



# COMPRESSED GAS SAFETY: Understanding Gas Types & Hazards

PART 1 OF THE  
AIRGAS EBOOK SERIES

**Airgas**<sup>®</sup>  
an Air Liquide company

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**Please note:**

The information in this guide is general information and should not be used as specific information for a particular gas, or in lieu of an SDS for any specific gas product. Emergency response activities must only be undertaken by certified hazmat technicians, in accordance with OSHA 29 CFR §1910.120(q). Further, this information is not a substitute for training nor is it to be used as a replacement reference for Federal and State laws and regulations. It simply presents brief highlights of some of the more common compressed gas categories, and associated compressed gas handling, storing and transporting procedures that are industry standards.



## What you need to know before getting started

While some gases have more dangerous properties than others, all compressed gases are considered hazardous materials. As such, they require specific training on federal and state regulations covering the safe storage, use and transportation before you can even touch a cylinder. Therefore, anyone handling compressed gas should be familiar with the potential hazards before using the gas by:

- Educating personnel who handle compressed gases through discussion with a supervisor or knowledgeable coworker before beginning a new task. Use available resources and understand your local and State regulations
- Outlining the actions necessary to complete any given job
- Addressing potential emergencies and corresponding measures necessary to safely avoid such emergencies
- Considering scenarios that could result in gas leaks or other emergencies in order to be fully prepared to react appropriately



## Defining compressed gas

Before understanding the properties and hazards of various gas types, it's important to understand what a compressed gas is.

**Compressed gas** is defined as any non-flammable material or mixture contained under pressure exceeding 41 psia (3 bar) at 70°F (21°C), or any flammable or poisonous material that is a gas at 70°F (21°C), stored at a pressure of 14.7 psia (1 bar) or greater. Most compressed gases will not exceed 2,000-2,640 psig (138-182 bar), though some go up to 6,000 psig (414 bar).

**Liquefied compressed gas** is any chemical or material that, under the charged pressure, is partially liquid at a temperature of 70°F (21°C).

**Non-liquefied compressed gas** is any chemical or material (other than gas in solution) that, under the charged pressure, is entirely gaseous at a temperature of 70°F (21°C).

**Compressed gas in solution** is a non-liquefied compressed gas that is dissolved in a solvent.



## Understanding hazard classifications and gas types

Many gases have flammable, toxic, corrosive, oxidizing, pyrophoric and other hazardous properties that can cause property damage, severe injuries or even death if proper safety precautions are not followed. In addition to the gas chemical hazards, the amount of energy resulting from the compression of the gas makes a compressed gas cylinder a potential rocket.

The Global Harmonized System (GHS) has created classification criteria that determine the nature and relative hazard severity of a chemical substance or mixture. These GHS classification categories (listed here) enable workers to easily identify the type of gas they're working with and its associated hazards.

This way, anyone handling a compressed gas can quickly determine whether it's toxic, explosive or a combination of properties, to ensure the safety of themselves and others in the workplace.



