB). Under the MTB, the Office of Hazardous Materials Operations (OHMO) and the Office of Pipeline Safety Operations (OPSO) were created to deal with specific areas of transportation. Between 1975 and 1977, CGA worked with DOT representatives to address concerns related to the turnover of top personnel in the agency and to advocate for the resolution of petitions submitted prior to the reorganization.

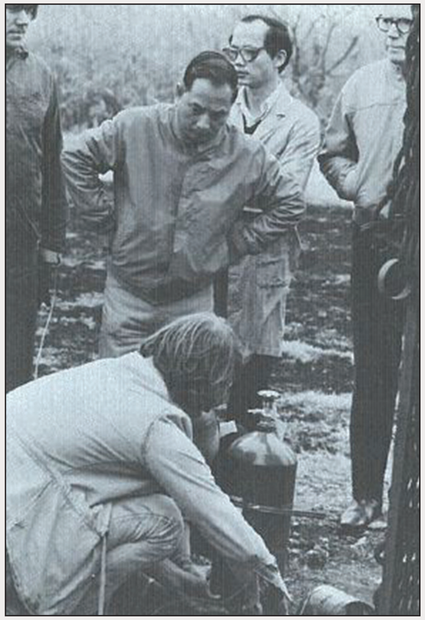
Driver Filling Tanker
(Courtesy of: Air Products and Chemicals, Inc.)

Bulk Trailer *(Courtesy of: Airgas, Inc.)*

Qualifying New Pressure Relief Devices

In 1978, CGA sponsored another series of fire tests at the BOE for the purpose of demonstrating the efficacy of CGA standard S-1.1 for qualifying new pressure relief devices. As a result of these tests, the CGA pressure relief device standards were incorporated by reference in the DOT Hazardous Materials Regulations.

In 1979, CGA's Cylinder Specification and Safety Device Committees completed the development and testing of a standard fire test apparatus to replace the wood bonfire test used by the BOE to test cylinder safety relief devices.



CGA, DOT, and BOE Officials Witness Fire Tests of Pressure Relief Devices, 1978
(Courtesy of: Compressed Gas Association, Inc.)

Working to Address Medical Devices

In 1972, the FDA created the Office of Medical Devices to promulgate requirements for medical devices. CGA entered a cooperative relationship with the new authority to consider proposals for medical device regulations in the fields of anesthesia and respiration.

The Metric Conversion Act

On December 23, 1975, U.S. President Gerald Ford signed the Metric Conversion Act into law. The Act declared the Metric system the preferred system of weights and measures for United States trade and commerce, and established a Metric Board to educate the American people about the Metric system.

In 1980, the Canadian Division published P-11, *Metric Practice Guide for the Compressed Gas Industry*, to aid in CGA's compliance with the Act.

Completion of Cryogenic Fluid Measurement Program

In 1976, the cryogenic fluid measurement program, jointly supported by industry through CGA and by the National Bureau of Standards, was concluded. A final report regarding the performance of the reference standard meters with argon and the field testing was published in 1976.

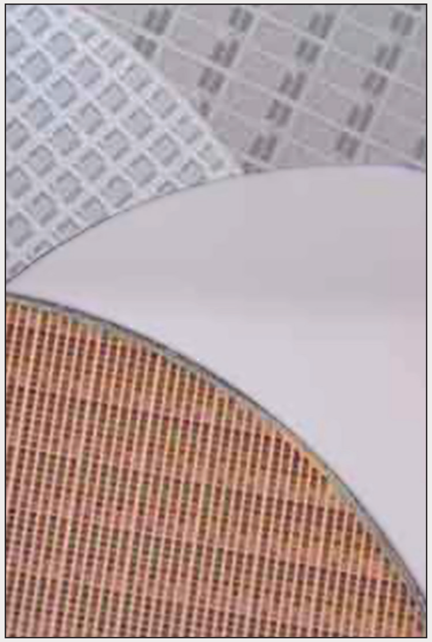
In 1980, members of the newly organized CGA Steering Committee on Flow Measurement held their first meeting at the National Bureau of Standards Laboratory in Boulder, Colorado. The group confirmed plans to modify the NBS facility to include lower flow measurements (down to ½ gallon per minute) and to initiate testing of new flowmeters.

Advanced Uses for Compressed Gases

Silicon Valley Drives the Electronics Era

In the 1970s, California's Silicon Valley rose to prominence, initiating one of the most significant industrial advancements since the invention of the automobile. With the introduction of the electronics industry came a demand for carrier and chemical gases. Nitrogen, the most typical carrier gas, was used in large quantities as a high purity product to protect components. Chemical gases were used directly in the semiconductor manufacturing process.

The semiconductor industry grew quickly in the 1980s, manufacturing smaller and smaller computer chips with an increasing demand for ultra-high purity products. Compressed gas manufacturers raced to develop means for producing the highest purity specialty gases, and to develop new means of contamination prevention. The use of electronic specialty gases would continue to grow as computers and flat-panel monitors gained popularity in the 1990s, the production of electronic specialty gases grew significantly to accommodate the development of new technology. The electronics industry boom would continue through the new millennium, becoming an increasingly important segment of the compressed gas industry.

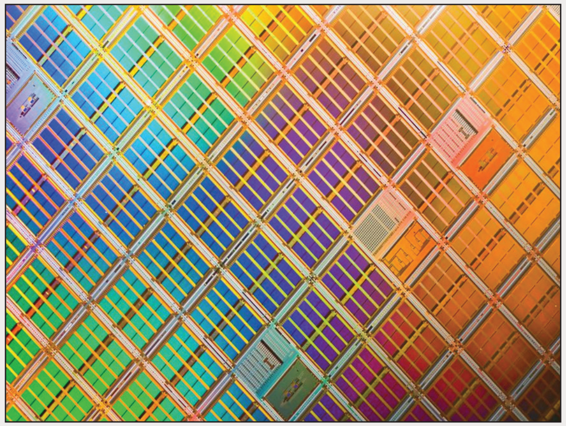


Chips *(Courtesy of: American Air Liquide Holdings, Inc.)*

The Energy Crisis and Specialty Gases

Originally, photovoltaic technology was developed in the 1950s and used in the 1960s for generating electricity onboard space vehicles. During the energy crisis in the 1970s, photovoltaic technology gained recognition as a source of power for domestic applications. This technology, which uses a semiconductor to turn sunlight into electricity, can address increased demands for energy with a renewable, reliable, and clean source. Many local and national governments across the globe initiated programs to increase the understanding and use of photovoltaic power.

Electronic Specialty Gas Distribution Cabinets
(Courtesy of: American Air Liquide Holdings, Inc.)



Wafer *(Courtesy of: American Air Liquide Holdings, Inc.)*

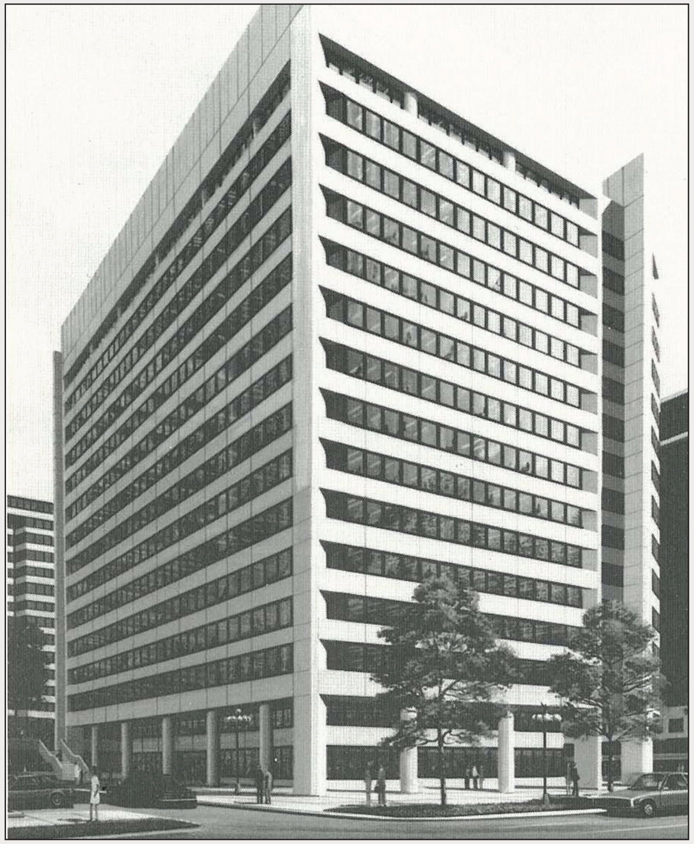
1981 – 1990: Moving Towards Self-Regulation

CGA Moves to Washington

After nearly three-quarters of a century in New York, CGA completed a move to Arlington, Virginia in 1981. The Board and the membership supported the move as a means to be closer to regulators and other major associations. Another big advance for the Association was the installation of the first computer system at CGA headquarters in 1982. Within a year, all CGA staff members were trained to use the computer, and the first electronic lists of CGA members and publications were created.

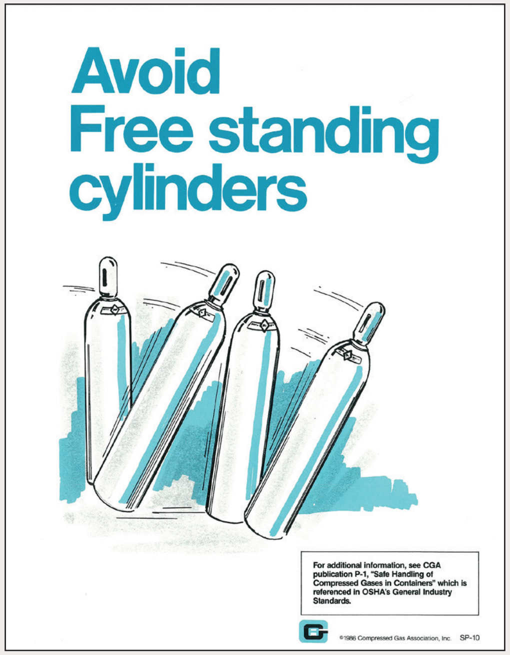
In 1984, CGA staff created and implemented a new system for documentation of reasons for changes to the commodity specification publications. This system was meant to preserve knowledge and demonstrate technical soundness to regulators when requesting changes to existing rulemakings. By the 1990s, reasons for changes were required for all CGA publications, a practice that continues today.

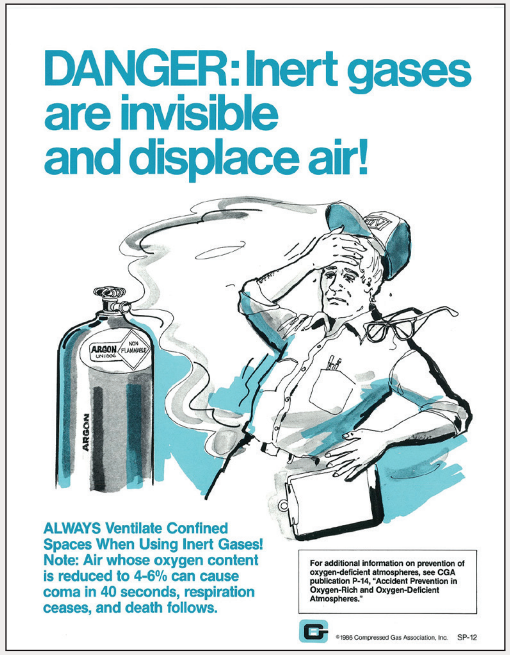
As CGA's publication and regulatory activities expanded, the need for reorganization became clear. In 1985, CGA's Board of Directors approved a new organizational structure to include seven main areas: the Industrial Gases and Related Products Division, the Compressed Gas Division, the Safety Coordinating Division, the Medical Division, the Container and Distribution Division, CGA Canada, and CGA International. Each Division was managed by a Steering Committee, responsible for coordinating work and communication throughout the Division. CGA also published the first safety posters, intended to convey basic safety information, in 1986. In 1989, CGA converted all audiovisual training aids to videotape format to improve access.

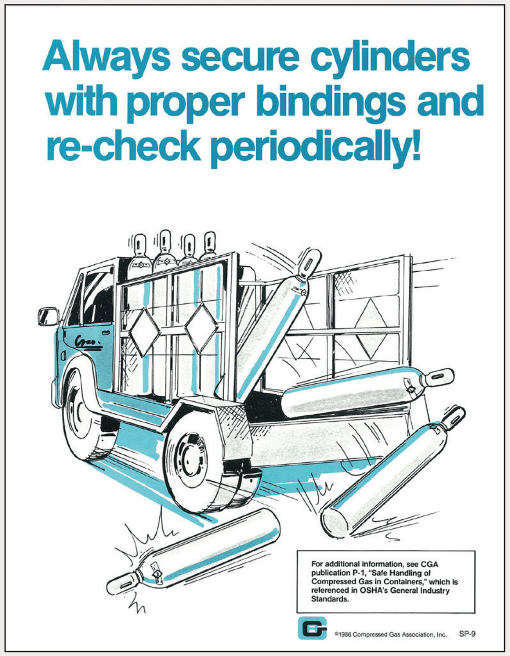


CGA Arlington Office
(Courtesy of: Compressed Gas Association, Inc.)

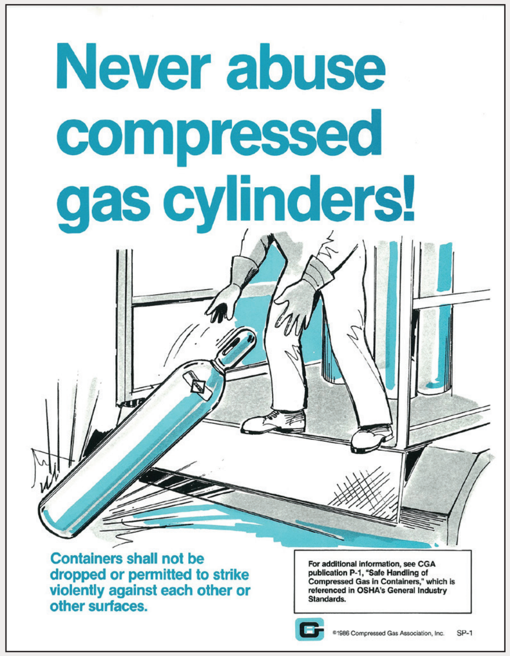

Mislabeling
can be fatal!
NITROGEN
OXYGEN
OXIDIZER
If you're not sure of a cylinder's contents, return it to your supplier at once! Containers not bearing legible written identification of the contents must not be used and must be returned to your gas supplier.
For additional information, refer to CGA publication C-7, "Precautionary Labeling and Marking of Containers," and CGA Safety Bulletin SB-10, "Correct Labeling and Proper Fittings on Cylinders/Containers."
©1986 Compressed Gas Association, Inc. SP-8

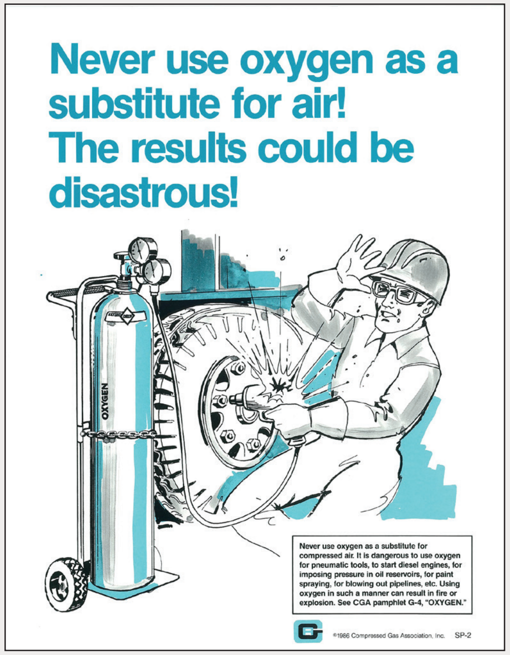

Avoid
Free standing
cylinders
For additional information, see CGA publication P-1, "Safe Handling of Compressed Gases in Containers" which is referenced in OSHA's General Industry Standards.
©1986 Compressed Gas Association, Inc. SP-10

