

Safetygram-5

Gaseous Helium

General

Gaseous helium is inert, colorless, odorless, noncorrosive, and nonflammable. Helium is the lightest rare gas. Helium is a monatomic chemically inert gas. It will not react with other elements or compounds under ordinary conditions.

Since helium is noncorrosive, special materials of construction are not required. Vessels and piping used in helium service should be designed to American Society of Mechanical Engineers (ASME) specifications or the Department of Transportation (DOT) codes for the anticipated pressures and temperatures.

Manufacture

Most commercial helium is recovered from natural gas through a cryogenic separation process. Normally, helium is present in less than 1% by volume in natural gas. Helium is recovered, refined, and liquefied. Liquid helium is typically shipped from production sources to storage and transfill facilities. Gaseous helium is then compressed into cylinders using oil- or water-lubricated compressors or by dry compression systems.

Uses

Gaseous helium is used as an inert shielding gas in metal arc and laser welding. Being both lighter than air and nonflammable, helium is used to inflate balloons and airships. Helium can provide a protective atmosphere in the production of reactive metals, such as titanium and zirconium. Gaseous helium is used as a coolant during the drawing of optical fibers, as a carrier gas for chromatography, and as a leak detection gas in a variety of industries.

Health Effects

Being odorless, colorless, tasteless, and non-irritating, helium has no warning properties. Humans possess no senses that can detect the presence of helium. Although helium is nontoxic and inert, it can act as a simple asphyxiant by displacing the oxygen in air to levels below that required to support life. Inhalation of helium in excessive amounts can cause dizziness, nausea, vomiting, loss of consciousness, and death. Death may result from errors in judgment, confusion, or loss of consciousness that prevents self-rescue. At low oxygen concentrations, unconsciousness and death may occur in seconds and without warning.

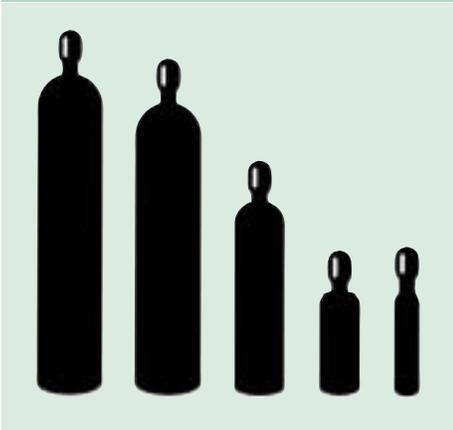
Personnel, including rescue workers, should not enter areas where the oxygen concentration is below 19.5%, unless provided with a self-contained breathing apparatus or air-line respirator.

For more information on oxygen-deficient atmospheres, consult Air Products' Safetygram-17, "Dangers of Oxygen-Deficient Atmospheres."

Containers

Gaseous helium is shipped and stored in high-pressure cylinders, tubes, or tube trailers, depending upon the quantity required by the user. Containers are designed and manufactured according to applicable codes and specifications for the pressures and temperatures involved. Cylinders are manufactured to Department of Transportation (DOT) regulations, which specify the material of construction, method of manufacture, testing, and with what products they are permitted to be filled, as well as other details. The quantity of product a container can hold is determined by its pressure rating and internal volume. Generally, the higher the pressure, the more helium is contained in a cylinder.



Figure 1**Typical Cylinder Shapes and Sizes****Cylinders**

A cylinder is a hollow tube with a closed concave base that permits the cylinder to stand upright. The opposite end is tapered to a small opening which is threaded to accommodate the installation of a valve. A threaded neck ring is attached to the tapered end to allow a protective cylinder cap to be installed.

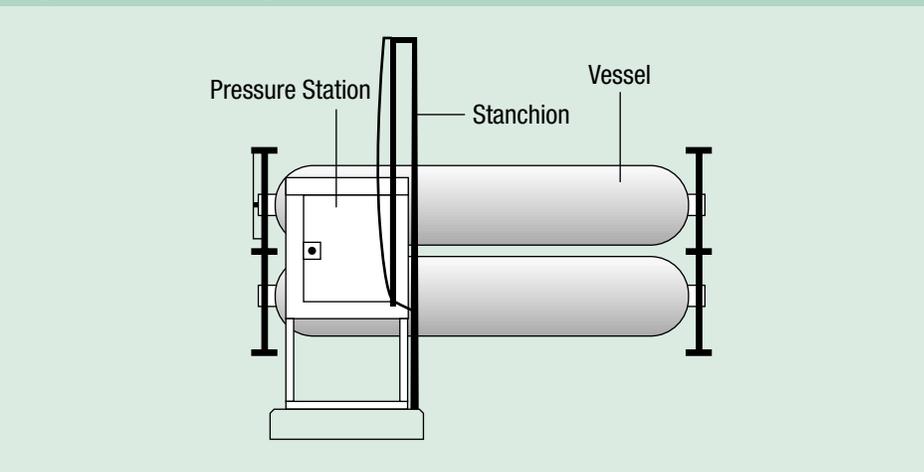
Cylinders may be used individually or in groups. When in groups, the cylinders should be piped together for stationary storage or to form portable banks.