**GHS01 | Explosives**



**GHS02 | Flammables**



**GHS03 | Oxidizers**



**GHS04 | Compressed Gases**



**GHS05 | Corrosives**



**GHS06 | Acute Toxicity**



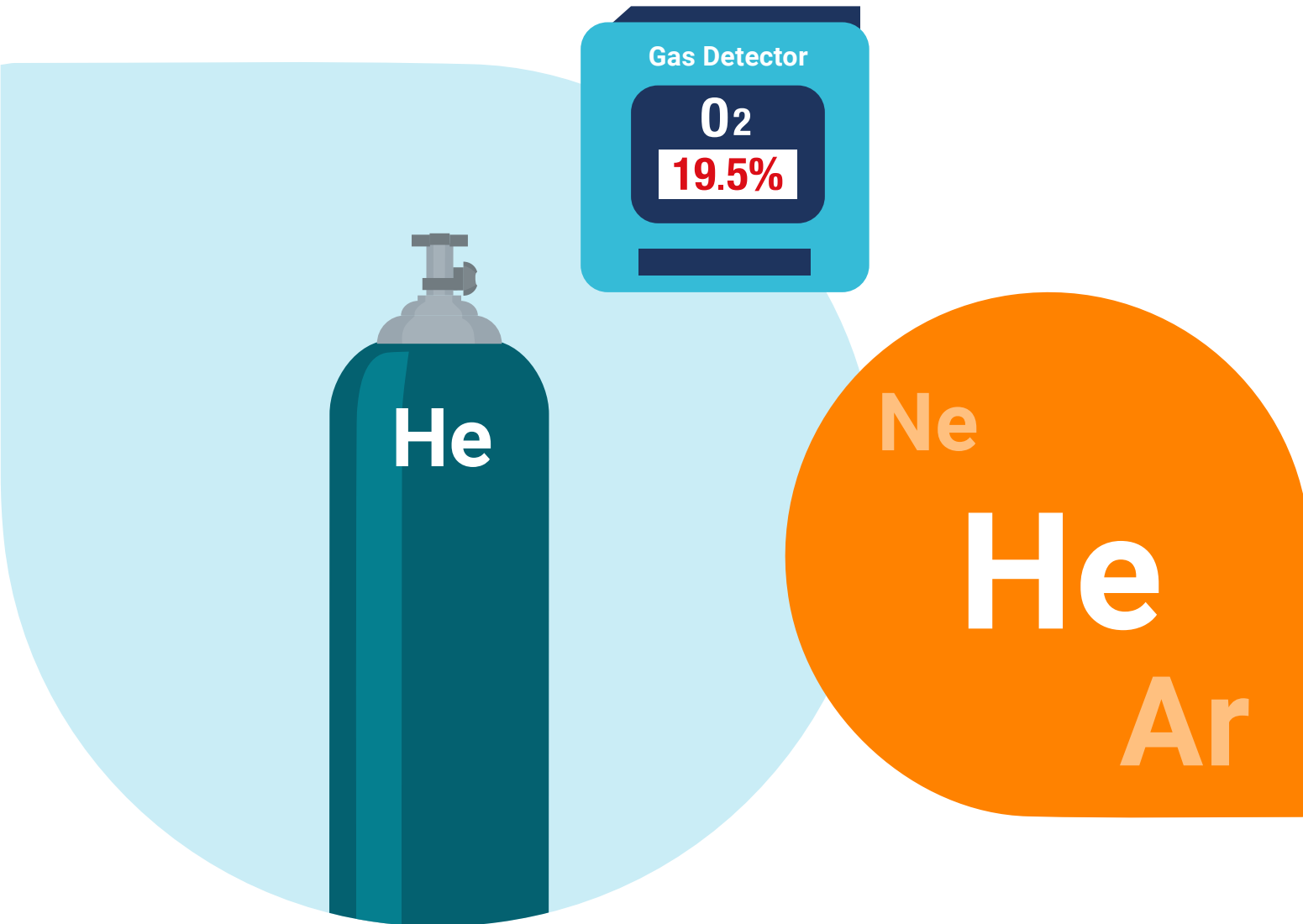
**GHS07 | Irritant**



**GHS08 | Health Hazard**



**GHS09 | Environment**



## Inert

Inert gases do not react with other materials at ordinary temperatures and pressure. They are also colorless, odorless, non-toxic and non-flammable.

While it might sound like inert gases are harmless, they can become life-threatening in a confined space and in large quantities. That's because they displace the oxygen in the air required to sustain life, leading to asphyxiation over long periods. And due to their colorless, odorless nature, they can be difficult to detect until you begin experiencing the effects of oxygen deprivation.

**To minimize the danger of asphyxiation and ensure the safety of everyone, always use adequate ventilation and monitor the oxygen levels in confined places.**

