COMPRESSED GAS CYLINDER SAFETY

Compressed gas cylinders are a common fixture in research laboratories. As such it is imperative to understand safe handling, transportation and use of compressed gas cylinders. A compressed gas is defined by the Occupational Health and Safety Administration (OSHA) per 29 CFR 1910.1200 as:

A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg. C) regardless of the pressure at 70 deg. F (21.1 deg. C); or a liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 deg. C) as determined by ASTM D-323-72.

The broad definition provided by OSHA makes it difficult to cover all prudent practices concerning compressed gas safety. Therefore, the scope of this document will address compressed gas cylinders that are common in a laboratory environment.

SAFE HANDLING AND USAGE

Most compressed gas cylinders, whether they are ultra-high purity or industrial grade, will be pressurized to around 2000 psi. This represents an enormous amount of potential energy. If the gas is released uncontrollably or over-pressurizes equipment, there is an immediate hazard to life and health. Furthermore, many compressed gas cylinders will contain flammable or toxic gas. Finally, the threat of asphyxiation due to oxygen displacement by release of compressed gas must also be considered.
Always review manufacturers Safety Data Sheet (SDS) before using compressed gas for specific personal protective equipment, usage, and storage guidelines.

TRACKING:

• When receiving compressed gases from the manufacturer or a distributor, record the prudent information in the OSU online chemical inventory that is part of the Chemical Safety Assistant.

• It is also good practice to record the general timeframe a cylinder will be used. This will help minimize cylinder rental fees and prevent the accumulation of unneeded cylinders.

•All compressed gas cylinders must be returned to the supplier when empty or no longer in use.

• Appropriately label empty cylinders as being empty.

STORAGE:

• Cylinders must be secured with appropriate strap or chain when in storage, transit, or use. Secure cylinders by firmly chaining or strapping them to a wall, lab bench, or other fixed support. See Figure 1.

Figure 1. Figure depicts proper compressed gas cylinders restraint with either chain or strap.

• Valve protection caps must be in place during transit or storage. The only time the cap should be removed is while it's being used.

• Cylinders must be stored in the upright position.

• Never allow storage temperature to exceed 125°F (52°C).

• Never permit smoking or open flames in oxidizer or flammable gas storage areas.

•Oxygen should be stored in an area that is at least 20 feet away from any flammable or combustible materials (including gases) or separated from combustibles by a non-combustible barrier at least 5 feet high and having a fire-resistance rating of at least 1/2 hour.

• Never expose cylinders to corrosive materials.

• Segregate full and empty cylinders.

• Store cylinders in a dry, cool, well ventilated, secure area that is protected from the weather and away from combustible materials.

• Store cylinders away from heavily traveled areas and emergency exits.

• Visually inspect stored cylinders on a weekly basis for any indication of leakage or problems.

• Protect cylinders from wet or damp ground.

USAGE:

• Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings to remove a stuck cylinder cap. Doing so may damage or open the valve. Only use an adjustable strap wrench to remove over-tight or rusted protective caps.

• Cylinders should never be rolled or dragged. Only use hand carts specifically designed for moving compressed gas cylinders. Cylinders must be strapped or chained to cart.

• Never allow any part of a cylinder to be exposed to temperatures exceeding 125°F (52°C).

• Do not use a cylinder that cannot be positively identified. Color coding is not a reliable way of identifying a cylinder because the colors can vary from supplier to supplier.

• Only tools provided by the cylinder supplier should be used to open or close a valve. At no time should pliers be used to open a cylinder valve.

• Regulators must be examined prior to connecting to compressed gas cylinder. Ensure the regulator is rated for pressure of cylinder. Even if CGA connections are correct, the regulator may not be rated for pressure of cylinder.

• Never attempt to mix gases in a cylinder or return product to a cylinder.

• Never heat a cylinder to increase its pressure or withdrawal rate.

• Never refill cylinder after use of the original contents.

• Never force cylinder valve connections that do not fit. Standard cylinder-valve outlet connections have been devised by the Compressed Gas Association (CGA).

• Never reduce the residual pressure of a cylinder below the operating pressure of the system or 25 psi, whichever is higher.

•The threads on cylinder valves, regulators, and other fittings should be examined to ensure they correspond are clean and undamaged.

•Orientate pressure relief devices so that it does not pose a hazard to personnel in the area when out-gassing.

•Regulators are gas specific and not necessarily interchangeable. Never use an adapter between the outlet valve of a cylinder and regulator.

•Where the possibility of flow reversal exists, the cylinder discharge lines should be equipped with adequate check valves to prevent inadvertent contamination of cylinder.

•Always use safety glasses (preferably a face shield) when handling and using compressed gases, especially when connecting and disconnecting compressed gas regulators and lines.

•After the regulator is attached, the cylinder valve should be slowly opened just enough to indicate pressure on the regulator gauge (no more than one full turn), and all the connections checked with a soap solution for leaks.