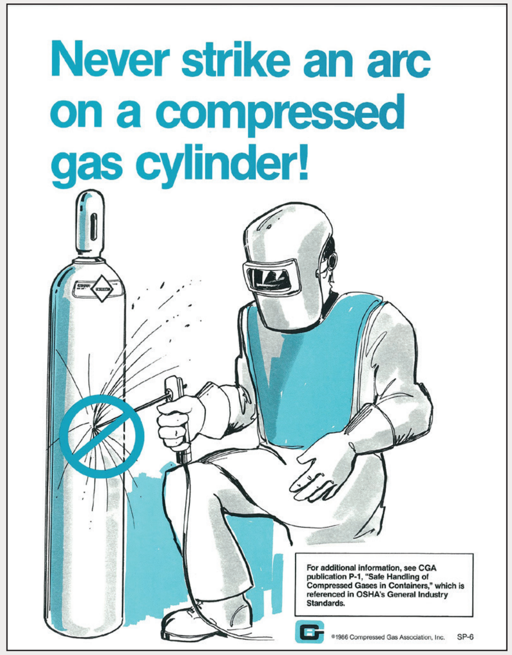

DANGER: Inert gases
are invisible
and displace air!
ARGON
ALWAYS Ventilate Confined Spaces When Using Inert Gases! Note: Air whose oxygen content is reduced to 4-6% can cause coma in 40 seconds, respiration ceases, and death follows.
For additional information on prevention of oxygen-deficient atmospheres, see CGA publication P-14, "Accident Prevention in Oxygen-Rich and Oxygen-Deficient Atmospheres."
©1986 Compressed Gas Association, Inc. SP-12

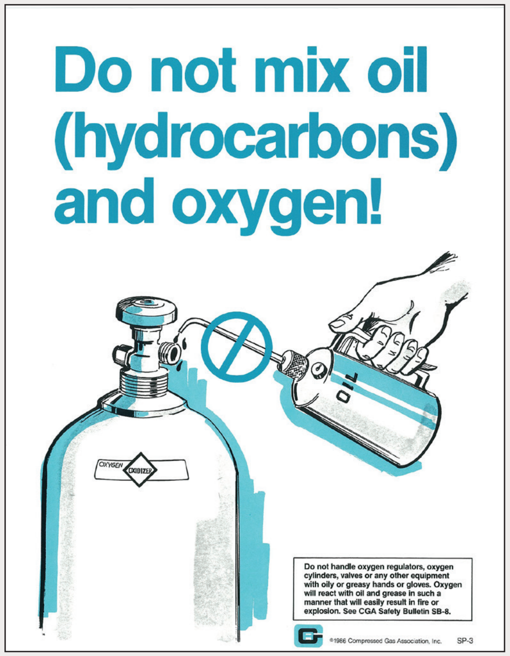

Always secure cylinders
with proper bindings and
re-check periodically!
For additional information, see CGA publication P-1, "Safe Handling of Compressed Gas in Containers," which is referenced in OSHA's General Industry Standards.
©1986 Compressed Gas Association, Inc. SP-9

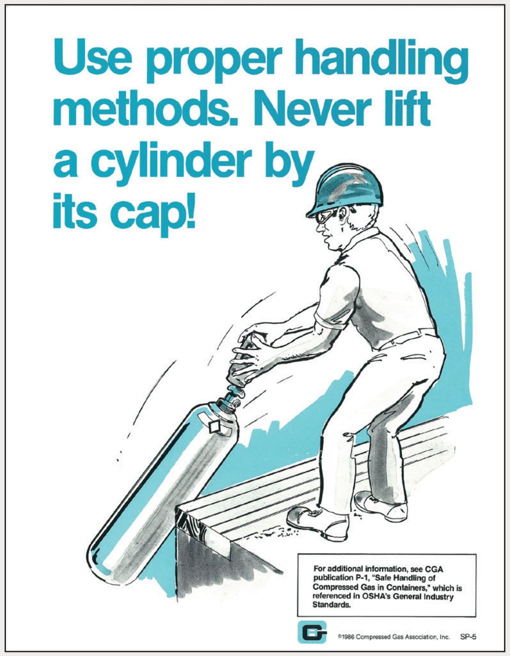

Put your best foot
forward...the one with
foot protection!
For additional information, see CGA publication P-1, "Safe Handling of Compressed Gases in Containers," which is referenced in OSHA's General Industry Standards.
©1986 Compressed Gas Association, Inc. SP-11

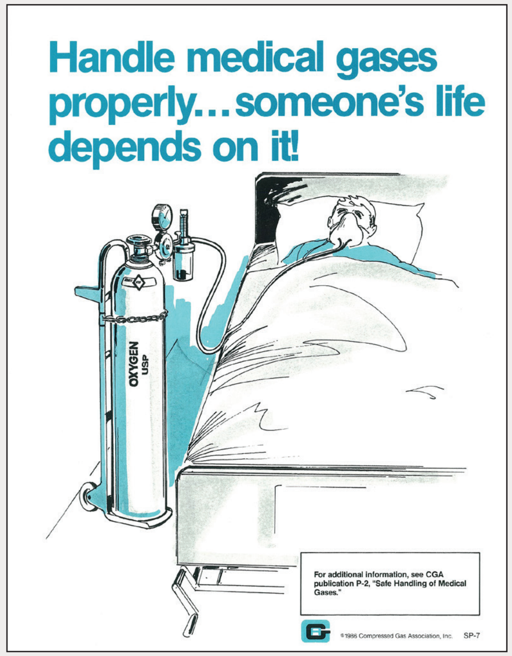

Never abuse
compressed
gas cylinders!
Containers shall not be dropped or permitted to strike violently against each other or other surfaces.
For additional information, see CGA publication P-1, "Safe Handling of Compressed Gas in Containers," which is referenced in OSHA's General Industry Standards.
©1986 Compressed Gas Association, Inc. SP-1











1986 CGA Safety Posters *(Courtesy of: Compressed Gas Association, Inc.)*

CGA 75th Anniversary Logo
(Courtesy of: Compressed Gas Association, Inc.)

CGA 73rd Annual Meeting *(Courtesy of: Compressed Gas Association, Inc.)*

CGA Response to Transport Emergencies

While transportation incidents involving compressed gases are rare, such incidents can pose potential hazards to persons and property and must be handled in a timely and effective manner.

Responsible Care

In 1985, the Canadian Chemical Producers' Association launched the Responsible Care program which was a global initiative among chemical companies to enhance employee health and safety, community awareness and emergency response, and security.

The COMPGEAP Program

Recognizing the need for timely and effective response to transportation incidents involving compressed gases, the members of the CGA maintain a voluntary program of aid in emergencies involving the physical distribution of compressed gases. In order to improve the effectiveness of such emergency response, CGA members established a program of coordinated emergency response known as the Compressed Gas Emergency Action Plan (COMPGEAP) in 1987.

The mission of the COMPGEAP program is to establish a mutual aid network of equipment, personnel, and technical expertise to optimize compressed gas emergency response coverage to protect communities and the environment. The program also serves to enhance safety, competence, and speed of response to compressed gas emergencies during transportation. COMPGEAP covers industrial, medical, specialty, electronic, and cryogenic gases, as well as refrigerated liquids.

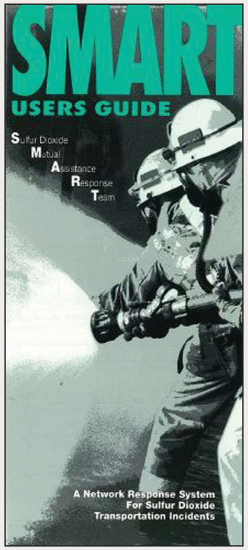
1989 COMPGEAP Patch
(Courtesy of: Compressed Gas Association, Inc.)

CGA's COMPGEAP Committee is responsible for maintaining a manual that contains a plan and operating rules, a signed agreement from all participating companies, training standards, and member resource information. The committee frequently hosts emergency response contractor presentations to learn about available resources and maintain a strong relationship with the emergency response community.

Cooperation with CHEMTREC and CANUTEC

The CGA's COMPGEAP program is conducted in cooperation with the Chemical Transportation Emergency Response Communications (CHEMTREC) network operated by the Chemical Manufacturers Association (now the American Chemistry Council) in the United States, and the Canadian Transport Emergency Centre (CANUTEC) program in Canada. CANUTEC is the national bilingual advisory service provided by Transport Canada to assist emergency response personnel in handling dangerous goods emergencies.

COMPGEAP Salvage Cylinder
(Courtesy of: Air Products and Chemicals, Inc.)



SMART User Guide *(Courtesy of: Compressed Gas Association, Inc.)*

As the CHEMTREC and CANUTEC communications networks operate on a 24-hour, seven-days-a-week basis, COMPGEAP utilizes these agencies to dispatch technical information and assistance to local sites anywhere within the United States and Canada.

In addition, COMPGEAP furnishes CHEMTREC and CANUTEC with location guides showing the locations and telephone numbers of designated COMPGEAP responders. In the event there is need for specially trained personnel and/or equipment at the site, and the shipper authorizes such assistance, a designated COMPGEAP emergency response team is dispatched to the site of the incident to help coordinate emergency response activities in cooperation with local police, fire, healthcare, and other local authorities.

The establishment of the COMPGEAP program is but the latest in a long series of activities conducted by CGA in order to promote safety in the industry, and improves the timeliness and effectiveness of response to distribution incidents involving compressed gases.

Fleet Safety Excellence Awards

Sponsored by Praxair, Inc., the awards were created in 1988 to recognize outstanding safety performance among the industry's bulk and cylinder truck delivery fleets. The award is based on a CGA member company's total Vehicle Accident Frequency Rate. There are four categories for this award, two each for Bulk Vehicle Fleets and Cylinder Vehicle Fleets.

Fleet Safety Excellence Award Presentation
(Courtesy of: Compressed Gas Association, Inc.)

Fleet Safety Excellence Safety Award Winners

Year	Category			
	Bulk under 20M mi	Bulk over 20M mi	Cylinder vehicle fleets under 3M mi	Cylinder vehicle fleets over 3M mi
2011	Western International Gas and Cylinders, Inc.	American Air Liquide Holdings, Inc.	Western International Gas and Cylinders, Inc.	Airgas, Inc.
2010	Western International Gas and Cylinders, Inc.	Airgas, Inc.	Roberts Oxygen Company, Inc.	Airgas, Inc.
2009	Western International Gas and Cylinders, Inc.	Airgas, Inc.	Western International Gas and Cylinders, Inc.	Airgas, Inc.
2008	Western International Gas and Cylinders, Inc.	Praxair, Inc.	Western International Gas and Cylinders, Inc.	Linde North America, Inc.
2007	Western International Gas and Cylinders	Praxair, Inc.	Western International Gas and Cylinders, Inc.	Linde Gas North America LLC
2006	Western International Gas and Cylinders, Inc.	Air Products and Chemicals, Inc.	Scott Specialty Gases, Inc.	BOC North America
2005	Western International Gas and Cylinders, Inc.	Airgas, Inc.	Western International Gas and Cylinders, Inc.	BOC North America
2004	National Welders Supply Co., Inc.	Jack B. Kelley, Inc.	Roberts Oxygen Company, Inc.	Linde Gas LLC
2003	Holox Ltd	BOC North America	Western International Gas and Cylinder, Inc.	Holox, Ltd.
2002	Western International Gas and Cylinders, Inc.	Air Liquide America	Western International Gas and Cylinder, Inc.	Airgas, Inc.
2001	Holox, Ltd.	Air Liquide America Corp.	Western International Gas and Cylinders, Inc.	Airgas, Inc.
2000	S. A. White Martins	MG Industries	Western International Gas and Cylinders, Inc.	Holox, Ltd.
1999	Holox, Ltd.	BOC Gases	Western International Gas and Cylinders, Inc.	Air Products & Chemicals, Inc.
1998	Holox, Ltd.	Jack B. Kelley Inc.	Scott Specialty Gases, Inc.	Tri-Gas Inc.
1997	Holox, Ltd.	BOC Gases	Scott Specialty Gases, Inc.	BOC Canada Limited
1996	Holox, Ltd.	BOC Gases	MG Industries	Holox, Ltd.
1995	Praxair Canada Inc.	BOC Gases	Scott Specialty Gases, Inc.	Air Liquide America Corp.
1994	BOC Canada Ltd.	BOC Gases	Scott Specialty Gases, Inc.	Holox, Ltd.
1993	Puritan-Bennett Corp.	Praxair, Inc.	Holox, Ltd.	Air Products and Chemicals, Inc.
1992	Puritan-Bennett Corp.	Airco Gases	Canadian Liquid Air Ltd.	Praxair Canada, Inc.
1991	Praxair Canada Inc.	Praxair, Inc.	Welsco, Inc.	Praxair, Inc.
1990	Union Carbide Canada Ltd., Linde Division	Jack B. Kelley Company	Canadian Liquid Air Limited	Liquid Air Corporation
1989	Welsco, Inc.	Union Carbide Industrial Gases Inc., Linde Division	Air Products Canada Ltd.	Air Products and Chemicals, Inc.
1988	Union Carbide Canada Ltd.	O.K. Kelley	Air Products Canada Ltd.	Air Products and Chemicals, Inc.

CGA Works to Shape Regulations

Cooperative Work to Assess Flowmeters

In 1984, CGA's Industrial Gases Apparatus Committee worked to develop new standards for welding and cutting, industrial gas flowmeters, and industrial gas manifold systems. This work was later used in a cooperative study with the National Bureau of Standards on flowmeters for cryogenic service, international standards on meters, and measuring systems for cryogenic service. CGA's work was ultimately used to revise NBS Handbook 44.

New Canadian Regulations for Transportation of Dangerous Goods

CGA Canada conducted a series of seminars to educate front-line managers on the new Canadian regulations for the Transportation of Dangerous Goods, which went into effect on July 1, 1985. Seven seminars were conducted over a two week period in seven major cities across Canada. The seminars were led by highly qualified volunteers from member companies. CGA garnered many accolades from provincial and federal officials who were impressed with the high quality of the seminar content and by the professional manner in which the presentations were made.

Later in the year, efforts began to seek reciprocity between the U.S. and Canada regarding shipping papers, labeling, and placarding requirements for trans-border shipments of hazardous materials. By 1986, Transport Canada issued a special permit in the first amendment to the dangerous goods regulations, clarifying placarding and labeling requirements as they applied to vehicles carrying compressed gases.

Continued Environmental Enforcement

In 1990, the EPA passed two acts which continue to impact compressed gas manufacture, transport, and disposal.

The Pollution Prevention Act (PPA) of 1990 established a national policy to prevent and reduce pollution at the source of facility processes using hazardous materials or generating hazardous wastes. The PPA emphasizes identifying methods to reduce the volume of waste before it is generated or sent for disposal. These source reduction programs include material substitution, closed-loop recycling, enhancement of current operating or maintenance programs, process improvements, or other appropriate measures.

The Oil Pollution Act (OPA) of 1990 strengthened EPA's ability to prevent and respond to catastrophic oil spills. A trust fund financed by a tax on oil is available to clean up spills when the responsible party is incapable or unwilling to do so. The OPA requires oil storage facilities and vessels to submit plans to the federal government detailing how they will respond to large discharges.

The Search for a Fuel Source

Driven by the 1973 Organization of the Petroleum Exporting Countries (OPEC) Oil Embargo, the oil industry in the U.S. thrived in the 1980s. In 1980, nitrogen replaced oxygen as the number one industrial gas in the U.S., largely due to the new application of nitrogen to stimulate gas and oil flow. Nitrogen was also used extensively to repressurize oil wells, significantly increasing the recoverable crude oil from land-based operations. As the U.S. expanded its search for oil to offshore locations, diving gases and equipment experienced a boom in popularity.

CGA Canada Transport of Dangerous Goods Seminar *(Courtesy of: Compressed Gas Association, Inc.)*

1991 – 2000: An International Approach

CGA Efforts in the International Community

Developing International Standards

The expansion of the global marketplace in the 1990's demanded a focus on the harmonization of standards. Harmonization efforts were initiated in order to reduce the variability in safety standards in operating standards. The benefits of harmonization include sharing of best practices, increased availability of safety information (particularly to developing nations that may not have expertise readily available to create standards), eliminating duplicate or conflicting regional efforts to address industry topics, reduced conflict in international regulatory requirements, and an increase in efficiency.

United Nations (UN)

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) was initiated by the United Nations (UN) in 1992 to develop a means of hazard classification and communication using labels, pictograms, and consistent hazard language on a global basis. Internationally, competent authorities may adopt the GHS in whole or in part and may also require additional information on labels.