Examples of inert gases include **argon, helium, krypton and neon.**

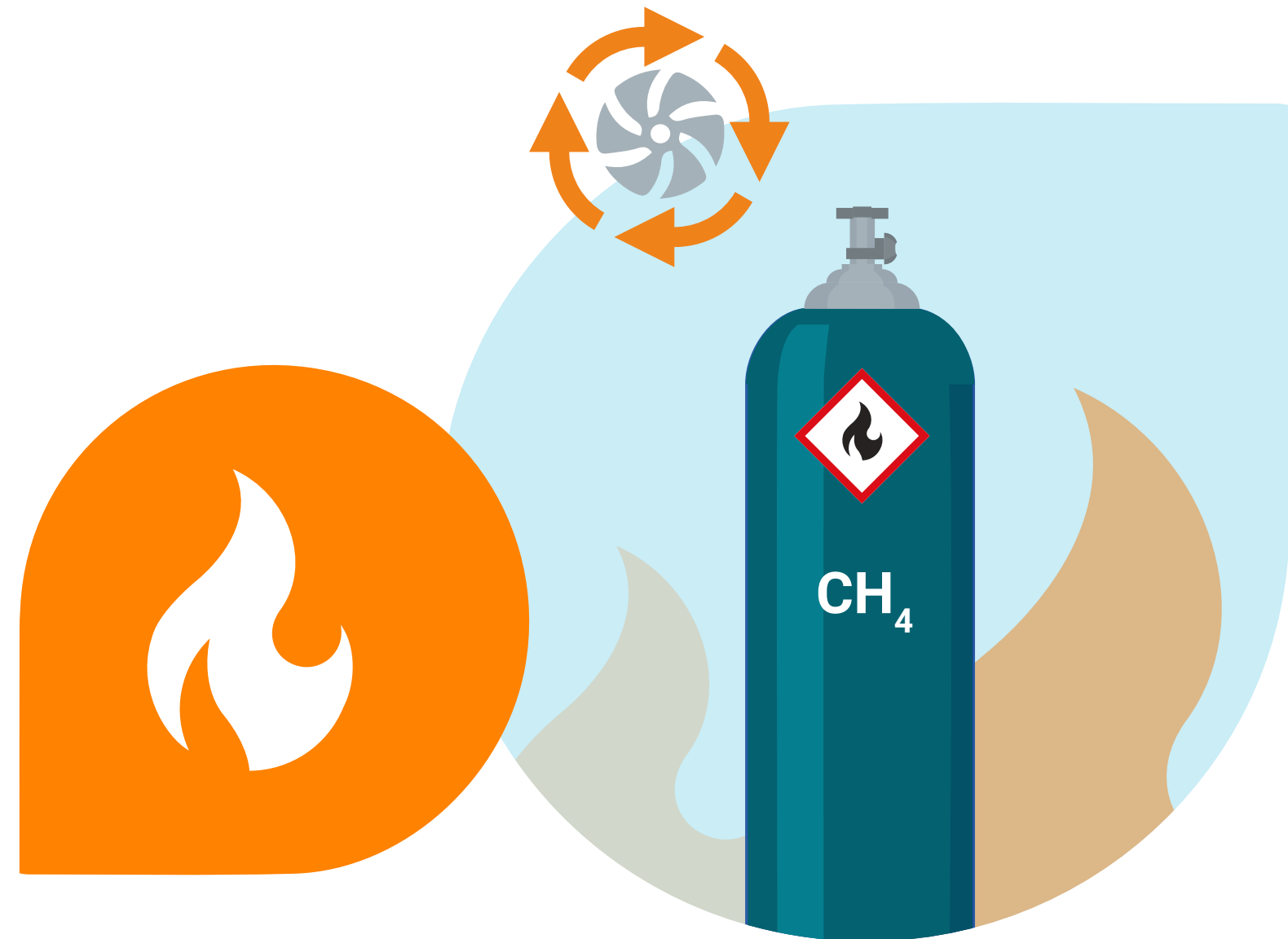
## Flammable

A flammable gas is a gas that burns in the presence of an oxidant when provided with a source of ignition. The risk of fire increases in relation to the amount of gas present. If the concentration of the flammable gas is below the Lower Explosion Limit (LEL), there is no reaction for lack of fuel; if it is above the Upper Explosion Limit (UEL), there is no reaction for lack of oxidant.

**When handling flammable gases, all possible sources of ignition must be eliminated. Use a vent line made of stainless steel as a flash arrestor to purge the area with inert gas in case of ignition. A handheld gas detector is also recommended to identify potential leaks and gas buildup.**

Wherever flammable gas is stored or used, it's essential to have a fire extinguisher on hand. However, it's important to remember that the source must be eliminated before attempting to put out a fire involving flammable gas.

Examples of flammable gases include **acetylene, butane, carbon monoxide, hydrogen, methane and propane.**





## Oxidizer

Oxidizers (or oxidants) are gases that support combustion and can displace oxygen from the air, with the exception of O<sub>2</sub> itself. While oxidants don't burn on their own, it is essential to eliminate all possible sources of ignition, as oxygen and oxidants can react rapidly and violently.

**Never store or allow readily combustible materials like oil, grease or flammable gases near oxidants, and ensure they do not come in contact with cylinders or other equipment used for oxidant services.** Only use equipment that is designed and intended for oxidants and regulators that are designated with a "cleaned for O<sub>2</sub> services" label.

