Safetygram-2

Gaseous Nitrogen

General

Nitrogen makes up the major portion of the atmosphere (78.03% by volume, 75.5% by weight). Gaseous nitrogen is inert, colorless, odorless, tasteless, nontoxic, noncorrosive, and nonflammable. Nitrogen is inert and will not support combustion; however, it is not life supporting.

Nitrogen is inert except when heated to very high temperatures, where it combines with some of the more active metals, such as lithium and magnesium, to form nitrides. It will also combine with oxygen to form oxides of nitrogen and when combined with hydrogen in the presence of catalysts, will form ammonia.

Since gaseous nitrogen is noncorrosive, special materials of construction are not required. Vessels and piping should be designed to the American Society of Mechanical Engineers (ASME) standards or Department of Trans-portation (DOT) codes for the pressure and temperatures involved.

Nitrogen may be compressed into cylinders using water- or oil-lubricated compressors or by dry compression systems.

Physical and chemical properties are listed in Table 1.

Manufacture

Nitrogen is produced at air separation plants either by liquefaction of atmospheric air and separation of the nitrogen by distillation or by adsorption processes.

Uses

Nitrogen is the largest volume inorganic chemical sold in the world and has a multitude of commercial and technical applications. Nitrogen's properties benefit applications such as heat treating atmospheres, blanketing atmospheres, propellants, pneumatics, purging and pressurizing, and analytical carrier gases.

Health Effects

Being odorless, colorless, tasteless, and nonirritating, nitrogen has no warning properties. Humans possess no senses that can detect the presence of nitrogen. Although nitrogen is nontoxic and largely inert, it can act as a simple asphyxiant by displacing the oxygen in air to levels below that required to support life. Inhalation of nitrogen 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 or air-line respirator**.

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

Containers

Gaseous nitrogen 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

A cylinder (Fig. 1) 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.

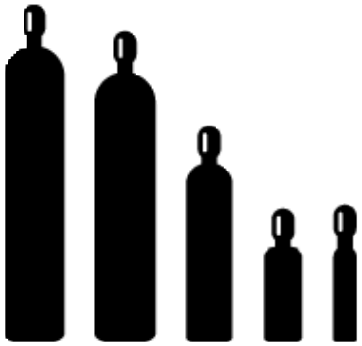


Fig. 1 Typical cylinder shapes and sizes.

Cylinders are manufactured according to DOT regulations. These regulations specify the material of construction, method of manufacture, method of testing, what products they are permitted to be filled with, as well as other details.

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 (Fig. 2) is a pipe that is tapered on both ends. Each end is then 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 on whether they are used for transportation or mounted permanently at a site. Tubes are generally mounted on truck-trailer chassis or railroad car beds, or placed at stationary locations when large amounts of nitrogen are needed.

Table 1: Gaseous Nitrogen Physical and Chemical Properties

Chemical Formula	N_2
Molecular Weight	28.01
Boiling Point @ 1 atm	320.5°F (–195.8°C)
Freezing Point @ 1 atm	–346.0°F (–210°C)
Critical Temperature	–232.5°F (–146.9°C)
Critical Pressure	492.3 psia (33.5 atm)
Density, Liquid, @ BP, 1 atm	50.45 lb/scf
Density, Gas @ 68°F (20°C), 1 atm	0.0725 lb/scf
Specific Gravity, Gas (air=1) @ 68°F (20°C), 1 atm	0.967
Specific Gravity, Liquid (water=1) @ 68°F (20°C), 1 atm	0.808
Specific Volume @ 68°F (20°C), 1 atm	13.80 scf/lb
Latent Heat of Vaporization	2399 Btu/lb mole
Expansion Ratio, Liquid to Gas, BP to 68°F (20°C)	1 to 694

Valve Connections

The Compressed Gas Association (CGA) recommends three different connections for nitrogen 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 nitrogen. Cylinders containing nitrogen at pressures up to 3000 psig use a CGA 580 connection; cylinders containing pressures between 3001 and 5500 psig use a CGA 680 connection; and cylinders containing pressures between 5501 and 7500 psig use a CGA 677 connection. The DISS connection assigned to nitrogen is DISS 718. For detailed drawings of these connections, consult CGA Pamphlet V-1. For general drawings consult the Air Products' *Specialty Gases and Equipment Catalog*.

