

Safetygram #3

Gaseous Argon

General

Gaseous argon is tasteless, colorless, odorless, noncorrosive, and nonflammable. Argon belongs to the family of rare inert gases. It is the most plentiful of the rare gases making up approximately 1% of the earth's atmosphere. It is monatomic and extremely inert, forming no known chemical compounds.

Since Argon is inert, special materials of construction are not required. Vessels and piping should be designed to American Society of Mechanical Engineers (ASME) or Department of Transportation (DOT) codes for the pressures and temperatures involved.

Manufacture

Argon is produced by an air separation unit (ASU) through the liquefaction of atmospheric air and separation of the argon by continuous cryogenic distillation. The argon is then removed as a cryogenic liquid.

Uses

Argon serves as a shielding gas to protect metals from oxidation during welding. Inert gas welding is the preferred method of joining several ferrous and nonferrous alloys.

The metals and semiconductor manufacturing industries employ argon as a purge or inerting gas in furnaces, or other processing steps. In some instances, liquid argon is introduced and then vaporized over the surface of volatile or reactive molten metals to significantly reduce oxidation and/or volatility using an inert "blanket" of gas.

High-volume flow rates of argon are introduced via specialized lances or "tuyeres" in a variety of melting and refining processes. The argon typically acts as a "shroud" gas to provide protection to the tuyere. It also promotes removal of impurities and/or dissolved gases in several refining processes.

Argon is also widely used in the lighting industry for filling bulbs and in combination with other rare gases for special color effects.

Health Effects

Since argon is odorless, colorless, tasteless, and non-irritating, it has no warning properties. Humans possess no senses that can detect the presence of argon. Argon is non-toxic 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 argon 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, which 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 (SCBA) or air-line respirator.

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

Containers

Argon 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. The quantity of product a container can hold is determined by its water capacity and pressure rating.

Cylinders

Cylinders are manufactured according to DOT regulations, which specify the material of construction, method of manufacture, testing, and what products they are permitted to be filled with, as well as other details. A cylinder is a hollow tube with a closed concave base that permits it to stand upright. The opposite end is tapered to a small opening, 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 used in groups, the cylinders should be piped together, for stationary storage or to form portable banks.

Tubes

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

Valve Connections

The Compressed Gas Association (CGA) recommends three different connections for argon, depending on the pressure of the container. In addition, a high-integrity connection, also known as a Diameter Index Safety System (DISS) connection, has been assigned to argon. Cylinders containing argon at pressures up to 3,000 psig use a CGA 580 connection; cylinders with pressures between 3,001 and 5,500 psig use the CGA 680 connection; and cylinders with pressures between 5,501 and 7,500 psig use a CGA 677 connection. The DISS connection assigned to argon is 718.

Pressure-Relief Devices

Argon containers are equipped with pressure-relief devices to protect from overpressurization. Argon cylinders less than 65" long use a frangible disk device. Cylinders over 65" use a combination device consisting of a frangible disk backed by a fusible alloy. Combination devices require that

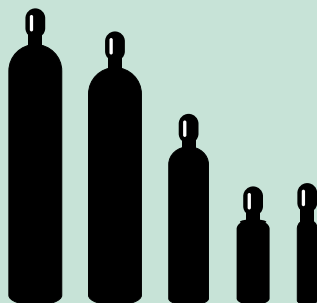
Table 1

Compressed Argon Physical and Chemical Properties

Chemical Formula	Ar
Molecular Weight	39.95
Boiling Point @ 1 atm	-302.6°F (-185.9°C)
Freezing Point @ 1 atm	-308.8°F (-189.4°C)
Critical Temperature	-188.4°F (-122.4°C)
Critical Pressure	705.8 psia (48.0 atm)
Density, Liquid, @ BP, 1 atm	87.40 lb/scf
Density, Gas @ 68°F (20°C), 1 atm	0.1034 lb/scf
Specific Gravity, Gas (air=1) @ 68°F (20°C), 1 atm	1.38
Specific Gravity, Liquid (water=1) @ 68°F (20°C), 1 atm	1.40
Specific Volume @ 68°F (20°C), 1 atm	9.68 scf/lb
Latent Heat of Vaporization	2,804 Btu/lb mole
Expansion Ratio, Liquid to Gas, BP to 68°F (20°C)	1 to 840

Figure 1

Typical Cylinder Shapes and Sizes



both the temperature and pressure requirements be reached before the device will relieve.

Container Stampings

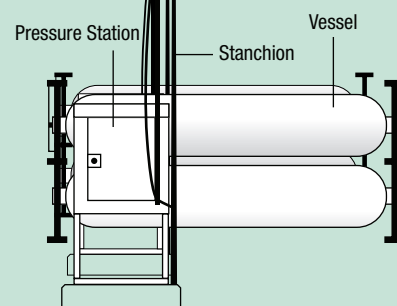
Each cylinder or tube is identified by stampings in the metal of the shoulder. Figure 3 shows these stampings and their meanings.