•For cylinders equipped with a stem valve, the valve spindle key should remain on the stem while the cylinder is in service.

•Never use oil or grease on the regulator or a cylinder valve.

•Oxygen cylinder valves should be opened all the way. Initially, open up the oxygen cylinder valve stem just a crack. Once the needle on the high pressure gauge has stopped, open up the valve all the way. Completely opening the valve will seat the valve, which creates the required seal.

•Certain categories of toxic gases must be stored and used in ventilated enclosures. Note specific gases that require ventilated storage. Maximum allowable storage limits are given in Table 1.

LECTURE BOTTLES

Lecture bottles are small compressed gas cylinders, typically 12–18 inches (300–460 mm) long and 1–3 inches (25–76 mm) in diameter. Lecture bottles present a significant hazard in the laboratory, and are comprised of hazardous or toxic gasses that are either not available or considered unfeasible to poses in larger amounts. Most of the aforementioned practices that are applied to larger compressed gas cylinders also apply to lecture bottles. Below are some special considerations when utilizing lecture bottles.

•Especially hazardous lecture bottles may require ventilated storage in a gas cabinet or exhausted enclosure. Refer to Table 1 for storage guidelines.

• Designated areas should be assigned in the lab for lecture bottle storage. Areas should be labeled for lecture bottle storage according to hazard class. Due to the small nature of lecture bottles, they are often stored in random areas which make them easily misplaced.

• Outdated lecture bottles containing corrosive gas pose a significant explosion hazard.

• Store lecture bottles upright and segregated according to hazard class.

• Remove regulators and replace protective caps or plugs when lecture bottles are not in use.

•Lecture bottles must be properly secured during use, and lecture bottles containing hazardous gases (corrosive or poison) must be used in a fume hood or gas cabinet.

•Lecture bottles must be properly labeled. Re-label the lecture bottle if the label becomes illegible or falls off. It is a good idea to also label the regulator with the gas it was last used for to prevent accidental misuse in the future.

• When purchasing lecture bottles, the manufacturers return policy should be considered. The disposal cost of lecture bottle may exceed the difference of purchase price. It is best to purchase lecture bottles from vendors that will allow return of the bottle.

•Inspect the lecture bottle and regulator prior to use. Never use lecture bottles or regulators that are damaged or corroded.

Table 1. Allowable Quantity of Gases per Laboratory

Materials	Unsprinklered Areas		Sprinklered Areas	
	No gas cabinet, gas room, or exhausted enclosure	**Gas cabinet, gas room, or exhausted enclosure**	**No gas cabinet, gas room, or exhausted enclosure**	**Gas cabinet, gas room, or exhausted enclosure**
Corrosive Gas Liquefied Nonliquefied	68 kg (150 lb) 23 m3 (810 ft3)	136 kg (300 lb) 46 m3 (1620 ft3)	136 kg (300 lb) 46 m3 (1620 ft3)	272 kg (600 lb) 92 m3 (3240 ft3)
Cryogenic Fluid Liquefied Nonliquefied	0 L (0 gal) 170 L (45 gal)	170 L (45 gal) 340 L (90 gal)	170 L (45 gal) 340 L (90 gal)	170 L (45 gal)*** 681 L (180 gal)
Flammable Gas Liquefied Nonliquefied	114 L (30 gal) 28 m3 (1000 ft3)	227 L (150 gal) 28 m3 (2000 ft3)	227 L (60 gal) 28 m3 (2000 ft3)	454 L (120 gal) 56 m3 (4000 ft3)
Highly Toxic Gas Liquefied Nonliquefied	0 kg (0 lb) 0 m3 (0 ft3)	2.3 kg (5 lb) 0.6 m3 (20 ft3)	0 kg (0 lb) 0 m3 (0 ft3)	4.5 kg (10 lb) 1.1 m3 (40 ft3)
Nonflammable Gas Liquefied Nonliquefied	No Limit No Limit	No Limit No Limit	No Limit No Limit	No Limit No Limit
Oxidizing Gas Liquefied Nonliquefied	57 kg (15 gal) 43 m3 (1500 ft3)	114 kg (30 gal) 85 m3 (3000 ft3)	114 kg (30 gal) 85 m3 (3000 ft3)	227 L (60 gal) 170 m3 (6000 ft3)
Pyrophoric Gas Liquefied Nonliquefied	0 kg (0 lb) 0 m3 (0 ft3)	0 kg (0 lb) 0 m3 (0 ft3)	1.8 kg (4 lb) 1.4 m3 (50 ft3)	3.6 kg (8 lb) 2.8 m3 (100 ft3)
Toxic Gas Liquefied Nonliquefied	68 kg (150 lb) 23 m3 (810 ft3)	136 kg (300 lb) 46 m3 (1620 ft3)	136 kg (300 lb) 46 m3 (1620 ft3)	272 kg (600 lb) 92 m3 (3240 ft3)

NOTE: Amounts above are subject to change depending on laboratory construction and location.

For additional information, call EHS.