Pressure Relief Devices

Nitrogen containers are equipped with pressure relief devices to protect from overpressurization. Nitrogen 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".

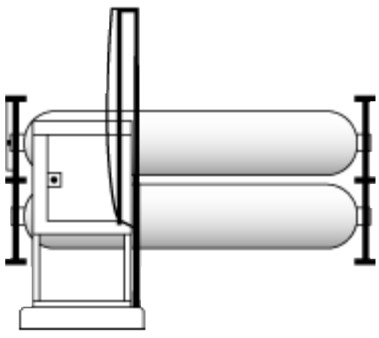


Fig. 2 A typical tube container system for bulk gas.

Container Stampings

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

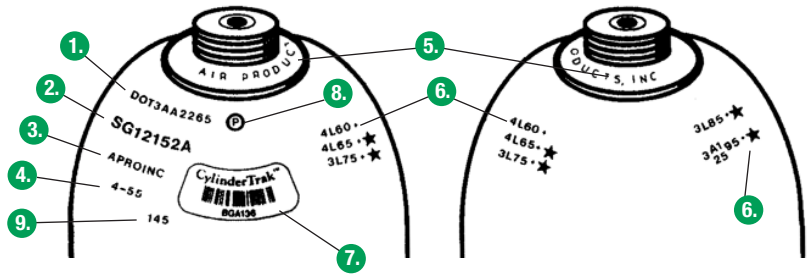
Shipment of Gaseous Nitrogen

All shipments of compressed nitrogen must comply with DOT regulations. This is true for motor freight, rail, water, and air shipments. The Department of Transportation Regulations, Code of Federal Regulations Title 49, also describes the labeling and identification required. All packaging used to transport nitrogen must be either "UN/DOT Specification" or "UN/DOT Authorized" and in proper condition for transport.

DOT Shipping Name: Nitrogen, Compressed
DOT Hazard Class: 2.2
DOT Shipping Label: Nonflammable gas (Fig. 4)
Identification Number: UN1066

Safety Considerations

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



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

Fig. 3 Key to cylinder stampings.

Buildings

Provide adequate ventilation where nitrogen is being used. Test the atmosphere in confined work areas for oxygen content. A 19.5% oxygen concentration in the air is the minimum recommended for working without special breathing equipment.

Remember: nitrogen has no warning properties!

Handling and Storage

Cylinders should be stored upright in a well-ventilated, secure area, protected from the weather (should be dry, cool, and preferably fire-resistant). Storage temperatures should **NEVER** exceed 125°F (52°C), and the 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 (FIFO) system. Keep good inventory records.

Do not drag, roll, or slide containers on their sides. 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.

Fig. 4 Nonflammable gas shipping label.

Use a suitable handtruck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure reducing regulator or separate control valve to safely discharge gas from cylinders. Use a check valve to prevent reverse flow into the cylinder. Do not overheat cylinders 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 overly tight or rusted caps.

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

Personal Protective Equipment (PPE)

Personnel must be trained in the properties and safety considerations before being allowed to handle nitrogen and/or its associated equipment. The use of safety glasses, safety shoes, and leather work gloves is recommended when handling cylinders. In emergency situations, self-contained breathing apparatus (SCBA) must be worn.

First Aid

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

Rescue in Oxygen-Deficient Atmospheres

Fiction: I can hold my breath long enough to rescue a downed co-worker.

Fact: Over 50% of the workers who die in confined spaces are attempting to rescue other workers.

Never *enter an oxygen-deficient atmosphere (<19.5% O_2) without self-contained breathing apparatus.*

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

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

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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