Examples of oxidizer gases include **fluorine, nitrous oxide, oxygen and ozone.**



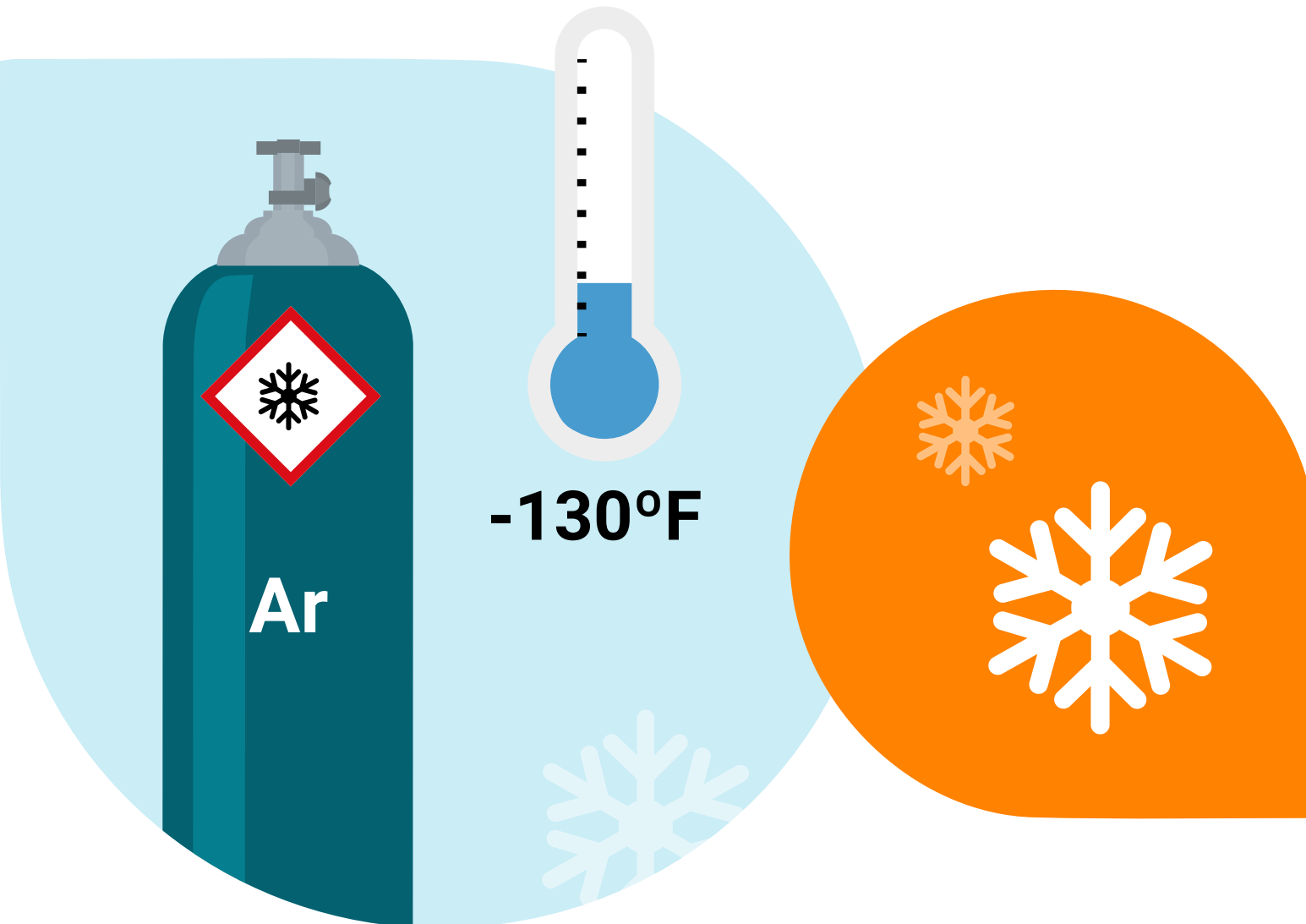
## Pyrophoric

Pyrophoric gases are commonly used in the semiconductor industry and they are extremely dangerous to handle as they do not require a source of ignition to explode or erupt in flames.

**Pyrophoric gases are highly volatile and will ignite spontaneously in air at or below 130°F (54°C), though specific gases may not ignite in all circumstances or may explosively decompose.** Under certain conditions, some pyrophoric gases can undergo polymerization, releasing large amounts of energy in the form of heat.