The first edition of GHS, which was intended to serve as the initial basis for the global implementation of the system, was approved in 2002 and published in 2003. Since then, GHS has been updated, revised, and improved every two years as needs arise and experience is gained in its implementation. While governments, regional institutions, and international organizations are the primary audiences for the GHS, it also contains sufficient context and guidance for those who will ultimately be implementing the requirements that have been adopted.

The UN Sub-Committee of Experts on the Transport of Dangerous Goods (SCETDG) accepted CGA as a non-governmental organization with consultative status in July 1999, at the sixteenth session of the SCETDG. The UN Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals (SCEGHS) accepted CGA as a non-governmental organization with consultative status in July 2001, at the first session of the SCEGHS.

The UN SCETDG and SCEGHS operate on a 2-year (biennium) cycle, and meets 4 times during the biennium.

As a non-governmental organization (NGO) with consultative status, CGA can represent CGA positions, submit papers for consideration, make comments regarding other submitted papers, and act as technical advisors to participating regulatory agencies. Many of the recommendations developed by the SCETDG and SCEGHS are adopted in U.S. and Canadian regulations through DOT, EPA, , the Occupational Safety and Health Administration (OSHA), Transport Canada (TC), and Health Canada (HC).

International Organization for Standardization (ISO)

During meetings held in 2000 between DOT, TC, CGA, and the European Industrial Gases Association (EIGA), the importance of the relationship between UN and ISO work became clear. The UN had a long history of adopting ISO positions for inclusion in the Model Regulations, but during those meetings DOT announced an intent to support the adoption of ISO standards into the UN Model regulations – and ultimately into the U.S. DOT Hazardous Materials Regulations. This brought a renewed emphasis to the value of CGA's participation in ISO activities.

CGA's primary focus at ISO is related to the work of ISO Technical Committee (TC) 58 – *Gas Cylinders*, and its subcommittees. In addition, CGA also participates in technical committees related to hydrogen technologies and cryogenic vessels.

ISO TC 58/SC 2 in Chantilly, Virginia
(Courtesy of: Compressed Gas Association, Inc.)

International Oxygen Manufacturers' Association (IOMA) and International Harmonization Council (IHC)

The International Oxygen Manufacturers' Association (IOMA) was founded in 1943 to serve as an association of United States independent gas producers. Over time, as the industry and IOMA's membership grew, the association became more globally focused.

On June 8, 1990, CGA signed a Memorandum of Cooperation with the Commission Permanente Internationale Europeene des Gaz Industriels et du Carbure de Calcium (CPI), the trade association for the industrial gases industry in Europe. The next year, CPI merged with the European Carbon Dioxide Trade Association to become the European Industrial Gases Association (EIGA). In 1996, Patrick Verschelde of Air Liquide America Corp. and Carl Johnson of CGA met with representatives from the International Council of Chemical Associations (ICCA) to review the possibility of forming a similar organization under IOMA to coordinate the development of industrial gases safety standards on a global scale. The recommendation to develop such a group was ultimately approved, and the IOMA Global Committee was formed as the oversight body for the harmonization of industrial gases safety standards. The first meeting of the IOMA Global Committee was held on June 12, 1998.

CGA and CPI Memorandum of Cooperation Signing
(Courtesy of: Compressed Gas Association, Inc.)

In 1997, CGA and the European Industrial Gases Association (EIGA) formed a committee to coordinate the development of new standards and the revision of existing standards. Following the formation of the IOMA Global Committee, CGA, EIGA, and the Japan Industrial Gases Association (JIGA), now the Japan Industrial and Medical Gases Association (JIMGA), formed the International Harmonization Council (IHC) in 2001. The IHC was further expanded in 2003 when the Asia Industrial Gases Association (AIGA) joined the Council. The goal of the IHC is to manage the harmonization work process, evaluate potential projects, and track progress of active projects. Roger Smith, CGA's Technical Director, was integral to the success of the IHC, formation of CGA's relationships with other Associations, and the management of CGA's harmonization efforts. Upon his retirement from CGA in 2011, Roger was granted honorary membership to the Association in recognition of his contributions to the compressed gas industry.

Today, CGA staff participates in many aspects of harmonization efforts, from the management of individual committee efforts to the administration of and technical participation in the IHC. At present, publications on over thirty topics have been successfully harmonized, and over thirty-five topics are undergoing active work to be harmonized.

International Harmonization Council Representatives in Frankfurt, Germany 2012
(Courtesy of: Compressed Gas Association, Inc.)

Work to Address Compressed Gas Abuse and Misuse

In the mid-1990s, nitrous oxide abuse came to CGA's attention as a serious and deadly problem. CGA and the National Welding Supply Association (NWSA) embarked in a cooperative effort to publish sales and security guidelines to prevent the diversion of nitrous oxide for the purpose of abuse. This information was also provided to regulatory organizations and other interested parties.

The concerted effort to prevent the abuse and misuse of compressed gases continued for many years. CGA and NWSA distributed letters to many companies using commercials promoting inhalation of helium, as well as promoting an understanding of the dangers of helium abuse to schools, advertising agencies, companies, entertainment developers, and so forth. In 2001, CGA and NWSA announced the National Inhalants and Poison Prevention Week. CGA President, Carl Johnson, spoke at the National Press Club in Washington, D. C. to discuss the dangers of abusing nitrous oxide. He also promoted model legislation prepared by CGA and NWSA, making the sale of nitrous oxide for recreational inhalation and inhalation of nitrous oxide to get high criminal offenses.

New CGA Awards Recognize Volunteers

Charles H. Glasier Safety Award

Sponsored by Air Liquide America Corporation, the award is in memory of Charles H. Glasier, a leader in the industry, a strong supporter of safety, a former CGA chairman (1980), and an active participant in the CGA for more than 40 years. The award, created in 1994, is presented annually to an individual in recognition of their safety leadership in the industrial gas industry.

Joe Barnett, Charles H. Glasier Safety Award Winner
(Courtesy of: Compressed Gas Association, Inc.)

Charles H. Glasier Safety Award Winners

Year	Name	Company
2011	Duane Young	Airgas, Inc. SAFECOR
2010	Ken Paul	Chart Industries, Inc.
2009	Joe Barnett	Matheson Tri-Gas, Inc.
2008	Rob Early	Praxair, Inc.
2007	William P. Schmidt	Air Products and Chemicals, Inc.
2006	David B. Sonnemann	Praxair, Inc.
2005	Thomas Joseph	Air Products and Chemicals, Inc.
2004	Guy Dalton	Linde Gas LLC
2003	Wade Holt	Airgas, Inc.
2002	Michael Injaian	Scott Specialty Gases, Inc.
2001	Jerrold D. Sameth	Matheson Tri-Gas, Inc.
2000	Eugene Y. Ngai	Air Products and Chemicals, Inc.
1999	David Scott	Air Products and Chemicals, Inc.
1998	John Thompson	BOC Gases
1997	Anthony McErlean	MG Industries
1996	Samuel W. Hoynes	Air Liquide America Corp.
1995	James Arvin	AGA Gas, Inc.
1994	John Pavlovcak	Air Products and Chemicals, Inc.

Chart Industries Distinguished Service Award

The award, created in 1996 and sponsored by Chart Industries, recognizes significant and distinguished service CGA and is presented to an individual who best exemplifies the character, commitment, and technical excellence prevalent in the volunteers from our member companies. It is given to an individual who has for many years given of him- or herself to uphold and further the mission of the CGA—to develop and promote safety standards and safe practices for the industrial gas industry.

Laurence J. Schmidt, Chart Industries Distinguished Service Award Winner *(Courtesy of: Compressed Gas Association, Inc.)*

Chart Industries Distinguished Service Award Winners

Year	Name	Company
2011	Joel Zemke	Praxair, Inc.
2010	W. Lee Birch	Luxfer Gas Cylinders, Inc.
2009	Patrick F. Murphy	Linde North America, Inc.
2008	John J. Anicello	Airgas, Inc.
2007	Samuel W. Hoynes	American Air Liquide, Inc.
2006	Michael Skrjanc	Linde Gas LLC
2005	Steven T. Gentry	Worthington Cylinder Corp.
2004	Laurence J. Schmidt	Air Liquide America L.P.
2003	Åke Nyborg	AGA Gas, Inc.
2002	Ed Saccoccia	Praxair, Inc.
2001	Chris Lloyd	Air Products and Chemicals, Inc.
2000	Ed McSweeney	Norris Cylinder
1999	Morris Gold	Hydro-Flex Canada
1998	Robert J. Daniels	Lotepro
1997	Robert Cieslukowski	MVE
1996	Lionel Wolpert	BOC Gases

H. Emerson Thomas Award for Lifetime Service to CGA

This award, originated in 1997, is presented to an individual involved in CGA activities in recognition of leadership in standards development, safety procedures, and/or regulatory affairs. The award is based solely on the individual's record of achievement on behalf of CGA and the industry; the individual's reputation in the industry and recognition by other authorities; and his/her professional recognition (national, international). H. Emerson Thomas, who passed away in 2001, served in a leadership capacity within the CGA for more than 60 years. Such consistent and sustained service is unique and should be recognized and rewarded. The H. Emerson Thomas Award for Lifetime Service to CGA is intended to recognize and reward individuals reflecting this achievement and dedication. The award should be considered annually, but need not be awarded every year if suitable candidates are not identified.

Roger A. Smith, H. Emerson Thomas Award for Lifetime Service to CGA Award Winner *(Courtesy of: Compressed Gas Association, Inc.)*

H. Emerson Thomas Award for Lifetime Service to CGA Award Winners

Year	Name	Company
2011	Roger A. Smith	Compressed Gas Association, Inc.
2008	Roderick R. Fink	Acme Cryogenics, Inc.
2007	Carl T. Johnson	Compressed Gas Association, Inc.
2003	David B. Sonnemann	Praxair, Inc.
2001	Glenn Fischer	Airgas, Inc.
2001	Peter McCausland	Airgas, Inc.
1999	Patrick F. Murphy	AGA Gas, Inc.
1998	William Kalaskie	Superior Valve Company
1997	Robert Landes	Taylor-Wharton International LLC

Environmental Awards

The CGA Environmental Recognition Program was established in 2000 to identify and share good environmental practices as well as promote environmental awareness and improvements within companies and the industry. A recognition award is presented annually to any CGA member facility, team, or individual in the compressed gas industry who has demonstrated environmental excellence through environmental accomplishments going above and beyond regulatory requirements. The Environmental Recognition Program is sponsored by Linde Gas North America LLC.

Environmental Award Presentation
(Courtesy of: Compressed Gas Association, Inc.)

Environmental Award Winners

Year	Company	Recipient(s)
2011	Air Products and Chemicals, Inc.	Electronics Manufacturing Facility Ammonium Bifluoride Reclamation Project (Hometown, PA)
	Air Products and Chemicals, Inc.	Solar Farm (Trexlertown, PA)
	Praxair, Inc.	Calcium Carbide Plant (White Martins Gases Iguatama Plant and Minas Gerais, Brazil)
	Linde North America, Inc.	AC Transit Hydrogen Fueling Project
2010	Air Products and Chemicals, Inc.	Santa Clara ASU Facility Recycle Water Use Initiative (Santa Clara Facility)
	Linde North America, Inc.	Bio-LNG Facility (Altamont, NY)
	Praxair, Inc.	Green Team Initiatives (Praxair Technology Center, Tonawanda, NY)
2009	American Air Liquide Holdings, Inc.	Installation of Environmental Resource Bulletin Boards and Environmental Resource Binders
	Airgas, Inc.	Green Distribution Centers
	Air Products and Chemicals, Inc.	Industrial Wastewater Discharge Reduction Project (Carlsbad, CA)
	Air Products and Chemicals, Inc.	Resource Conservation Projects: Waste Heat Recovery and NF3 Vent Gas Recovery (Hometown, PA)
	Air Products and Chemicals, Inc.	Nanke C3F8 And Carbon Dioxide (Greenhouse Gas) Emission Reductions
	Praxair, Inc.	Mexico National Environmental Leadership Program
	Praxair, Inc.	US GO Green Program (Praxair US Businesses)
	American Air Liquide Holdings, Inc.	SMR Condensate Polisher (Bayport, MN)
	Matheson Tri-Gas, Inc.	Arsine Neutralization Tank Process Scrubber
2008	Air Products and Chemicals, Inc.	Implementation of an Enterprise Wide Environmental Information Management System
	Air Products and Chemicals, Inc.	Flare Gas Reduction Project (Hopkinton, MA, LNG Facility)
	FIBA Technologies	Environmental Improvements (Millbury, MA; East Greenville, PA; Louisville, KY; Rayne, LA)
	Linde North America, Inc.	Bio Remediation of Ammonia (Carson, CA)
	Matheson Tri-Gas, Inc.	Cylinder Recycle Project
	Praxair Distribution	Closed Loop Cooling Water Recycle Project (Roseville, MN)
	Praxair, Inc.	Elimination of River Water Potential Oil Contamination by Exchanger Replacement (Ecorse , MI)
	Praxair Distribution	Acetylene Plant Cooling Water Recycle Project (Varennes, Quebec)
	Praxair, Inc.	Recycling & Waste Reduction Programs (New Castle, PA)

Year	Company	Recipient(s)
2007	American Air Liquide Holdings, Inc.	Converting the Lime Impoundment to a Stormwater Retention Basin (Jacksonville, FL)
	Air Products and Chemicals, Inc.	Plant Ammonia Stripper (Baytown, TX)
	Air Products and Chemicals, Inc.	Greenhouse Gas Reduction Program (Morrisville, PA)
	Air Products and Chemicals, Inc.	Cylinder Painting Shrinkwrap Initiative (Hometown, PA)
	Matheson Tri-Gas, Inc.	Pipeline Load Following Systems and Strategies (Delisle, MS ASU; Westlake, LA ASU)
2006	Acme Cryogenics, Inc.	Environmental Upgrades & Resource Recovery Project (Allentown, PA Facility)
	Air Products and Chemicals, Inc.	Nitrous Oxide (Greenhouse Gas) Purge Elimination
	Airgas, Inc.	Hurricane Katrina Cylinder Clean Up
	Linde Gas LLC	ECOCYL® R and V series integrated flow control refillable small cylinders
	Matheson Tri-Gas, Inc.	Turning waste into a sellable product (Newark, CA, Facility)
	Matheson Tri-Gas, Inc. and Taiyo Nippon Sanso	MTG Shield™ – An Integrated Cover Gas Melt Protection SF_6 Replacement System for the Magnesium Industry
	Praxair, Inc.	Demolition Team Project (Niagara Falls, NY)
	Praxair, Inc.	Installation of the Dilute Oxygen Combustion System at a Hot Strip Mill Reheat Furnace
2005	Air Products and Chemicals, Inc.	Hazardous Waste Reduction Initiatives (Carlsbad, CA)
	Air Products and Chemicals, Inc.	Production Process Environmental Enhancements (Morrisville, PA)
	Air Products and Chemicals, Inc.	Excess Silane Reclamation Project (Moses Lake, WA)
	BOC Gases	Nitrogen Liquefier Unit Expander Efficiency Upgrade (City of Industry, CA)
	Praxair Distribution	Propylene Recovery
	White Martins Gas Industriais, Ltda.	Social and Environmental Education Program
2004	Air Liquide America L.P.	Water Softener Installation (Merritt Island, FL ASU)
2003	American Welding and Tank	Waste Water Discharge Elimination
2002	AGA Gas, Inc.	Sulfur Hexafluoride (SF_6) ReUse™ Program
	Air Products and Chemicals, Inc.	Facility, Resource Conservation Initiative (Hometown, PA)
	BOC Gases	Liquid Capacity and Power Efficiency Improvement Project (Hartford, IL)
	White Martins Gases Industrial	Verde & White Program
2001	Air Products and Chemicals, Inc.	Cylinder Recovery Team
	BOC Gases	Truck Fleet Efficiency and Pollution Prevention Improvement Program
	Praxair, Inc.	PAH Mitigation
2000	Jack B. Kelley, Inc.	Fuel Conversion of Heavy Duty vehicles
	Mine Safety Appliances Co.	Calibration Gas Cylinder Recycling Program
	Air Products and Chemicals, Inc.	Fleet Waste Reduction Program
	Air Products and Chemicals, Inc.	Special Gases Manufacturing Facility, Hometown Spent Potassium Hydroxide Recovery (Hometown, PA)
	BOC Gases	ISO 14001 Certification and EPA Star Track Participant (Kittery, ME)
	AGA Gas, Inc.	Healthcare Facility Non-refillable Cylinder Disposal
	Airgas, Inc.	Mobile Analytical Lab for Cylinder Remediation
	Airgas, Inc.	Refillable Cylinders for Refrigerants

A New Age for Associations

In the 1990s, many Associations faced change as technology became more widely available for use. Like many other Associations, CGA faced the challenge of keeping up with technology while still allowing members who did not have the latest technology to access safety information. In 1992, CGA installed a phone system which allowed members to access information about publications and work items through a dial-in directory. By 1994, CGA completed the development of a comprehensive database, which contained information regarding member records, work efforts, publications, sales, and much more. This development was followed shortly by the launch of the CGA world wide website in 1997, which contained safety bulletins, position statements, the CGA publication catalog, and other important safety information. At the end of the decade, CGA transitioned to all electronic communications, ceasing mailings of all committee agendas, publication work, and work item information.