Tubes

A tube is a pipe tapered at both ends. Each end is threaded to allow the installation of valves, connections, or relief devices. Tubes are manufactured according to DOT regulations or they may be made to ASME codes, depending upon whether they are used for transportation or mounted permanently at a site. Tubes are generally mounted on truck-trailer chassis, railroad car beds, or placed at stationary locations when large amounts of helium are needed.

Properties

Molecular Symbol	He
Molecular Weight	4.003
Boiling Point @ 1 atm	-452.1°F (-268.9°C)
Freezing Point @ 367 psia	-459.7°F (-272.2°C)
Critical Temperature	-450.3°F (-268.0°C)
Critical Pressure	33.0 psia (2.26 atm)
Density, Liquid @ B.P., 1 atm	7.798 lb./cu.ft.
Density, Gas @ 32°F (0°C), 1 atm	0.0103 lb./cu.ft.
Specific Gravity, Gas (Air = 1) @ 32°F (0°C), 1 atm	0.138
Specific Gravity, Liquid @ B.P., 1 atm	0.125
Specific Volume @ 32°F (0°C), 1 atm	89.77 cu.ft./lb.
Specific Volume @ 68°F (20°C), 1 atm	96.67 cu.ft./lb.
Latent Heat of Vaporization	34.9 Btu/lb. mole
Expansion Ratio, Liquid to Gas, B.P. to 32°F (0°C)	1 to 754

Figure 2**A Typical Tube Container System for Bulk Gas****Valve Connections**

The Compressed Gas Association (CGA) recommends three different connections for helium, depending on the pressure of the container. In addition, a high-integrity connection known also as a Diameter Index Safety System (DISS) connection has also been assigned to helium. Cylinders containing helium at pressures up to 3000 psig use a CGA 580; cylinders containing pressure between 3001 psig and 5500 psig use a CGA 680; and pressures between 5501 psig and 7500 psig use a CGA 677. The DISS connection assigned to helium is the DISS 718. For detailed drawings of these connections, consult Compressed Gas Association Pamphlet V-1. For general drawings, consult the Air Products Specialty Gases and Equipment Catalog.

WARNING: NEVER use adapters to make cylinder connections!!!

Table 1: Helium Service Connections

Cylinder Service	CGA Connection
Helium <3000 psig	580
Helium at 3001 to 5500 psig	680
Helium at 5501 to 7500 psig	677
Semiconductor	718

Pressure Relief Devices

Helium containers are equipped with pressure relief devices to protect from overpressurization. Helium cylinders less than 65 inches long use a frangible disc device. Cylinders over 65 inches use a combination device consisting of a frangible disc backed by a fusible alloy. Combination devices require that both the temperature and pressure requirements be reached before the device will relieve. For more information on pressure relief devices, consult Air Products' Safetygram-15, "Cylinder Pressure Relief Devices."

Container Stampings

Each cylinder or tube is identified by stampings in the metal of the shoulder. Figure 3 depicts an example of these stampings and what they mean.

Shipment of Gaseous Helium

All shipments of compressed helium must comply with DOT regulations. This applies to motor freight, rail, air, and water shipments. For air shipments, all packages must be in compliance with International Air Transport Association/International Civil Air Organization (IATA/ICAO) Dangerous Goods Regulations, as well as DOT regulations. Water vessel shipments must also be prepared in accordance with International Maritime Organization (IMO) regulations. All packaging used to transport helium must be either "UN/DOT Specification" or "UN/DOT Authorized" and in proper condition for transport.

Department of Transportation Regulations, Code of Federal Regulations Title 49, also describes the labeling and identification requirements.

DOT Shipping Name: Helium, Compressed

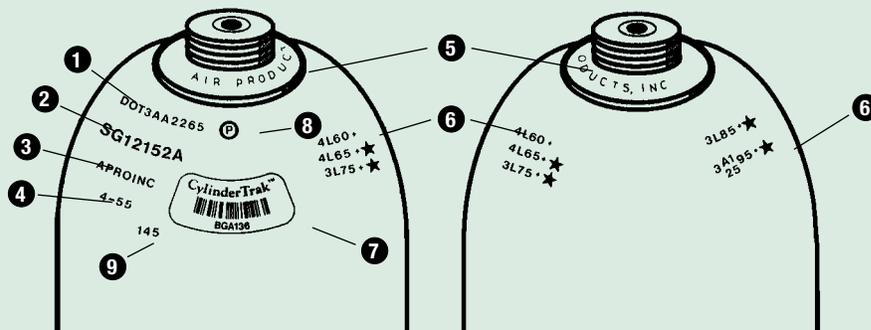
DOT Hazard Class: 2.2

DOT Shipping Label: Nonflammable Gas (Fig. 4)

Identification Number: UN1046

Figure 3

Key to Cylinder Stampings



1. Cylinder Specification

- DOT – Department of Transportation, which is the regulatory body that governs the use of cylinders.
- Specification of the cylinder type of material of construction (e.g., 3AA).
- Service or working pressure in pounds per square inch (e.g., 2,265 psi).