Examples of pyrophoric gases include **arsine, diborane, phosphine and silane.**





## Cryogenic

Cryogenic gases have a boiling point of  $-130^{\circ}\text{F}$  ( $-90^{\circ}\text{C}$ ) at atmospheric pressure. While they can be non-flammable, flammable or oxidizing, they're extremely cold and can easily cause intense burns if mishandled. At sub-freezing temperatures, system components can become brittle and crack, leading to damage and dangerous conditions.

Cryogenic liquids can also build immense pressure, so it's critical to never block a filled line. Otherwise, the tremendous pressure could burst the tube. It's also why your system should be designed with safety relief valves and a vent line, depending on the gas.

**When handling cryogenic materials, always wear gauntlet gloves and a cryogenic apron to protect the body and exposed skin. To prevent liquids from getting trapped inside your shoes, wear long pants that cover your footwear. You should also wear safety glasses and a face shield as cryogenic liquids tend to bounce when they are spilled.**

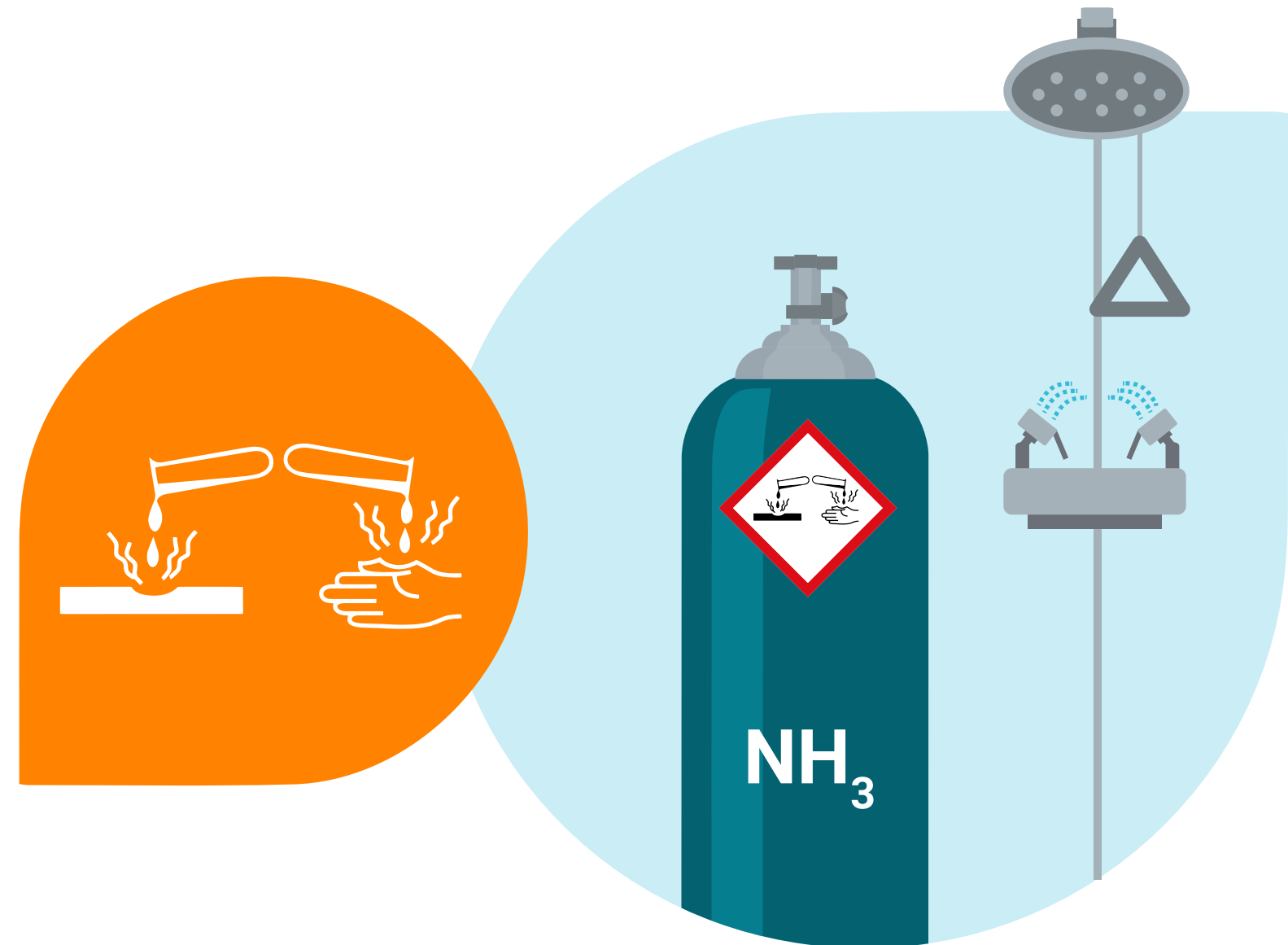
Examples of cryogenic gases include **argon, helium, hydrogen, nitrogen and oxygen.**