With the transitions, CGA was able to greatly improve the efficiency of committee work and reduce the time of work needed to revise publications. From 1999 – 2000, CGA tested a new work structure that significantly reduced the time required to complete the publication process.

Regulatory Advancements

In 1990, the reauthorization of the Hazardous Materials Transportation Act was a prominent area of interest for CGA members. In the closing moments of Congress, a compromise bill was passed and sent on to the President, who signed it on November 16, 1990. Later in the year, CGA culminated a 13 year effort to persuade the DOT to include an acetylene cylinder requalification program in the regulations. As a result, DOT published a Notice of Proposed Rulemaking incorporating CGA C-13, *Guidelines for Periodic Visual Inspection and Requalification of Acetylene Cylinders*, as an appropriate compliance method.

Representatives from the Medical Gases and Equipment Committee met with the Health Protection Branch (HPB) of Health and Welfare Canada to present the CGA position on the need for GMP to cover on-site oxygen concentrators, quality control requirements at filling locations, the use of DINS by transfillers, and visual inspections of cylinders. HPB inspectors responded very positively to the CGA requests. In addition, CGA also sent a letter to the Canadian Minister of Transportation requesting that Special Permits and Certificates of Registration be issued more quickly. As a result, the documents requested were issued without unreasonable delay.

By 1993, CGA was reorganized to attain a stronger advocacy role within the regulatory arena. CGA dedicated one staff position to monitor activities in Washington, assist federal agencies and legislators, and share industry positions. The CGA Board of Directors and committees were also restructured in support of CGA's renewed regulatory interests.

Developing a Clean Energy Source

As the 20th century came to a close, a heightened awareness of environmental impacts drove the development of sustainable, clean energy sources. Hydrogen, long used in many applications, came to the forefront as a potential clean energy fuel source. While prototype hydrogen vehicles had been developed in the 1960s, they had gone largely unsupported by the general public until the 1990s, when mainstream automakers began to experiment with hydrogen vehicles.

Hydrogen would later be evaluated for use in many energy intensive applications, such as the provision of electricity and heat, but the main focus for the next decade would continue to be on developing safe hydrogen fuel cells for automotive applications. U.S. regulators adopted laws aimed at reducing the sulphur content of gasoline and the overall U.S. fuel consumption, which further drove the development of large-scale hydrogen production as a potential source for clean energy.

Hydrogen Fueling Station
(Courtesy: Air Products and Chemicals, Inc.)

Hydrogen Powered Shuttle Bus
(Courtesy: Air Products and Chemicals, Inc.)

2001 – 2010: A Focus on the Association

CGA Efficiency Improvements

In the new millennium, CGA made many changes to benefit members and promote efficiency within the Association. Staff focused on providing streamlined access to CGA materials to members, reducing work inefficiencies, and restructuring the dues program to promote fair distribution based on company size. CGA also eliminated charges for attendance at committee meetings in order to promote increased participation in standards development. The CGA office was also moved out of the Washington, D. C. area, and into Chantilly, Virginia in an effort to reduce operating costs and gain access to more space for offices and conference rooms.

CGA Office in Chantilly, Virginia; 2001 – 2012
(Courtesy of: Compressed Gas Association, Inc.)

New Web Access for Members

In 2001, CGA released its member website, populated with information from CGA's internal database. This new website contained information on membership records, contact information, work item information, publications, and so forth. A year later, CGA would become one of the first trade associations to offer locked electronic publications. At this time, a decision was made to modify the dues structure and provide electronic publications for free to employees of member companies, in order to promote use and ease of access of the CGA safety publications.

This unique approach to sharing Association information and electronic publications would become a significant resource for CGA in the coming years. The member website was later modified to collect proposed changes to publications, provide members with information about action items, and post documents for meetings. Today, the website continues to grow as an integral part of CGA's communication system.

A New Work Process

Early in the decade, CGA staff recognized the need to improve the work process and reduce the time required to complete committee work. This was particularly important to support CGA's ability to respond to regulators, which typically imposed short timelines. In 2000, CGA staff introduced a new work item process, which featured the creation of an expedited process to address items with external deadlines.

In 2005, the Safety and Environmental Advisory Council (SEA) and the Technology and Safety Standards Council (TASS) were merged to promote more effective communication, reduce duplicative meetings, and increase CGA's ability to respond more quickly to incidents, requests for positions, and inquiries from committees.

In 2006, CGA implemented further changes to the work process. Several of the 25 standing committees were consolidated to reduce duplicative work efforts; 20 committees remained after the consolidation. Work Process 2006 also increased the review period for publications, provided considerations for the resolution of negative Standards Council ballots, established a sunset rule for work items with no activity in a 12 month span, and implemented a prioritization process for proposed new work items. Though some adjustments have been made through the years, Work Process 2006 is the primary process used by CGA today.

Later in the decade, CGA staff developed and implemented a Standards Quality Improvement Program, aimed at increasing the quality and enforceability of CGA publications as a means to enhance the adoption of CGA positions in regulations and codes. Under this program, committees undertook an exhaustive review of their publications to improve the language quality while maintaining technical accuracy.

Changes in Leadership

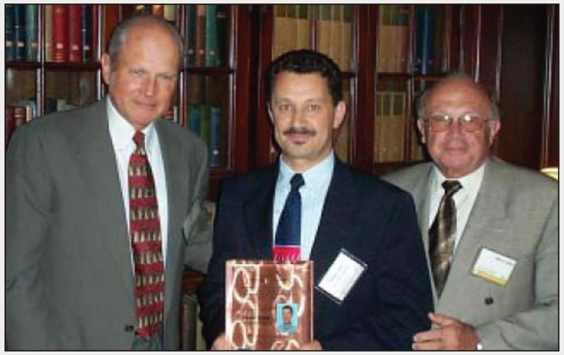
After serving as CGA's President and CEO since 1988, Carl T. Johnson announced his retirement from the Association in 2006. His tenure marked CGA's entrance to the international stage to promote harmonization of safe practices for the compressed gas industry, a renewed focus on self-regulation in North America, the modernization of CGA's technology and procedures to best serve the membership, a program dedicated to rewarding volunteerism and excellent safety records, and many other changes that forever impacted CGA's operations.

Following Mr. Johnson, Marc J. Meteyer served as CGA's President and CEO until 2010. Mr. Meteyer worked to empower the membership to ensure a level of excellence that helped sustain CGA's superior reputation within the industry and with public policy officials. Additionally, he placed a tremendous value on the relationships that he developed with those in and outside of the industry to advance CGA's mission. His work to develop and communicate an industry position related to environmental laws culminated in a long-standing cooperative relationship between CGA and the American Chemistry Council (ACC). Sadly, after a long illness, Mr. Meteyer passed away in 2010.

Michael B. Tiller, a long-time CGA employee, was appointed President and CEO in late 2010, where he still serves. Under Mr. Tiller's guidance, CGA formed the Industrial Gases Panel with the ACC in 2011 to address items of interest that were not safety issues and did not have a unique impact on the compressed gas industry. This cooperative effort ensures that CGA continues to focus on safety issues.

Recognizing Canadian Members: The Morris Gold Award

The Morris Gold Award is presented periodically to recognize the outstanding contributions made by an individual through leadership and participation in CGA Canada and the compressed gas industry. The award was established in 2001 and was originally named the CGA Canada Recognition Award. In 2002, the award was re-named in honor of Morris A. Gold, of Hydro-Flex Canada, who was an active and passionate member of CGA from 1979 to 2001. Morris was Chairman of CGA Canada in 1985 and served on the CGA Board of Directors, representing Hydro-Flex, from 1988 through 1999. Morris was the only Canadian member on the CGA Board of Directors and, during this time, used his Board status to champion CGA Canada causes and efforts. Morris never hesitated to mentor junior association members and always promoted the importance of CGA work both in Canada and the U.S. In December 2001, Morris was granted honorary membership to CGA in recognition of his extensive service to the Association.



Mohand Abdelli, Morris Gold Award Winner
(Courtesy of: Comrpressed Gas Association, Inc.)

Morris Gold Award Winners

Year	Name	Company
2011	Patrick Litwin	VitalAire
2010	Robin Opersko	Air Products Canada, Inc.
2008	Richard LaLonde	Praxair Canada, Inc.
2007	Tony Campos	BOC Canada, Ltd.
2006	Ken Lum	Praxair Canada, Inc.
2003	Roger Emmett	Praxair Distribution, Inc.
2002	James Marsh	Worthington Cylinder Canada
2001	Mohand Abdelli	Air Liquide Canada, Ltd.

Security: A Growing Regulatory Focus

The potential theft and misuse of compressed gases is an ongoing concern. Compressed gases have been obtained for illegal drug use and manufacture, and for potential terrorist activities. Concerns about terrorism, sabotage, theft, or intentional product contamination give companies a compelling reason to implement security measures.

CGA addresses security issues that are relevant to the compressed gas industry by interfacing with relevant trade organizations, and with regulatory government agencies such as the Department of Homeland Security (DHS), the Chemical Sector Coordinating Council (CSCC), and the American Chemistry Council (ACC). The CGA Security Committee develops publications for industry users which help them to comply with changing regulatory requirements.

Aside from developing publications on security, the CGA Security Committee reviews existing CGA publications and external documents for security related problems, tracks the progress of new security legislation, and communicates security-related information to CGA members.

Terrorism Impacts

DHS was created in response to the September 11, 2001 terrorist attacks. The ACC partook in developing the Site Security Guidelines for the U.S. Chemical Industry, which provided general guidelines to assist managers at fixed facilities to make appropriate security decisions. A year later, the ACC created the voluntary Responsible Care Security Code to enhance security at facilities and in communities through internal security assessments and subsequent plans to address vulnerabilities. The same year, DHS created the Safety Act, which provided liability protection to companies which implemented antiterrorism procedures.

However, mounting concerns over terrorism caused chemical security to become more stringently regulated with the potential for fines and facility closure for non-compliance.

In 2007, DHS developed a list of three hundred chemicals of interest and their screening threshold quantities, which determine the need to inspect chemical facilities. The Security Committee plays a vital role in balancing the industry's interests while coordinating with DHS to ensure that chemical facilities function safely. Two legislative programs which the Security Committee monitors are the Maritime Transportation Security Act (MTSA) and the Chemical Facility Anti-Terrorism Standards (CFATS) program.

Maritime Transportation Security Act (MTSA)

In 2002, DHS implemented the Maritime Transportation Security Act (MTSA). The program attempts to protect U.S. ports and waterways from terrorist attack. The act requires that ports and vessels conduct vulnerability assessments and then create plans for addressing any noted vulnerabilities. Under the MTSA, DHS created the Transportation Worker Identification Credential (TWIC) in 2008.

TWIC cards are tamper-resistant credentials issued to workers who require unescorted access to secure facilities across the U.S. These cards ensure that unauthorized individuals are not permitted on chemical facility grounds. The program has a wide range, affecting 12-15 million workers, and hazardous materials drivers in Canada and Mexico. By interfacing with DHS, the Security Committee can highlight areas of needed improvement in the TWIC program. For instance, when the TWIC program was implemented, transportation workers needed to endure an expensive and time consuming process to obtain their cards.

Chemical Facility Anti-Terrorism Standards (CFATS)

On January 22, 2008, DHS implemented the Chemical Facility Anti-Terrorism Standards (CFATS). CFATS attempts to secure the nations chemical facilities by requiring that designated facilities prepare and submit reports on their security vulnerabilities and how they plan to address them. The Security Committee consistently tracks CFATS activities and updates its publications based on changes to the program. DHS members have participated in Security Committee meetings to answer questions and provide status updates on CFATS and the Security Committee meets to develop positions on the program's progress, its successes, and its areas of needed improvement.

Government Support of Hydrogen Infrastructure Development

In 2004, CGA was awarded a contract from the U.S. Department of Energy (DOE) through the National Renewable Energy Laboratory to develop codes and standards for the developing hydrogen infrastructure. This work, which continues today, includes CGA committee development of hydrogen publications, representation of the industry at national code and standards meetings, technical aid for government officials, and participation in international work to harmonize industry hydrogen requirements.

To support this work, CGA formed a hydrogen strategic task force in 2007 to prioritize the development of hydrogen safety topics and to determine what areas of the hydrogen infrastructure were appropriate for CGA to address.

2011 – Today: Advances in Self-Regulation

CGA Today

Today, CGA is a fully staffed technical organization, which continues to follow the technical direction established in the early years. In 2012, the CGA Headquarters moved to a different office building in Chantilly, Virginia to accommodate more committee meetings with increased participants.

CGA Headquarters, 2012 – Today
(Courtesy of: Compressed Gas Association, Inc.)

The focus continues to be on safety-oriented issues, which has aided CGA in the mission to aid the industrial gases industry in achieving self-regulation.

More than 115 member companies continue to work together through the committee system to create technical specifications, safety standards, technical seminars, and other educational materials; cooperate with governmental agencies in formulating responsible regulations and standards; and promote compliance with these regulations and standards in the workplace.

CGA Regulatory Efforts

Today, CGA works to support industry self-regulation by establishing positions in the U.S. Code of Federal Regulations (CFR) through the incorporation by reference of CGA publications. CGA regularly petitions many government agencies, including DOT, FDA, and OSHA to reference CGA publications in U.S. federal regulations. CGA cooperates with government agencies to create responsible regulations, to promote compliance, and to achieve uniformity in the codes of various jurisdictions. When incorporated into the CFR, CGA references add technical value, enhance public safety, and harmonize enforcement.

Medical Gas Safety Act

The Medical Gas Safety Act, H.R. 2227, was introduced in June 2011 before the House of Representative and was eventually incorporated as a part of the Food and Drug Administration Safety and Innovation Act (FDASIA) which addressed the impacts of unapproved drug requirements on medical gases. In July 2012, FDASIA was signed into U.S. law by President Obama. The Medical Gas Safety Act was the culmination of a lot of hard work and dedication by CGA and Gases and Welding Distributors Association (GAWDA) members. With this approval, oxygen, nitrogen, nitrous oxide, carbon dioxide, helium, carbon monoxide, and medical air, all became approved drugs. In addition, the term medical gases means, "a drug that is manufactured or stored in a liquefied, nonliquefied, or cryogenic state and is administered as a gas."

Additionally, approved in 2012, the National Association of Boards of Pharmacy (NABP) and CGA developed a separate "Model Rules for the Licensure of Medical Gases and Medical Gas Related Equipment Wholesale Distributors." CGA members put in a tremendous amount of effort to work with NABP to develop appropriate language in 2011. CGA will now continue work to promote the language to state legislatures for adoption, which will be a significant resource commitment for the CGA and our members.

Code Work

CGA also participates in the model code revision process to enhance public safety and self-regulation and to establish harmony among model codes that affect CGA membership. CGA committees and staff work regularly with the National Fire Protection Association (NFPA), the International Code Council (ICC), and other code developers to represent compressed gas industry positions. Self-regulation prompts industry experts to create well-informed, practical, and safe provisions while harmony ensures consistent enforcement across jurisdictions. CGA's continued participation in model code development, by sitting on model code development committees maintains CGA's stewardship role.