2. Cylinder Serial Number

- The letters SG precede the serial numbers for Specialty Gas cylinders.

3. Registered Owner Symbol

- Symbol used to indicate the original owner of the cylinders.
- APROINC is a Registered Owner Symbol for Air Products.

4. Date of Manufacture

- This date (month-year) also indicates the original hydrostatic test.

5. Neck Ring Identification

- The cylinder neck ring displays the name of the current owner of the cylinder.

6. Retest Markings

- The format for a retest marking is: Month-Facility-Year-Plus Rating-Star Stamp.
- The + symbol (Plus Rating) indicates that the cylinder qualifies for 10% overfill.
- The ★ symbol (Star Stamp) indicates that the cylinder meets the requirements for 10-year retest.

7. CylinderTrak™ Bar Code Label

- The CylinderTrak bar code label provides a unique cylinder identifier and is used by computer systems to track cylinders throughout the fill process. As an optional service, we have the capability of tracking cylinders to and from customers.

8. Cylinder Manufacturer's Inspection Marking

9. Cylinder Tare (Empty) Weight

Figure 4

Nonflammable Gas Shipping Label



Safety Considerations

The hazards associated with helium are asphyxiation and the high pressure of the gas in containers and systems.

Buildings

Provide adequate ventilation where helium is being used.

Provide monitoring for areas where oxygen displacement may occur.

OSHA has established 19.5% oxygen concentration as the minimum for working without supplied air.

Remember, helium has no warning properties!

Storage

- Cylinders should be stored upright in a well-ventilated, dry, cool, and preferably fire-resistant, secure area that is protected from the weather.
- Storage temperatures should **NEVER** exceed 125°F (52°C) and area should be free of combustible materials.
- Storage should be away from heavily traveled areas and emergency exits.
- Avoid areas where salt or other corrosive materials are present.
- Valve protection caps and valve outlet seals should remain on cylinders not connected for use. Separate full from empty cylinders. Avoid excessive inventory and storage time. Use a first-in, first-out system. Keep good inventory records.

Handling

- Do not drag, roll, or slide containers on their sides.
- Use a suitable handtruck designed for cylinder movement.
- Never attempt to lift a cylinder by its cap.
- Do not remove or interchange connections. If the user experiences any difficulty operating the container valve or with the container connections, discontinue use and contact the supplier. Use the proper connections.
- **DO NOT USE ADAPTERS!**
- Use piping and equipment designed to withstand pressures to be encountered.
- It is recommended that all vents be piped to the exterior of the building.
- Secure cylinders at all times while in use.
- Use a pressure-reducing regulator or separate control valve to safely discharge gas from cylinder. Use a check valve to prevent reverse flow into the cylinder.
- Do not overheat cylinder to increase pressure or discharge rate.
- **NEVER** insert an object (e.g., wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage the valve, causing it to leak.
- Use a special cap wrench or adjustable strap-wrench to remove overtightened or rusted caps.

NOTE: Refilling or shipping compressed gas cylinders without the consent of the owner is a violation of Federal Law.

Personnel Equipment

Personnel must be thoroughly familiar with properties and safety considerations before being allowed to handle helium and/or its associated equipment. The use of safety glasses, safety shoes, and leather work gloves is recommended when handling cylinders. Only trained and certified emergency responders should respond to emergency situations. In emergency situations, self-contained breathing apparatus (SCBA) must be used.

First Aid

Persons suffering from lack of oxygen should be moved to fresh air. If the victim is not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Obtain immediate medical attention.

Self-contained breathing apparatus (SCBA) may be required to prevent asphyxiation of rescue personnel.

Fire Fighting

Since helium is nonflammable, special fire fighting equipment and instructions are not needed. However, upon exposure to intense heat or flame, cylinder may vent rapidly and/or rupture violently. Most cylinders are designed to vent contents when exposed to elevated temperatures. Pressure in a container can build up due to heat, and it may rupture if pressure relief device should fail to function.

Emergency Response System

- Call: **+1 (800) 523-9374**
(Continental U.S. and Puerto Rico)
- Call: **+1 (610) 481-7711** (other locations)
- 24 hours a day, 7 days a week
- For assistance involving Air Products and Chemicals, Inc. gases and equipment

Product Safety Information

- For MSDS and Safetygrams:
www.airproducts.com/productstewardship
- Fax-on-Demand:
Call: **+1 (800) 245-2746**
- Enter MSDS Index No. 1000 for a complete list of available safety literature
- 24 hours a day, 7 days a week

Technical Information Center

- Call: **+1 (800) 752-1597** (U.S.)
- Call: **+1 (610) 481-8565** (other locations)
- Fax: **+1 (610) 481-8690**
- E-mail: **gasinfo@apci.com**
- Monday–Friday, 8:00 a.m.–5:00 p.m. EST

Information Sources

- Compressed Gas Association
- 1725 Jefferson Davis Highway, Suite 1004
Arlington, VA 22202-4102
Phone: +1 (703) 412-0900
- National Fire Protection Association
1 Batterymarch Park, P.O. Box 9101
Quincy, MA 02269-9101
- Phone: +1 (800) 344-3555

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