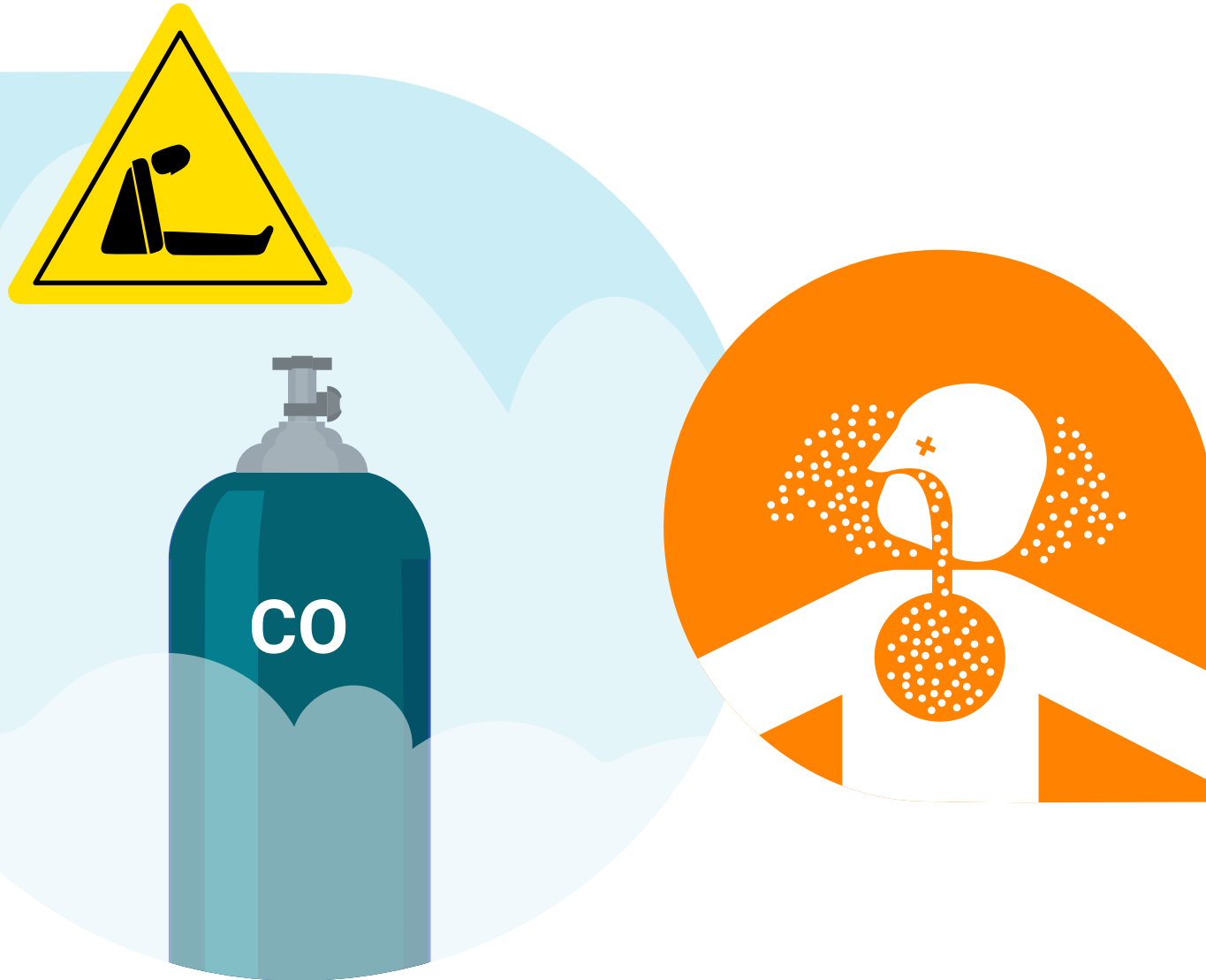
## Corrosive

Corrosive gases are those that corrode material or organic tissue on contact or in the presence of water. They are highly reactive and can also be toxic, flammable and/or an oxidizing agent. Most are hazardous in low concentrations over extended periods of time, so it's essential that the equipment used for handling corrosive gases be constructed of proper materials. Where there is a possibility of water or other inorganic materials getting sucked back into the cylinder, use check valves and traps in your system.