CGA Canada

Today, CGA Canada is a full division of CGA with its own technical manager, committee administrator, executive committee, and standing committees on connection standards, cylinder specifications, medical gases and equipment, membership, metrication, safety and health and transportation. Representatives from base technical committees and Canadian technical committees liaise to share important information and ensure a consistent approach throughout CGA's positions and other responses to regulators.

CGA Committees

CGA has made many changes in its organizational structure to meet the needs of a growing membership and advancing technology. At present, there are twenty-one standing committees, which operate in the U.S., and five Canadian Committees. In addition to these committees, CGA also forms Expedited Work Process committees to address short notice issues, Ad Hoc Committees to approve CGA positions, and Ad Hoc Code Committees to provide CGA responses to ongoing work by external code organizations.

All committees are supported by volunteer participants from CGA member companies. These volunteers are responsible for creating, reviewing, and maintaining CGA's publication library, as well as monitoring external regulatory issues and the work of other Associations which may impact CGA.

Gases: The Invisible Ingredient of a Modern Society

Nitrogen

Nitrogen has many commercial and technical applications. In its gaseous form, these applications include: heat treating of primary metals; blanketing of oxygen-sensitive liquids and volatile liquid chemicals; production of semiconductor electronic components; blowing of foam-type products; food processing and packing; inhibition of bacteria growth; and the propulsion of liquids through pipelines. It is used in many applications where an inert atmosphere is needed, such as within light bulbs and in air-tight chambers protecting historical materials.

Liquid nitrogen also has multiple uses including the freezing of highly perishable foods, deflashing of rubber tires; cooling of concrete; and the coldtrapping of materials such as carbon dioxide from gas streams (commonly used in this way in systems that produce high vacuums). It is used as a coolant for electronic equipment, for pulverizing plastics, and for simulating the conditions of outer space.

Other ways in which liquid nitrogen is used include: creating a very high pressure gaseous nitrogen through liquid nitrogen pumping; in food and chemical pulverization; for the freezing of liquids in pipelines for emergency repairs; for low temperature stabilization and hardening of metals; for low temperature research; for low temperature stress relieving of aluminum alloys; for the preservation of whole blood, livestock sperm, and other biologicals; for refrigerating foods in local and longdistance hauling; for refrigeration shielding of liquid hydrogen, helium, and neon; for the removal of skin blemishes in dermatology; for shrink fitting of metal parts; and for maintaining constant pressures in automotive tires, particularly in racing applications.

Liquid nitrogen also has a number of classified applications in the missile and space programs of the United States, in which it is used in large quantities.

NASCAR Delivery Truck *(Courtesy of: Airgas, Inc.)*

Hydrogen

In the 21^{st} century, hydrogen is a critical product to a wide variety of key industries; applications can be found in the automotive, chemical, power generation, aerospace, food production, telecommunications industries. It is widely used in the production of many common goods, including glass, plastics, and electronics. Hydrogen is an authorized food additive; it is used to test for leaks in food packaging and as an anti-oxidizing agent in packaged foods. It can also be used as a hydrogenating agent in food production to increase the level of saturation of unsaturated fats and oils. Hydrogen is also widely used as a coolant. It is often used as the rotor coolant in electrical generators at power stations, due to its high thermal conductivity, high specific heat, low density, and low viscosity.

A significant use of hydrogen occurs in the petroleum and chemical industries, where it is used to process fossil fuels and in the Haber process of ammonia production, as well as in other processes such as hydroealkylation, hydrodesulfurization, and hydrocracking. Hydrogen is used in the production of many chemicals, including dyes, catalysts, flavors, fragrances, pesticides, halogen organics, and other specialty chemicals.

As the world focus on environmental impact grows, hydrogen becomes more prevalent as a clean and efficient energy source for various applications. Nickel hydrogen batteries are used as a long-lasting power source in some applications, such as powering technology satellites during the dart phase of orbit. The Hubble Space Telescope was powered by these batteries, which were replaced in May 2009 after 19 years of use. Hydrogen is being explored as a fuel alternative for passenger vehicles, where it can be used in fuel cells to power electronic motors or burned in internal combustion engines. Today, the U.S. Department of Energy (DOE) sponsors the Hydrogen, Fuel Cells, and Infrastructure Technologies Program to address the full range of barriers facing the development of hydrogen and fuel cells with the ultimate goals of decreasing U.S. dependence on oil, reducing carbon emissions, and enabling clean, reliable power generation. The National Renewable Energy Laboratory (NREL) also sponsors hydrogen and fuel cells research. Since 2004, CGA has participated in the NREL research effort through a subcontract to develop national and international standards for hydrogen applications.

Hydrogen Plant *(Courtesy of: Matheson)*

Hydrogen Car *(Courtesy of: Air Products and Chemicals, Inc.)*

Hydrogen Car Exhibition at UK Parliament
(Courtesy of: Air Products and Chemicals, Inc.)

Rare Gases

Helium

Today, helium is commercially available at 99.95% purity. It has special importance in welding, leak detection, cryogenic research, in medicine and breathing therapy, and in helium-oxygen breathing mixtures. Magnetic Resonance Imaging (MRI), which provides physicians with a look inside the human body without surgery, is made possible by superconducting magnets cooled first with liquid nitrogen, and then with liquid helium, which lowers their temperature to near absolute zero. Helium is also essential to the manufacture of fiber optics. Current concerns regarding the long-term availability of helium as a natural resource have been a prominent theme in regulatory discussions; in 2012, the U.S. Senate proposed the Helium Stewardship Act of 2012, which would extend the 2015 deadline for the sell-off of the helium reserve and allow the federal government to supply helium at market prices.

Neon

Today, neon continues to be popular in providing lights for advertisements and other signs. It is also used in vacuum tubes, high-voltage indicators, lightning arrestors, wave meter tubes, television tubes, and helium-neon lasers. Liquefied neon is used in commercial applications as a cryogenic refrigerant.

Helium Trailer at the Macy's Day Parade
(Courtesy of: Linde North America, Inc.)

MRI Fill Operation *(Courtesy of: Air Products and Chemicals, Inc.)*

Child Patient Receiving Oxygen
(Courtesy of: Air Products and Chemicals, Inc.)

Xenon

Xenon, an extremely rare gas, is used in light bulbs, detectors, ion propulsion, as a component in excimer lasers gas mixtures, and semiconductor and medical applications.

Medical and Food Gases

Gases in Medicine

Today, high purity compressed oxygen, nitrous oxide, helium, carbon dioxide and a wide range of other gases and medical gas mixtures are used in anesthesia, medical treatment, and respiratory therapy. Cryogenic or liquefied gases such as nitrogen are also used in freezing tissue and in special surgical procedures.

CGA has been instrumental in the development of standards for medical gas cylinders, for medical/surgical vacuum systems, and other apparatus used in the storage and distribution of these gases, including special connections and fittings to prevent the improper mixture of medical gases.

Hyperbaric Oxygen Chamber
(Courtesy of: Air Products and Chemicals, Inc.)

Hospital Fill *(Courtesy of: Airgas, Inc.)*

Portable Oxygen Therapy
(Courtesy of: Air Products and Chemicals, Inc.)

Medical Cylinders *(Courtesy of: Airgas, Inc.)*

Hospital Installation *(Courtesy of: Chart Industries, Inc.)*

Gases in Food

There are many applications in the Food and Beverage Industry involving the use of compressed gas. Gases are used for preservation, ripening, spoilage prevention, freezing, chilling, carbonation, and many more applications.

Certain compressed gases, when used as food ingredients, additives, or contact agents are regulated by FDA under Title 21 of the U.S. Code of Federal Regulations (21 CFR), Parts 182 and 184. However, additional food regulations may be applicable. Typical food gases include carbon dioxide, helium, isobutane, nitrogen, nitrous oxide, normal butane, propane, and sulfur dioxide. These gases have been granted GRAS status (Generally Recognized as Safe) by FDA for use in food and beverage applications. Other gases used in the food industry include argon, carbon monoxide, hydrogen, and oxygen.

In the United States, food distributors and manufacturers may have to register in accordance with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002.

Health Canada regulates the food industry to include substances involved in the manufacture of food. The Canadian Food Inspection Agency (CFIA) is responsible for enforcement of the food industry. Gases which come in direct contact with food substances should meet the requirements of the applicable monograph of The Food Chemical Codex (FCC). Substances, including gases, intended for use in the food industry should be registered with CFIA. CFIA will issue a Letter of No Objection if CFIA determines that the substance is acceptable.

Freezing Chicken with Liquid Nitrogen
(Courtesy of: Linde North America, Inc.)

Freezing Cupcakes *(Courtesy of: Praxair, Inc.)*

Shelf Life Extension

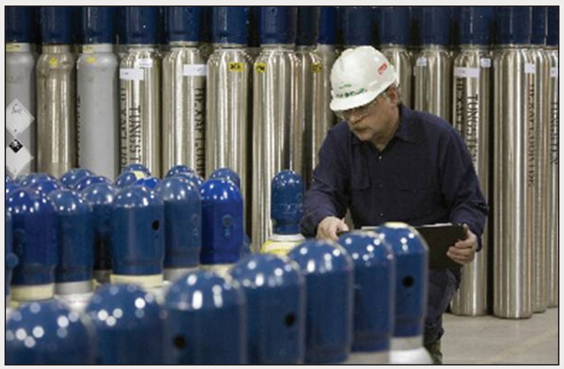
Aerobic bacteria, molds, and oxygen can cause undesirable changes in foods. Food can become at best, unpalatable, or at worst, unsafe for consumption due to these processes. Two techniques used for prolonging the shelf-life of fresh or minimally processed foods are Modified Atmosphere Packaging (MAP) and Equilibrium Modified Atmosphere Packaging (EMAP). Both techniques involve a reduction of the presence of oxygen, and an increase in the concentration of nitrogen or carbon dioxide in the product package. Both techniques also reduce spoilage by reducing oxidation and the growth of anerobic organisms.

In EMAP the permeability of the packaging film takes an active role in the establishment of gas equilibrium in the package, and is more widely used with fruits, vegetables, and other respiring products. Non-respiratory food products, such as meat, fish, and cheese, typically use less permeable films in an application of MAP.

Food Cryogenics

To improve flavor, shelf life, and reducing processing time, many of today's foods are frozen very quickly by reducing the product's core temperature. Liquid nitrogen and liquid carbon dioxide are suitable for freezing and chilling a variety of products including: meat, poultry, seafood, prepared entrees, bagels, pizza and more. Liquid nitrogen and liquid carbon dioxide are commonly used with stand-alone freezers and chillers, to increase the speed at which food products are frozen.

In addition, soft drinks are supplied with carbonation and to maintain the specific taste of the drinks, high quality carbon dioxide is required. Pure carbon dioxide is also used for wine, but a mixture of carbon dioxide and nitrogen can be used with beer to improve pressurization and dispensing.



Tungsten Hexafluoride, Widely Used in the Semiconductor Industry *(Courtesy of: Air Products and Chemicals, Inc.)*

The Medical Gases Regulatory Policy (MGRP) Group, Medical Gases Committee, Medical Equipment Committee, and Food Gases Committee continue to cooperate in the development of standards as the needs arise in these rapidly growing fields.

Specialty Gases

With demand for technology growing steadily throughout the 21st century, specialty gases are being used in more and more electronic related applications including light-emitting diodes (LEDs), compound and silicon semiconductors, photovoltaic (solar) power systems, optoelectronic devices, flat panel displays, and microelectromechanical systems (MEMS).

Many of the devices that consumers use every day would not be possible without MEMS including inkjet printers, accelerometers in modern cars used for airbag deployment, and accelerometers in consumer electronic devices like cell phones, game controllers, and digital cameras. Specialty gases are also used in LEDs, which are used in a diverse group of every day applications such as traffic lights and signals, exit signs, automobile brake and emergency vehicle lighting, glow sticks, aquariums, flashlights, and LED-based holiday lights.

Packaged Gases Cylinder Fill Station, Malaysia
(Courtesy of: Air Products and Chemicals, Inc.)

Today's Air Separation Plants

Air Separation Plants

Air separation technology has progressed over the decades, including advances in both cryogenic and noncryogenic methods. This technology continues to evolve because of engineering and standards development efforts by CGA members. Today, typical air separation units range from very small plants which produce 1 to 5 tons of product per day, to very large plants which exceed 4,000 tons of product per day. Recent advances include the use of linked air separation plants to form generation trains for extremely high volume production, which can exceed 40,000 tons of nitrogen per day.

Modern ASU Plant *(Courtesy of: American Air Liquide Holdings, Inc.)*

Modern Cylinders, Equipment, and Test Methods

While modern bulk transport of cryogenic liquids has reduced the use of cylinders for bulk users of compressed gases, the compressed gas cylinder remains the chief means of transporting compressed and liquefied gases to the many thousands of users of these gases within local markets.

Modern Cylinders and Bulk Storage Equipment

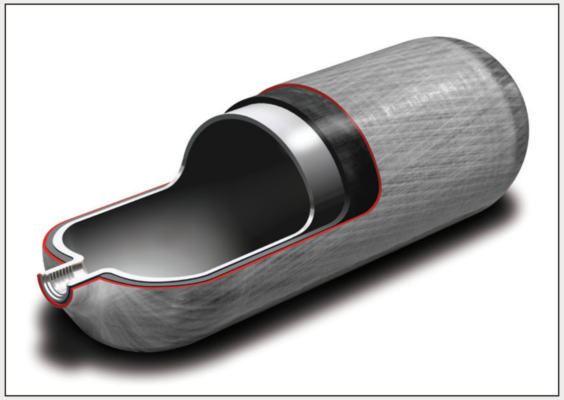
Recent advances include the development of composite, aluminum, and aluminum alloy cylinders. These ultra-lightweight, high capacity cylinders are typically used in emergency personnel life support, medical, automotive, aviation, inflation, alternative fuel, and paintball applications.

Modern Trailer and ASU *(Courtesy of: Matheson)*

Composite Cylinder on Everest
(Courtesy of: Luxfer Gas Cylinders USA)

First Responders with Medical Cylinders *(Courtesy of: Airgas, Inc.)*

Liquid Cylinders *(Courtesy of: Chart Industries, Inc.)*



Full-Wrap Composite Cylinder Cutaway
(Courtesy of: Luxfer Gas Cylinders USA)

Cylinder Extrusion *(Courtesy of: Taylor-Wharton International, LLC)*

Another major advance includes the development of microbulk systems, which allows consumers to utilize the advantages of bulk storage without requiring a large area for the installation of a bulk tank. Microbulk systems consist of an on-site storage container, which is refilled on-site by a gas supplier. These systems have greatly improved access to gas for welding and cutting facilities, analysis labs, biological storage and research facilities, medical facilities, food packaging operations, and many more.

Microbulk Gas Supply Operation
(Courtesy of: Air Products and Chemicals, Inc.)

Cylinder Protection

Frangible Disks and Fusible Plugs

Frangible disks and fusible plugs were the first pressure relief devices used on compressed gas containers, and they are still widely used today. In some applications, however, they have one serious drawback: once the frangible disk or fusible plug is activated, the entire contents of the container is vented, with resulting loss of product. In the case of flammable and other hazardous gases, the release of a cylinder's entire contents may also create additional hazards. In some applications, frangible discs and fusible plugs are replaced with reseating pressure relief devices. In other applications, such as highly toxic gases, cylinder pressure relief devices are eliminated completely.

Cylinder Test Methods

Water Jacket Test

Developed in the early 1900s, the water jacket method remains the most common method for testing high pressure cylinders in the compressed gas industry in the U.S. and Canada.

Cylinder Wash Rinse *(Courtesy of: Matheson)*

Direct Expansion Method

The direct expansion method determines the total and permanent expansion of a cylinder by measuring the amount of liquid required to be forced into a cylinder in order to reach test pressure, and measuring the amount of liquid expelled from the cylinder when the pressure is released. The difference in these two values represents the permanent expansion of the cylinder; the total expansion of the cylinder is calculated by subtracting the compressibility of the total volume of liquid under pressure from the measured amount of liquid forced into the cylinder to achieve test pressure.

Proof Pressure Method

The proof pressure method may be used where regulations do not require the determination of total and permanent expansions of a cylinder to be tested. The test consists of applying an internal pressure equal to the prescribed test pressure for at least 30 seconds and examining the cylinder being tested under pressure for evidence of leakage or distortion.