Shipment of Gaseous Argon

All shipments of compressed argon must comply with the DOT Code of Federal Regulations, Title 49. This applies to motor freight, rail, air, and water shipments. For air shipments, all packages must also comply with International Air Transport Association/International Civil Air Organization (IATA/ICAO) Dangerous Goods Regulations. Water vessel shipments must also be prepared in accordance with International Maritime Organization (IMO) regulations. All packaging used to transport argon must be either "UN/DOT Specification" or

Figure 2

A Typical Tube Container System for Bulk Argon



"UN/DOT Authorized" and in proper condition for transport. DOT Code of Federal Regulations, Title 49, specifies the following labeling and identification requirements:

DOT Hazard Class: 2.2

DOT Shipping Label: Nonflammable Gas

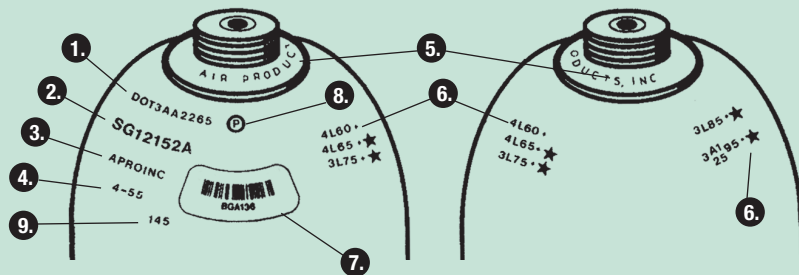
DOT Placard: Nonflammable Gas

Identification Number: UN1006

DOT Shipping Name: Argon, Compressed

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

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. Bar Code Label

- The bar code label provides a unique cylinder identifier and is used by computer systems to track cylinders throughout the fill process.

8. Cylinder Manufacturer's Inspection Marking

9. Cylinder Tare (Empty) Weight

- Avoid areas where salt and other corrosive materials are present.
- The valve outlet seal and valve protective cap should be left in place until the cylinder has been secured against a wall or bench, or placed in a cylinder stand and is ready for use.
- When returning empty cylinders, insure the valve is closed and that some positive pressure remains in the cylinder. Replace any valve outlet and protective caps originally shipped with the container and label the cylinder as “Empty”. Do not store full and empty containers together.

Handling

- Never drop, drag, roll or slide cylinders. Use a specifically designed hand-truck for cylinder movement.
- Never attempt to lift a cylinder by its cap.
- Wrenches should never be used to open or close a valve equipped with a handwheel. If the valve is faulty, contact the gas supplier.
- If difficulty is experienced operating the container valve or using the container connections, discontinue use and contact the gas supplier. Use only the proper connections on the container. **DO NOT USE ADAPTERS!**
- Always open a compressed gas cylinder valve slowly to avoid rapid system pressurization.
- **NEVER** insert an object (e.g. wrench, screw driver, pry bar, etc.) into the opening of the cylinder cap. Doing so may damage or inadvertently open the valve. Use only a specially designed strap-wrench to remove over-tightened or rusted caps.
- Never tamper with the safety devices on valves or cylinders.
- Use piping and equipment designed to withstand the maximum pressures encountered.
- Use a pressure reducing regulator or separate control valve along with properly designed pressure relief devices to safely discharge gas to working systems.
- Use a check valve to prevent reverse gas flow into the containers.
- It is recommended that all vents be piped to the exterior of the building and are in accordance with local regulations.
- **Refilling or shipping a compressed gas cylinder without consent of the owner is a violation of federal law.**

Figure 4

Nonflammable Gas Shipping Label



Safety Considerations

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

If oxygen-deficient atmospheres are suspected or can occur, use oxygen monitoring equipment to test for oxygen-deficient atmospheres. Review the appropriate Material Safety Data Sheet (MSDS).

Buildings

Provide adequate ventilation in areas using argon. 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, argon has no warning properties!

Storage

- Cylinders should be stored upright in a well ventilated, dry, cool, secure area that is protected from the weather and preferable fire-resistant.
- No part of a cylinder should ever be allowed to exceed 125° F (52° C) and areas should be free of combustible materials. Never deliberately over-heat a cylinder to increase the pressure or discharge rate.
- Cylinders should be stored away from heavily traveled areas and emergency exits.

Personal Protective Equipment (PPE)

Personnel must be thoroughly familiar with properties and safety considerations before being allowed to handle argon and/or its associated equipment. Safety glasses, safety shoes, and leather work gloves are recommended to handle cylinders. In emergency situations, wear a self-contained breathing apparatus (SCBA).

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.

Fighting Fires

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

The accuracy or completeness of all statements, technical information and recommendations contained herein is not guaranteed and no warranty of any kind is made in respect thereto. Such statements and information are given for general use only and should not be solely relied upon by the recipient when establishing appropriate procedures for his or her own operation.

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. products

Product Safety Information

- For MSDS, Safetygrams, and Product Safety Information www.airproducts.com/productsafety

Technical Information Center

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

Information Sources

- Compressed Gas Association (CGA) www.cganet.com
- American Chemistry Council www.americanchemistry.com

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