Due to the probability of irritation and damage to the lungs, mucous membranes and eye tissues from contact, you should rigidly observe the gas threshold limit values. **Minimize exposure to corrosive materials by utilizing the proper protective clothing and equipment. Ensure that a full-body shower and eyewash station are available in case of emergencies.**

Examples of corrosive gases include **ammonia, hydrogen chloride, nitrogen dioxide and sulfur dioxide.**





## Asphyxiant

Asphyxiants are gases that are either minimally or entirely non-toxic but can dilute the oxygen in the surrounding air when released. This can lead to death by asphyxiation if inhaled for a long enough period of time.

In large enough concentrations, toxic gases can also cause asphyxiation and lead to death by other mechanisms. This can include interactions with the respiratory system where oxygen is outcompeted (such as carbon monoxide poisoning) or direct damage caused by the gas (such as phosgene).

**Because asphyxiant gases are relatively inert, their presence might not be recognized – even in large amounts – until you experience the effects of low oxygen levels.**

Examples of asphyxiant gases include **argon, carbon dioxide, carbon monoxide, helium, methane, nitrogen and propane.**

## Toxic or Poison

Toxic or poisonous gases produce varying, potentially lethal health effects and can be high-pressure, reactive, flammable and/or oxidizing. Keep inventory to a minimum and refer to local building codes for storage information.

To ensure safety, read the [SDS](#) before handling, strictly adhere to [OSHA's permissible exposure levels](#) and never work with toxic gas alone. You should also thoroughly test and inspect the containment system and purge all lines with an inert gas before use.

**Only use toxic gases in a well-ventilated area, with gas detection, self-contained breathing apparatus, and proper protective equipment and PPE. Never work alone. You should have the breathing apparatus, a full-body shower, eye wash station, fire alarms and extinguishers readily available in case of emergency.**

After completing a project, return leftover cylinders to Airgas. Never store them for future use as this could result in accidental label removal, making it an unnecessary hazard and increasing the cost of proper disposal.

Examples of toxic/poisonous gases include **carbon monoxide, hydrogen sulfide, nitrogen oxide and ozone.**







## Conclusion: Understanding gas types and hazards

Understanding the types of compressed gases and their individual safety requirements is vital to ensuring workplace safety and protecting yourself and other employees. Knowing how to safely store, handle and transport these gases can mean the difference between a successful project or ending up in the emergency room. That's why it's critical to complete training on any applicable Federal and State regulations along with reading and understanding the Safety Data Sheet (SDS) when using hazardous materials like compressed gases. More resources for your team are listed below.

- Information on specific compressed gases is contained in [SDS](#) publications, which provide safety, technical and regulatory information on gas products. These are available from your point of product purchase or can be downloaded from [Airgas.com/sds-search](https://airgas.com/sds-search).
- The [Compressed Gas Association \(CGA\)](#) offers publications on handling compressed gases such as pamphlet P-1, "Safe Handling of Compressed Gases in Containers," and they also sell videos on compressed gas subject matter.
- Additional information on compressed gases can be found at [encyclopedia.airliquide.com](https://encyclopedia.airliquide.com).

At Airgas, we want you and your team to be safe — please don't hesitate to contact your Airgas representative for more information on general compressed gas safety or specific products.

**To learn more about compressed gas safety, please continue reading all three parts of our ebook series!**

PART 1:  
Compressed Gas Basics

PART 2:  
Storage & Handling

PART 3:  
Usage



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The information in this guide is general information and should not be used as specific information for a particular gas, or in lieu of an SDS for any specific gas product. Emergency response activities must only be undertaken by certified hazmat technicians, in accordance with OSHA 29 CFR §1910.120(q). Further, this information is not a substitute for training nor is it to be used as a replacement reference for Federal and State laws and regulations. It simply presents brief highlights of some of the more common compressed gas categories, and associated compressed gas handling, storing and transporting procedures that are industry standards. **In the event of an emergency, please dial 911.**