Acoustic Emission Method

When tubes that contain flaws are pressurized, elastic waves (AE) can be produced by the flaws. The waves travel throughout the structure. In gas tubes, waves can be produced by several different sources (such as contact between flaw surfaces as the cylinder strains, fracture or rubbing of mill scale within a flaw as the cylinder strains, and actual propagation of cracks). These sources produce AE at pressures less than, equal to, and greater than service pressure.

Piezoelectric sensors mounted on a tube surface respond to stress waves. They are connected to a microprocessor-based signal processor that records parameters associated with passage of waves. Elastic waves travel at predictable speeds. With two sensors, one mounted at each end of a tube, the locations of flaws are derived from measured time of elastic wave arrival at the sensors. If two sensors do not provide the required location accuracy, more sensors are used.

When flaws are detected and after AE data acquisition is completed, flaw size is determined by secondary NDT techniques such as shearwave UT. If flaw size exceeds a maximum allowable flaw size, the tube is removed from service.

Maximum allowable flaw sizes are based upon fracture mechanics analysis, estimated fatigue crack growth rates, and tube specifications. Fracture mechanics analysis use the parameter fracture toughness, which is specific to the material of construction and to its heat treatment. Fatigue crack growth rates are specific to the material of construction and the gas that a tube normally contains.

Eddy Current Method

Eddy current is a nondestructive evaluation (NDE) technique used for measuring conductivity, coating thickness, and detection of surface and subsurface discontinuities.

This test method lends itself very well to automation because test results are instantaneous. Test systems can also be designed for high-speed inspection in a "go/no-go" situation.

The effectiveness of this technique depends on the electrical conductivity of the material to be tested. Typically, the higher the conductivity of the material, the higher the sensitivity of detection. Aluminum alloys and stainless steels usually are appropriate for this kind of testing. It is sometimes difficult to test ferromagnetic material using eddy current. Testing composite materials is always impractical and most often not possible.

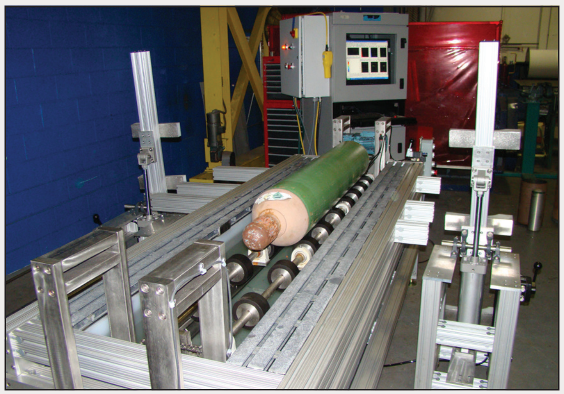
Ultrasonic Evaluation Method

Modern ultrasonic evaluation (UE) automates the inspection of cylinders and the measurement of wall thickness. UE also automates the detection of both internal and external pits, cracks, and other flaws that might or might not be detected by visual inspection methods.

The objective of UE of compressed gas cylinders and tubes is to ensure product safety and reliability by providing a means of:

- obtaining a visual indication of flaw(s) in the cylinder or tube;
- identifying the nature of the flaw(s) without impairing the material; and
- separating acceptable and unacceptable cylinders and tubes in accordance with predetermined rejection criteria.

UE can be used to measure the thickness of a material or to examine the internal structure of a material for possible discontinuities such as voids and/or cracks.



Ultrasonic Cylinder Testing Station
(Courtesy of: FIBA Technologies, Inc.)

Ultrasonic Cylinder Testing *(Courtesy of: FIBA Technologies, Inc.)*

Pressure Regulators

While pressure relief devices are necessary for venting of excess pressure, they do not provide for the continuous controlled release of gas required for normal use. This necessary function is performed by compressed gas regulators. Proper pressure regulation and control is a primary safety concern in the compressed gas industry. Over the years, the CGA has developed numerous standards for regulators, flow meters, flow gauges, torches, and related equipment for the safe dispensing and use of compressed gases from pressurized containers.

CGA's continuing efforts to improve standards for pressure relief devices, regulators, and associated gases apparatus is but one more activity reflecting the industry's on-going commitment to safety.

CGA Founding Members

Albany Calcium Light Co.
Alexander Wilburn Co.
American Carbonate Co.
American Oxyhydric Co.
Atlantic Blaugas Co.
Bishop-Babcock-Becker Co.
Blaugas Co. of America
Blaugas Co. of Canada, Ltd.
Carbon Dioxide and Magnesia Co.
Central Welding and Manufacturing Co.
Chespeake Blaugas Corporation
Chicago Carbonic Gas Co.
Crescent Chemical Manufacturing Co.
Crescent City Carbonnate Co.
Davis Bournonville Co.
Eastern Blaugas Co.
Feature Film and Calcium Light Co.
General Carbonic Co.
Goldschmidt Detinning Co.
Hunter Manufacturing Co., Inc.
International Acetylene Association
International Oxygen Co.
Linde Air Products Co.
Liquid Carbonic Co.
Manufacturers Oxygen Co.
Mississippi Valley Blaugas Co.
National Carbonic Co.
Nebraska Blaugas Co.
New England Calcium Light Co.
New York Calcium Light Co.
Ohio Chemical and Manufacturing Co.
Penn Nitrous Oxide Co.
Philadelphia Calcium Light Co.
Pure Carbonic Co.
S.S. White Dental Manufacturing Co.
Schenk Liquide Gas Co.
Standard Carbonic Co.
Standard Oxygen Co.
Tarifville Oxygen and Chemical Co.

Current CGA Members

A

Abdulla Hashim Industrial Gases and Equipment

Aceti Oxigeno, S.A.

Acme Cryogenics, Inc.

Air Products and Chemicals, Inc.

Airgas, Inc.

All India Industrial Gases Manufacturers Association

AMCS Corporation

Amerex Corporation

American Air Liquide Holdings, Inc.

Applied Home Healthcare Equipment

Arrowhead Industrial Services, Inc.

Asia Industrial Gases Association

Association of American Railroads

ATMI, Inc.

Australia New Zealand Industrial Gas Association

Authorized Testing Inc.

B

Bay Corporation

Bestobell Valves Inc.

BIC Corporation

British Compressed Gases Association

BTI Coopermatics, Inc.

Burkert Fluid Control Systems

C

Canadian Propane Association

Caplugs

Carbide Industries, LLC

Cashco, Inc.

Catalina Cylinders

Cavagna, North America, Inc.

CCRD Partners

Chart Industries, Inc.

Chlorine Institute, Inc.

City Machine & Welding, Inc. of Amarillo

Clean Harbors Environmental Services, Inc.

Clean Vehicle Education Foundation

CP Industries, CP Industries Holdings, Inc.

Cryogenic Society of America, Inc.

Cryostar USA

Cylinder Services, Inc.

Cyl-Tec, Inc.

D

Digital Wave Corporation

Drew Marine

E

Eleet Cryogenics, Inc.

Ellenbarrie Industrial Gases, Ltd.

Equate Petrochemical Co., KSCC

Essex Industries

European Cylinder Makers Association

European Industrial Gases Association

F

Fabrigas Belize, Ltd.

FIBA Technologies, Inc.

Fire Suppression Systems Association

Flexible Components, Division of Saint-Gobain

Four Corners Welding and Gas Supply

Freeport Gases, Ltd.

G

Galiso, Inc.

Gas and Air Systems, Inc.

Gas and Supply

Gas Engineering, LLC

Gas Equipment Company, Inc.

Gas Innovations

Gas Pro, Division of PRHS Corporation

Gases and Welding Distributors Association

GasFlo Products, Inc.

Generant Company, Inc.

Genox Transportation, Inc.

Gulf Cryo Holding

H

Harris Products Group

Harrison Worldwide, LLC

HEROSE, GmbH

High Pressure Gas Safety Institute of Japan

Hyperkinetics Corporation

I

IGL, Ltd.

IGV Industriegaseverband e.V.

Ikaria, Inc.

Industrial Gases, Ltd.

Infra G.I. de Costa Rica, S.A.

INOX CVA

International Beverage Dispensing Equipment Association

International Isotopes

International Oxygen Manufacturers Association

Island Gases, Ltd.

Iwatani Corporation

J

James Russell Engineering Works, Inc.

Japan Industrial and Medical Gases Association

K

Kenan Merchant Gas Group

L

Lincoln Composites, Inc.

Linde North America, Inc.

Luxfer Gas Cylinders USA

M

MagneGas Corporation

Marianas Gas Corporation

Matheson

Matrix Metal Products, Inc.

McDantim, Inc.

Midwest Cylinder Company

Mine Safety Appliances Company

Morris A. Gold*

N

National Propane Gas Association

Newcrest Mining, Ltd.

Nordco Rail Services and Inspection Technologies

Norris Cylinder Company

Norwalk Compressor Company, Inc.

NuCO2, Inc.

O

Oxigeno Carabobo CA

Oxygen and Argon Works, Ltd.

P

PBM, Inc.

Pelchem (Pty), Ltd.

PGI International

Praxair, Inc.

Productos del Aire de Guatemala, S. A.

R

Ratermann Manufacturing, Inc.

Refrigeration and Oxygen, Ltd.

RegO Cryoflow Products, Division of ECII

Respironics, Inc.

Rexarc International, Inc.

Roberts Oxygen Company, Inc.

Roger A. Smith*

Rotarex, Inc. North America

S

Schrader Bridgeport International, Inc.

SET Environmental, Inc.

Southern Africa Compressed Gases Association

Specgas, Inc.

Specialty Trailer Leasing, Inc.

Steigerwalt Associates, Inc.

STI Components, Inc.

Superior Products, Inc.

T

Taiyo Nippon Sanso Corp.

Taylor-Wharton International, LLC

Tekno Valves

TH Cochrane Laboratories, Ltd.

Thermo Gas Products, LLC

Thunderbird Cylinder, Inc.

Tomco Equipment Company

TrackAbout, Inc.

Trinity Containers, LLC

U

Unisource Manufacturing Inc.

V

Vale Canada, Ltd.

Voltaix, LLC

W

Welders Supplies, Ltd.

Weldship Corp.

WesMor Cryogenic Companies

Western Enterprises

Western International Gas & Cylinders, Inc.

Western Sales and Testing of Amarillo, Inc.

Worthington Cylinder

Other

3M

As of November 1, 2012.

*Designates honorary lifetime members.

CGA Committees

Acetylene
Atmospheric Gases and Equipment
Board of Directors
Bulk Distribution Equipment and Standards
Canadian Cylinder Specifications
Canadian Health, Safety, and Environment
Canadian Medical, Food, and Beverage Gases and Equipment
Canadian Pressure Vessels and Piping Systems
Canadian Transportation
Carbon Dioxide
COMPGEAP
Cylinder Specifications
Cylinder Valve
Distribution and Fleet Safety
Environmental
Executive
Food Gases
Hazard Communication
Hazardous Materials Codes
Hydrogen Technology
HYCO
Industrial Gases Apparatus
Legal
Liquefied Petroleum Gas
Medical Equipment
Medical Gases
Medical Regulatory Policy Group
Safety and Health
Security
Specialty Gases
Standards Council

As of November 1, 2012.

2012 CGA Board of Directors – (Front row, l to r) Thomas S. Thoman, Patrick F. Murphy, Michael Brown, Michael A. Tarala, Mark Davis, Christopher Smith, Nelson Squires, Bob Roberts, Ara Hacet, and Robert Arcieri. (Back row, l to r) Eric M. Rottier, Michael B. Tiller, Eduardo Menezes, John F. Finn, Gary R. Heeman, Thomas Carey, Jerry Van Auken, Mark Lostak, John J. Anicello, Richard A. Craig, and William J. Kroll. (Not pictured) Jeffrey R. Hannis, James M. Knox, and John S. Rhodes.

Current CGA Publications

CGA Publications

C-Series Publications: Cylinders

C-1, *Methods for Pressure Testing Compressed Gas Cylinders*

C-3, *Standards for Welding on Thin-Walled, Steel Cylinders*

C-5, *Wall Stress Requalification Criteria for High Pressure Seamless Steel*

C-6, *Standards for Visual Inspection of Steel Compressed Gas Cylinders*

C-6.1, *Standards for Visual Inspection of High Pressure Aluminum Compressed Gas Cylinders*

C-6.2, *Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders*

C-6.3, *Guidelines for Visual Inspection and Requalification of Low Pressure Aluminum Compressed Gas Cylinders*

C-6.4, *Methods for External Visual Inspection of Natural Gas Vehicle (NGV) and Hydrogen Vehicle (HV) Fuel Containers and Their Installations*

C-7, *Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers*

C-8, *Standard for Requalification of DOT-3HT, CTC-3HT, and TC3HTM Seamless Steel Cylinders*

C-9, *Standard Color Marking of Compressed Gas Containers for Medical Use*

C-10, *Recommended Procedures for Changes of Gas Service for Compressed Gas Cylinders*

C-11, *Recommended Practices for Inspection of Compressed Gas Cylinders at Time of Manufacture*

C-12, *Qualification Procedure for Acetylene Cylinder Design*

C-13, *Guidelines for Periodic Visual Inspection and Requalification of Acetylene Cylinders*

C-14, *Procedures for Fire Testing of DOT Cylinder Pressure Relief Device Systems*

C-15, *Procedures for Cylinder Design Proof and Service Performance Tests*

C-16, *CGA Registration Program for Cylinder Owner Symbols*

C-16.1, *CGA Cylinder Owner's Registration Symbols and Company Names*

C-17, *Methods to Avoid and Detect Internal Gas Cylinder Corrosion*

C-18, *Methods for Acoustic Emission Requalification of Seamless Steel Compressed Gas Tubes*

C-19, *FRP-3 – Guideline for Filament-Wound Composite Cylinders with Nonloadsharing Liners*

C-20, *Methods for Ultrasonic Examination of Metallic, DOT and TC 3-Series Gas Cylinders and Tubes*

C-21, *Design, Qualification, and Testing of Pressure Vessels for Portable, Reversible Metal Hydride Systems*

C-23, *Inspection of Tube Neck Mounting Surfaces*

E-Series Publications: Equipment

E-1, *Standard for Rubber Welding Hose and Hose Connections for Gas Welding, Cutting, and Allied Processes*

E-3, *Low Pressure Pipeline Station Outlet/Regulator Inlet Connection Standard*

E-4, *Standard for Gas Pressure Regulators*

E-5, *Torch Standard*

E-6, *Standard for Hydraulic Type Pipeline Protective Devices as Required by NFPA 51*

E-7, *Medical Gas Pressure Regulators, Flowmeters, and Orifice Flow Selectors*

E-8, *Gas Flowmeters*

E-9, *Standard for Flexible, PTFE-Lined Pigtails for Compressed Gas Service*

E-10, *Maintenance of Medical Gas and Vacuum Systems in Health Care Facilities*

E-11, *Stationary Compressed Gas Cylinder Discharging Manifolds for Working Pressures up to 3000 psig*

E-12, *Safety Devices Used in Welding, Cutting, and Allied Processes*

E-14, *Maximum Leakage Rates (Gas Tightness) of Equipment Used for Welding, Cutting, and Allied Processes*

E-15, *Periodic Service Program for Industrial Gas Regulators*

E-16, *Compressed Gas Check Valves up to 3000 psig*

E-17, *Hose Line Quick-Connect Couplings for Welding, Cutting, and Allied Processes*

E-18, *Medical Gas Valve Integrated Pressure Regulators*

G-Series Publications: Gases

G-1, *Acetylene*

G-1.1, *Commodity Specification for Acetylene*

G-1.2, *Acetylene Metering and Piping*

G-1.5, *Carbide Lime: Its Value and Uses*

G-1.6, *Standard for Mobile Acetylene Trailer Systems*

G-1.7, *Standard for Storage and Handling of Calcium Carbide in Containers*

G-1.8, *Guidelines for the Operation and Closure of Carbide Lime Ponds*

G-1.9, *Recommended Practices for Maintaining the Proper Solvent Level*

G-2, *Anhydrous Ammonia*

G-2.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*

G-2.2, *Guideline Method for Determining Minimum of 0.2% Water in Anhydrous Ammonia*

G-3, *Sulfur Dioxide*

G-4, *Oxygen*

G-4.1, *Cleaning Equipment for Oxygen Service*

G-4.3, *Commodity Specification for Oxygen*

G-4.4, *Oxygen Pipeline Systems*

G-4.6, *Oxygen Compressor Installation and Operation Guide*

G-4.7, *Installation Guide for Stationary, Electric-Motor-Driven, Centrifugal Liquid Oxygen Pumps*

G-4.8, *Safe Use of Aluminum-Structured Packing for Oxygen Distillation*

G-4.9, *Safe Use of Brazed Aluminum Heat Exchangers for Producing Pressurized Oxygen*

G-4.10, *Design Considerations to Mitigate the Potential Risks of Toxicity When Using Nonmetallic Materials in High Pressure Oxygen Breathing Gas Systems*

G-4.11, *Reciprocating Compressors for Oxygen Service*

G-4.13, *Centrifugal Compressors for Oxygen Service*

G-5, *Hydrogen*

G-5.3, *Commodity Specification for Hydrogen*

G-5.4, *Standard for Hydrogen Piping Systems at User Locations*

G-5.5, *Hydrogen Vent Systems*

G-5.6, *Hydrogen Pipeline Systems*

G-5.7, *Carbon Monoxide and Syngas Pipeline Systems*

G-6, *Carbon Dioxide*

G-6.1, *Standard for Insulated Liquid Carbon Dioxide Systems at Consumer Sites*

G-6.2, *Commodity Specification for Carbon Dioxide*

G-6.3, *Carbon Dioxide Filling and Handling Procedures*

G-6.4, *Safe Transfer of Liquefied Carbon Dioxide in Insulated Cargo Tanks, Tank Cars, and Portable Containers*

G-6.5, *Standard for Small, Stationary, Insulated Carbon Dioxide Supply Systems*

G-6.6, *Standard for Elastomer-Type Carbon Dioxide Bulk Transfer Hose*

G-6.7, *Safe Handling of Liquid Carbon Dioxide Containers That Have Lost Pressure*

G-6.8, *Transfilling and Safe Handling of Small Carbon Dioxide Cylinders*

G-6.9, *Dry Ice*

G-6.10, *Flammable Gases and/or Oxygen Contamination in Carbon Dioxide Feed Gas*

G-6.11, *Concentration of Impurities in Bulk Carbon Dioxide Storage Tanks at Customer Sites*

G-7, *Compressed Air for Human Respiration*

G-7.1, *Commodity Specification for Air*

G-8.1, *Standard for Nitrous Oxide Systems at Customer Sites*

G-8.2, *Commodity Specification for Nitrous Oxide*

G-9.1, *Commodity Specification for Helium*

G-10.1, *Commodity Specification for Nitrogen*

G-11.1, *Commodity Specification for Argon*

G-12, *Hydrogen Sulfide*

G-13, *Storage and Handling of Silane and Silane Mixtures (an American National Standard)*

G-14, *Nitrogen Trifluoride*

G-15, *Fluorine and Fluorine Mixtures with Inert Gases*

G-16, *Arsine*

G-17, *Phosphine*

H-Series Publications: Hydrogen

H-1, *Service Conditions for Portable, Reversible Metal Hydride Systems*

H-2, *Guidelines for the Classification and Labeling of Hydrogen Storage Systems with Hydrogen Absorbed in Reversible Metal Hydrides*

H-3, *Cryogenic Hydrogen Storage*

H-4, *Terminology Associated with Hydrogen Fuel Technologies*

H-5, *Installation Standards for Bulk Hydrogen Supply Systems*

H-10, *Combustion Safety for Steam Reformer Operation*

M-Series Publications: Medical

M-1, *Guide for Medical Gas Supply Systems at Consumer Sites*

M-2, *General Guide for the Manufacturer of Medical Gases Classified as Drugs*

M-3, *Guide for the Manufacturer of Bulk Medical Gases*

M-4, *Validation of Medical Cylinder Filling Systems*

M-5, *Guide for Home Respiratory Car Firms Filling or Distributing Liquid Oxygen USP*

M-6, *Guideline for Analytical Method Validation*

M-7, *Guideline for Qualifying Suppliers Used by Medical Gas Manufacturers and Distributors*

M-8, *Guideline for the Manufacturer of Calibration Gas Standards Used to Analyze Medical Gases*

M-9, *Maintaining Bulk Gas Supplier Fingerprint Analysis at Compressed Medical Gas Filling Facilities*

M-10, *Food Safety Management Systems and Good Manufacturing Practices for Food Gas Manufacturers*

M-11, *Compliance with the Quality Systems Approach to Pharmaceutical CGMPs Guidance*

M-12, *Investigating Out-of-Specification Test Results for Medical Gas Manufacturing*

M-13, *Certifying Third Party Testing Laboratories*

M-14, *Bulk Liquid Oxygen and Bulk Liquid Nitrogen Trailer Change of Grade*

P-Series Publications: Protection and Safe Handling

P-1, *Safe Handling of Compressed Gases in Containers*

P-2, *Characteristics and Safe Handling of Medical Gases*

P-2.5, *Transfilling of High Pressure Gaseous Oxygen Used for Respiration*

P-2.6, *Transfilling of Liquid Oxygen Used for Respiration*

P-2.7, *Guide for the Safe Storage, Handling, and Use of Small Portable Liquid Oxygen Systems in Health Care Facilities*

P-5, *Suggestions for the Car of High Pressure Air Cylinders for Underwater Breathing*

P-6, *Standard Density Data, Atmospheric Gases and Hydrogen*

P-7, *Standard for Requalification of Cargo Tank Hose Used in the Transfer of Carbon Dioxide Refrigerated Liquid*

P-8, *Safe Practices Guide for Cryogenic Air Separation Plants*

P-8.1, *Safe Installation and Operation of PSA and Membrane Oxygen and Nitrogen Generators*

P-8.2, *Guideline for Validation of Air Separation Unit and Cargo Tank Filling for Oxygen USP and Nitrogen NF*

P-8.3, *Perlite Management*

P-8.4, *Safe Operation of Reboilers/Condensers in Air Separation Units*

P-8.5, *The Impact of Ambient Air Contaminants on Validation Requirements for the Air Separation Process*

P-8.6, *Unmanned Air Gas Plants – Design and Operation*

P-8.8, *Safe Design and Operation of Cryogenic Enclosures*

P-9, *The Inert Gases: Argon, Nitrogen, and Helium*

P-11, *Metric Practice Guide for the Compressed Gas Industry*

P-12, *Safe Handling of Cryogenic Liquids*

P-15, *Filling of Industrial and Medical Nonflammable Compressed Gas Cylinders*

P-16, *Recommended Procedures for Nitrogen Purging of Tank Cars*

P-17, *Procedures for Pneumatic Retesting of Cargo and Portable Tanks*

P-18, *Standard for Bulk Inert Gas Systems (an American National Standard)*

P-19, *CGA Recommended Hazard Ratings for Compressed Gases*

P-20, *Standard for Classification of Toxic Gas Mixtures*

P-21, *Guidelines for the Development of Pre-trip Inspection Checklist and Reports for MC-338, TC-338, TC-341, and CGA-341 Cargo Tanks*

P-22, *The Responsible Management and Disposition of Compressed Gases and Their Cylinders*

P-23, *Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components*

P-24, *Guide to the Preparation of Material Safety Data Sheets*

P-25, *Guide for Flat-Bottomed LOX/LIN/LAR Storage Tank Systems*

P-26, *Guidelines for Inspection and Repair of MC-330 and MC-331 Anhydrous Ammonia Cargo Tanks*

P-27, *Recommended Hose Management Practice for Uninsulated Stainless Steel Cryogenic Cargo Tank Hose*

P-28, *Risk Management Plan Guidance Document for Bulk Liquid Hydrogen Systems*

P-29, *Application of OSHA PSM and EPA RMP to the Compressed Gas Industry*

P-30, *Portable Cryogenic Liquid Containers – Use, Care, and Disposal*

P-31, *Liquid Oxygen, Nitrogen, and Argon Tanker Loading System Guide*

P-34, *Safe Handling of Ozone-Containing Mixtures Including the Installation and Operation of Ozone-Generating Equipment*

P-35, *Guidelines for Unloading Tankers of Cryogenic Oxygen, Nitrogen, and Argon*

P-36, *The Safe Preparation of Gas Mixtures*

P-37, *Good Environmental Management Practices for the Compressed Gas Industry*

P-38, *Guidelines for Devalving Cylinders*

P-39, *Oxygen-Rich Atmospheres*

P-40, *Calculation Method for the Analysis and Prevention of Overpressure During Refilling of Cryogenic Tanks with Rupture Disk(s)*

P-41, *Locating Bulk Storage Systems in Courts*

P-42, *Recommended Hose Management Practice for Compressed Gas Transfer Hoses*

P-44, *Selection of Personal Protective Equipment*

P-45, *Fire Hazards of Oxygen and Oxygen-Enriched Atmospheres*

P-50, *Site Security Standard*

P-51, *Transportation Security Standard for the Compressed Gas Industry*

P-52, *Security Standard for Qualifying Customers Purchasing Compressed Gases*

P-53, *Security Code Top Screen*

P-55, *U.S. Environmental Regulations Inventory for Industrial Gas Operations*

P-56, *Cryogenic Vaporization Systems – Prevention of Brittle Fracture of Equipment and Piping*

P-57, *Avoidance of Failure of Carbon Monoxide and of Carbon Monoxide/Carbon Dioxide Mixtures Cylinders*

P-59, *Prevention of Overpressure During Filling of Cryogenic Vessels*

P-60, *Guidelines for the Use of the North American Industrial Classification System and the Standard Industrial Classification Indices*

P-61, *Ergonomic Guidelines for the Industrial and Medical Gas Industry*

P-62, *Guidelines for the Transport by Sea of Multiple Element Gas Containers (MEGCs) and Portable Tanks for Transport of Gases*

S-Series Publications: Pressure Relief Devices

S-1.1, *Pressure Relief Device Standards – Part 1 – Cylinders for Compressed Gases*

S-1.2, *Pressure Relief Device Standards – Part 2 – Portable Containers for Compressed Gases*

S-1.3, *Pressure Relief Device Standards – Part 3 – Stationary Storage Containers for Compressed Gases*

S-7, *Method for Selecting Pressure Relief Devices for Compressed Gas Mixtures in Cylinders*

S-8, *Recommendations to Minimize Hazards of CG-7 Pressure Relief Valves and Ancillary Devices for Liquefied Petroleum Gas Cylinders*

V-Series Publications: Valve Connections

V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections*

V-5, *Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)*

V-6, *Standard Bulk Refrigerated Liquid Transfer Connections*

V-7, *Standard Method of Determining Cylinder Valve Outlet Connections for Industrial Gas Mixtures*

V-7.1, *Standard Method of Determining Cylinder Valve Outlet Connections for Medical Gases*

V-9, *Compressed Gas Association Standard for Compressed Gas Cylinder Valves*

V-10, *High Pressure Gas Trailer Connections*

V-11, *General Guidelines for the Installation of Valves into High Pressure Aluminum Alloy Cylinders*

V-12, *Leak Detection Fluids Use with Gas Cylinder Packages*

V-14, *Performance Standard for Sealing Gaskets Used on CGA 870 Connections for Medical Oxygen Service*

CGA Technical Reports

TR-1, *Large Scale Silane Release Tests*

TR-2, *High Pressure Steel Cylinders In-Service Performance*

CGA Positions, Bulletins, and Alerts

CGA Position Statements

PS-1, *CGA Position Statement on Odorizing Atmospheric Gases (Oxygen, Nitrogen, and Argon)*

PS-2, *CGA Position Statement on Establishing and Industry Standard Color Code for Compressed Gas Cylinders*

PS-3, *CGA Position Statement on Odor Testing for Cylinder Contaminants*

PS-4, *CGA Position Statement on Periodic Proof Testing of Stationary, Cryogenic Liquid, Vacuum-Jacketed Tanks*

PS-5, *CGA Position Statement on the Suitability of Carbon Steel Containers for Stationary Carbon Dioxide Storage*

PS-6, *CGA Position Statement on Securing Compressed Gas Cylinders from Falling at Gas Manufacturers' and Distributors' Facilities and Users' Sites*

PS-7, *CGA Position Statement on the Safe Transportation of Cylinders in Passenger Vehicles*

PS-9, *CGA Position Statement on the Use of Copper in Acetylene Service*

PS-10, *CGA Position Statement on the Location of Pressure Relief Devices in Small Acetylene Cylinders*

PS-13, *CGA Position Statement on Definition of a Threshold Oxygen-Mixture Concentration Requiring Special Cleaning of Equipment*

PS-16, *CGA Position Statement on Suitability of DOT-3A Type Cylinders for Continued Service*

PS-19, *CGA Position Statement on the Use of Oxygen and Acetylene Cylinders on a Cylinder Cart*

PS-22, *CGA Position Statement on Conforming with USP/NF Monographs for Medical Gases*

PS-24, *CGA Position Statement on the Use of Tapered and Parallel (Straight) Threads in Aluminum Alloy Cylinders*

PS-26, *CGA Position Statement on the Use of Carbon Fiber, Fully Wrapped Composite Storage Vessels Permanently Installed in Stationary Gaseous Hydrogen Fueling Systems*

PS-27, *CGA Position Statement on Use of Excess Flow Control*

PS-28, *CGA Position Statement on the Use of Non-ASME Certified Pressure Relief Valves Used for Thermal Expansion Relief in Piping Systems*

PS-29, *CGA Position Statement on Marking of DOT Monolithic Compressed Gas Cylinders*

PS-30, *CGA Position Statement on the Use of Railroad Tank Cars for Stationary Liquid Carbon Dioxide Storage*

PS-31, *CGA Position Statement on Cleanliness for Proton Exchange Membranes Hydrogen Piping/Components*

PS-33, *CGA Position Statement on Use of LPG or Propane Tank as Compressed Hydrogen Storage Buffers*

PS-34, *CGA Position Statement on Applying Codes and Standards for Hydrogen Storage, Use, and Dispensing Systems*

PS-35, *CGA Position Statement on Filling and Distributing Emergency Oxygen Cylinders Without a Prescription*

CGA Safety Alerts

SA-2, *Safety Alert, Acetylene*

SA-11, *Safety Alert, Potential for Hidden Cryogenic Liquid Cylinder Contamination*

SA-15, *Safety Alert, Gas Mixtures Containing Flammable and Oxidizing Components*

SA-16, *Safety Alert, Blended Breathing Air Fatalities*

SA-17, *Safety Alert, Hazards of Nitrogen/Inert Gas Creating an Oxygen-Deficient Atmosphere*

SA-20, *Safety Alert, Use of Nitrogen NF for Surgical Air Tools*

SA-21, *Safety Alert, Hazards of Compressed Gas Cylinders in the Magnetic Resonance Imaging (MRI) Environment*

SA-22, *Safety Alert, Potential of Carbonated Beverage Systems to Create Life-Threatening Environment*

SA-23, *Safety Alert, Acetylene Cylinders Missing Required Markings*

SA-24, *Safety Alert, Emergency Medical Services Filling Oxygen or Air for Human Respiration*

CGA Safety Bulletins

SB-1, *Hazards of Refilling or Reusing Compressed Refrigerant (Halogenated Hydrocarbon) Gas Cylinders*

SB-2, *Oxygen-Deficient Atmospheres*

SB-4, *Handling Acetylene Cylinders in Fires*

SB-6, *Nitrous Oxide Security and Control*

SB-7, *Rupture of Oxygen Cylinders in the Offshore Marine Industry*

SB-8, *Use of Oxy-Fuel Gas Welding and Cutting Apparatus*

SB-9, *Recommended Practice for the Outfitting and Operation of Vehicles Used in the Transportation and Transfilling of Liquid Oxygen Used for Respiration*

SB-10, *Precautions for Connecting Compressed Gas Containers to Systems*

SB-11, *Use of Rubber Welding Hose*

SB-12, *Use of Regulator Pressure Gauges*

SB-13, *Use of Regulators on Compressed Gas Cylinders Over 3000 psig*

SB-15, *Managing Hazards in Confined Work Spaces During Maintenance, Construction, and Similar Activities*

SB-16, *Use of High Flow Oxy-Fuel Gas Heating Torch Apparatus*

SB-18, *Use of Refrigerant (Halogenated Hydrocarbon) Recovery Cylinders*

SB-19, *Potential Valve Thread and Cylinder Thread Mismatch*

SB-20, *General Information on Quick-Connecting Couplings for Compressed Gas Service*

SB-21, *Recommended Practice for Removing Hazardous Material Containers During Repair and Maintenance of Cylinder Trucks and Trailers*

SB-22, *Aluminum Cylinders – Guidelines for Heat Exposure Indicating Systems*

SB-23, *Liquid Oxygen Withdrawal from Health Care Facilities' Bulk Systems*

SB-24, *Guidelines for Common Carrier Vehicle Shipments of Compressed Gas Cylinders*

SB-26, *Cylinder Connections on Portable Liquid Cryogenic Cylinders*

SB-27, *Safe Use and Handling of Small Cylinders*

SB-28, *Safety of Instrument Air Systems Backed Up by Gases Other Than Air*

SB-29, *Prevention of Injury and Loss from Carbon Dioxide Delivery to Small Customer Sites*

SB-30, *Hazards Associated with the Decontamination, Disposal, or Requalification of Cylinders in Diborane, Diborane Mixture, and Pentaborane Service*

SB-31, *Hazards of Oxygen in the Health Care Environment*

SB-32, *Portable Cylinder Banks*

SB-33, *Static Electricity Hazards of Liquid or Solid Carbon Dioxide*

SB-34, *Product Migration in Manifolded Cylinders Due to Temperature Variations*

SB-35, *Guidelines for Employee Safety at Customer Locations*

SB-36, *Prevention of Cylinder Lading Contamination*

SB-37, *Nitrous Oxide Decomposition*

SB-38, *Guidance for the Safe Transportation of Medical Oxygen for Personal Use on Buses*

SB-39, *Potential Hazards of Quick Opening Cylinder Valves Used with Firefighting Gases*

SB-40, *Guidance for Roadside Inspections of Vehicles Transporting Class 2 Hazardous Materials*

SB-41, *Safe Maintenance of Cargo Tanks, Portable Tanks, Tube Trailers, and Multiple Element Gas Containers (MEGCs) Containing Class 2 Hazardous Materials*

SB-42, *Increased Pressure Rating of Gas Trailer Outlet Connections*

SB-43, *Medical Gas Quick Disconnect Wall Adaptors*

SB-45, *Proper Handling of Insulated Tanks that are in Obvious Signs of Loss of Vacuum*

CGA Technical Bulletins

TB-3, *Oxy-Fuel Hose Line Flashback Arrestors*

TB-8, *Evidence of Ownership of Compressed Gas Cylinders*

TB-9, *Guidelines for the Proper Handling and Use of the CGA 630/710 Series Ultra High Integrity Service Connections*

TB-13, *Correct Assemblies and Installation of Rupture Disk and Fusible Plug Type Pressure Relief Devices*

TB-14, *Torque Guidelines for Sealing CGA Valve Outlet Connections*

TB-15, *Requirements for the Post Manufacture Tare Weight Marking of Cylinders*

TB-16, *Recommended Coding System for Threaded Cylinder Outlets and Threaded Valve Inlets*

TB-17, *Test Methods for Evaluating Paints and Coatings on Refillable Steel Compressed Gas Cylinders*

TB-19, *Uses of Eddy Current to Detect Imperfections in Refillable High Pressure Vessels*

TB-20, *Required Markings and Manufacturer Identification on Post-Type Medical Cylinder Valves*

TB-21, *Prevention of "Odor Fade" in Carbon Steel Propane Cylinders and Tanks*

TB-22, *Guidelines for the Inspection, Maintenance, and Requalification of Liquefied Petroleum Gas Cylinders*

TB-23, *Inspection and Correct Installation Procedure for Tube Trailer Relief Device Elbows*

TB-24, *Recommendations to Mitigate Hazards from Small Pressure Relief Valves that Fail to Open at Set Pressure (Cracking Pressures Less Than 100 psig)*

TB-25, *Design Considerations for Tube Trailers*

TB-26, *Filling Nonliquefied Gases in TC/DOT Specification Cylinders to a Specified Settled Pressure*

TB-27, *Recommendations for CG-7 Pressure Relief Valves Used in Propylene Service*

TB-28, *Guidelines for the Safe Filling of Liquefied Petroleum Gas Cylinders*

TB-29, *Use of Gaskets in High Pressure Medical Oxygen Cylinder Service*

TB-30, *Embrittlement Due to Overheating of DOT-4L and TC 4LM Liquid Cylinders*

CGA Audiovisual Training Materials

AV-1, *Safe Handling and Storage of Compressed Gases*

AV-5, *Safe Handling of Liquefied Nitrogen and Argon*

AV-7, *Characteristics and Safe Handling of Carbon Dioxide*

AV-8, *Characteristics and Safe Handling of Cryogenic Liquid and Gaseous Oxygen*

AV-9, *Handling Acetylene Cylinders in Fire Situations*

AV-10, *Safe Handling and Use of Medical Equipment and Gases in a Homecare Environment*

AV-12, *Avoiding Medical Gas Mix-Ups*

Other CGA Publications

CGA-341, *Specification of Insulated Cargo Tank for Nonflammable Cryogenic Liquids*

HB, *CGA Handbook of Compressed Gases*

As of November 1, 2012.

CGA Summary Timeline

1901 - 1910: The Early Years

1902 Expansion engine invented

1902 First U.S. seamless cylinder plant

1907 First U.S. air separation plant

1908 High pressure cylinders introduced

1908 ICC given power to regulate explosives

1911 - 1920: Need for an Industry Voice

1911 First compressed gas regulations

1911 Water Jacket Test method proposed for regulation

1913 Compressed Gas Manufacturers' Association founded

1913 CGMA prepares regulatory recommendations

1913 CGMA standardizes cylinder tests

1914 First CGMA work with NFPA

1915 BOE requests war expertise from CGMA

1915 CGMA starts program to return lost cylinders

1917 CGMA evaluates value of hammer test

1918 CGMA standardizes cylinder valve connections

1918 American Standards Institute formed

1919 CGMA requests that BOE perform cylinder inspections

1921 - 1930: The Industry Grows

1921 CGMA Canadian Section formed

1924 First CGMA Pamphlet, Safe Handling of Compressed Gases

1925 CGMA advocates labeling of cylinders

1927 First cryogenic storage and transportation system

1929 First liquid oxygen production

1929 Liquefied petroleum gas widely accepted as auto fuel

1929 CGMA develops cylinder acceptance tests

1930 CGMA standardizes valve threads

1931 - 1940: The Cryogenic Age

1931 First vacuum insulated trucks and tank cars

1932 CGMA fire tests aid BOE accepting spring-loaded PRDs

1933 ICC regulates transport of compressed gases by truck

1936 CGMA research to calculate cylinder yield point

1936 Vacuum/powder insulation for cryogenic tanks

1938 CGMA celebrates its 25th Anniversary

1939 CGMA forms a Munitions Board Advisory Committee

1939 CGMA drafts label requirements for medical gases

1939 First railroad tank car shipment of liquid oxygen

1941 - 1950: The War Years

1942 CGMA serves as an expert for the War Department

1942 Small oxygen generators allow on site production; first on site plant opened

1945 CGMA develops specification for single-use cylinders

1945 CGMA works with the UN to develop international standard for cylinder filling

1945 CGMA improves test methods to detect cylinder brittleness

1946 CGMA begins using docket numbers

1948 Name changed to Compressed Gas Association

1948 CGA conducts pressure vessel design research

1949 First CGA publications (C-1, G-1, P-1, P-2) published

1949 ISO TC 58 organized; CGA takes role as administrator

1950 Rapid growth expands need for compressed gases

1951 - 1960: Storage and Transportation Revolution

1953 CGA adopts first Pin Index Safety System

1955 First vacuum/powder insulated cylinders

1955 CGA evaluates use of fiberglass for cylinder construction

1957 First commercial liquid hydrogen plant

1959 CGA adopts first Diameter Index Safety System

1960 FTSC code developed

1960 Bureau of Mines passes Helium Act Amendments

1961 - 1970: A New Era of Regulation

1962 CGA develops specification for insulated portable tanks

1962 First CGA Safety Seminar

1962 CGA initiates incident reporting program

1962 First shipment of cryogenic product by ocean-going vessel

1963 CGA celebrates its 50th Anniversary

1963 International Acetylene Association consolidated into CGA

1965 CGA develops shipping regulations with the Coast Guard

1966 First CGA Handbook of Compressed Gases published

1967 DOT begins revision of compressed gas transport regulations

1967 Agreement with U.S. Pharmacopoeia to develop medical product specifications

1967 CGA members classified as "voting" or "corresponding

1968 New CGA logo released

1968 CGA works with National Bureau of Standards on cryogenic fluid flow measurement

1968 CGA hosts first North American meeting of ISO/TC58/SC3

1970 CGA's Tank Car Research Committee evaluates tank design

1970 CGA works to develop international standards for cylinders

1971 - 1980: Standardization Becomes a Priority

1973 CGA recommends color coding of medical cylinders

1975 CGA begins early harmonization efforts with the Industrial Gas Committee of CPI

1976 CGA becomes increasingly involved in ISO and UN work

1978 DOT adopts the CGA pressure relief device standards

1978 First CGA Chairman's Meeting

1978 The Leonard Parker Pool Safety Awards are established

1979 First CGA audio/visual safety program released

1980 Non-cryogenic air separation methods gain popularity

1981 - 1990: Moving Towards Self-Regulation

1981 CGA headquarters move to Arlington, VA

1982 First computer system installed at CGA headquarters

1983 CGA responsible for cylinder symbol ownership registration

1984 CGA begins to document reasons for changes to positions

1985 CGA is restructured into technical areas

1985 CGA Canada Transportation of Dangerous Goods Seminars

1986 CGA publishes first safety posters

1987 The Compressed Gas Emergency Action Plan (COMPGEAP) is established

1988 CGA celebrates its 75th Anniversary

1988 CGA establishes the Fleet Safety Excellence Awards

1989 CGA forms the Helium Advisory Council

1990 CGA signs a Memorandum of Cooperation with CPI/EIGA

1991 - 2000: An International Approach

1991 CGA expands the Medical Gases Division to cover food and medical devices

1992 UN Globally Harmonized System of Classification and Labeling of Chemicals established

1993 CGA completes a committee restructuring effort

1993 CGA hosts its first Member Business Exchange

1994 CGA builds a comprehensive computer database

1994 CGA establishes the Charles H. Glasier Safety Award

1995 CGA works with NWSA to address nitrous oxide abuse

1996 The Helium Privatization Act adopted by the U.S. Congress

1997 CGA's website is released

1997 The H. Emerson Thomas Award for Lifetime Service to CGA is established

1998 IOMA establishes a Global Committee to support harmonization

1999 CGA transitions to electronic communications

1999 CGA is granted observer status with the UN SCETDG

2000 CGA implements Docket Process 2000

2000 CGA establishes the Environmental Recognition Program

2001 - 2010: A Focus on the Association

2001 CGA establishes the Morris A. Gold Recognition Award

2001 CGA releases a database driven member's website

2001 CGA is granted observer status with the UN SCEGHS

2002 CGA starts collecting proposed changes online

2002 CGA offers its first locked electronic publications for sale

2002 DHS creates the Safety Act, raising security as a primary focus for the industry

2004 CGA awarded a contract from the Department of Energy to develop hydrogen standards

2005 CGA's TASS and SEA Councils are merged to form Standards Council

2006 CGA implements Work Process 2006

2007 CGA evaluates the feasibility of personnel certification

2008 CGA initiates the Standards Quality Improvement Program

2008 CGA establishes a relationship with the National Association Boards of Pharmacy (NABP)

2011 - 2013: Advances in Self-Regulation

2011 CGA works with the ACC to form the Industrial Gases Panel (IGP)

2011 CGA forms a partnership with GAWDA to disseminate safety information

2012 CGA's Medical Gas Safety Act is signed into law as part of FDASIA

2012 CGA's Model Rules for the Licensure of Medical Gases and Medical Gas Related Equipment Wholesale Distributors are approved by NABP

2013 CGA celebrates its 100th Anniversary

Acknowledgements

The Compressed Gas Association wishes to thank all of those who contributed to this brief historical review of the Association and the industry it serves. Unfortunately, it is impossible to thank each of the scores of individuals and companies who contributed to the effort.

A special thank you is due, however, to Mrs. Laura Brumsey, CGA's Director of Operations and Administration, for her tireless efforts in putting this book together. CGA expresses thanks for the contributions by the members of the 100th Anniversary Celebration team: Laura Brumsey, Compressed Gas Association, Inc.; Thomas Carey, Chart Industries, Inc.; Naser Chowdhury, Air Products and Chemicals, Inc.; Nancy Flower, Compressed Gas Association, Inc.; Tabatha Martin, Chart Industries, Inc.; Kristy Mastromichalis, Compressed Gas Association, Inc.; Kristen McCarthy, Praxair, Inc.; Laurie McKay, Taylor-Wharton International, LLC; Jodie Olson, Chart Industries, Inc.; Christine Scully, Matheson; Michael Tiller, Compressed Gas Association, Inc.; and Len York, Taylor-Wharton International, LLC.

Special thanks are also due to AGA Gas, Inc.; Air Liquide American Holdings, Inc.; Air Liquide Canada, Inc.; Air Products and Chemicals, Inc.; Airgas, Inc.; the BOC Group; Carbide Industries, LLC; Chart Industries, Inc.; E.I. DuPont de Nemours & Co., Inc.; FIBA Technologies, Inc.; Harsco Corporation; Linde North America, Inc.; Liquid Air Corporation; Liquid Carbonic Industries Corporation; Luxfer Gas Cylinders USA; Matheson; Phillips Petroleum Company; Praxair, Inc.; Sherwood Valve, LLC; Taylor-Wharton International, LLC; and Western International Gas and Cylinders, Inc., who contributed much of the factual information and most of the photographs which appear in this publication. Many of these photographs had been previously published in various company publications, and permission to republish them here is gratefully acknowledged. Additionally, CGA thanks Krista Lee, Carl Johnson, and Roger Smith for their reviews and contributions to this publication.

While much of the material for this publication was contributed by CGA member companies, it should be noted that much of this contributed material has been revised, rewritten, shortened, and reorganized in order to meet constraints of size and budget. Thus, while a serious attempt has been made to include in this review some mention of the major developments which shaped the Compressed Gas Association and the industry over the past on-hundred years, it is acknowledged that this review is far from complete. Those who contributed historical material are therefore relieved of responsibility for errors, omissions, or misinterpretations of history.

In marking its centennial anniversary, the Compressed Gas Association wishes also to acknowledge, with thanks, the assistance of its many sister associations, technical societies, and standards-making bodies whose cooperation over the years has helped the CGA in furthering the cause of safety throughout the industry.

Foremost among these from a historical point of view were:

- the International Acetylene Association (founded in 1898), which became a part of the Compressed Gas Association in 1962
- the National Bottled Gas Association, which became a division of the CGA in 1933, but later moved to Chicago to become the National LP-Gas Association
- the National Soft Drink Association, with whom the CGA has cooperated for many years in development of standards for safety in the use of carbon dioxide in beverage plants and consumer sites
- the Gases and Welding Distributors Association (formerly the National Welding Supply Association), which has continued its cooperation with the CGA in the development of safety standards and training programs for distributors of compressed gas products nationwide

- the American Chemistry Counsel, (formerly the Chemical Manufacturers Association), with whom the CGA's Compressed Gas Emergency Action Plan (COMPGEAP) coordinates with ACC's CHEMTREC , as well as the coordination the activities of the newly formed Industrial Gases Panel within ACC,
- the association members of the International Harmonization Counsel: the European Industrial Gases Association, the Asia Industrial Gases Association, and the Japan Industrial and Medical Gases Association each of whom CGA works very closely to develop worldwide harmonized publications.

The foregoing are just a few of the scores of trade associations and technical societies that have cooperated with the CGA over the years. Others include The Chlorine Institute, the Fertilizer Institute, the National Fire Protection Association, the American Welding Society, the Semiconductor Safety Association, the American Society for Testing and Materials, the American National Standards Institute, the American Society of Mechanical Engineers, the Canadian Chemical Producers Association, the Canadian Standards Institute, the Canadian Propane Gas Association, the British Compressed Gases Association, the International Oxygen Manufacturers Association, the International Standards Organization, the International Oxygen Manufacturers Association and the National Propane Gas Association.

To all of these, and others not mentioned, our sincere thanks for your continued support.

CELEBRATING CGA Compressed Gas Association • 100 YEARS •