

Compressed Gas Cylinder Safety

Compressed gas cylinders are frequently utilized in laboratories for a variety of applications. Cylinders can contain a wide variety of both hazardous and non-hazardous materials. A compressed gas is any material or mixture in a container with either an absolute pressure exceeding 40 psia at 70°F or an absolute pressure exceeding 104 psia at 130°F. Depending on the gas and cylinder construction, contents can reach pressures of more than several thousand pounds per square inch (PSI). When handled correctly and used as intended, cylinders are a safe means of working with compressed gases. Before beginning work involving cylinders or compressed gases, consult with the supplier as well as Laboratory Safety before ordering any material to ensure that you have the correct procedures, equipment, storage area, and laboratory space necessary to work with the material.

Storing Cylinders:

Cylinders must always be stored upright (unless otherwise directed by the vendor) with the valve cap securely in place. All cylinders must be secured with appropriate chains or straps to prevent them from falling. Storage areas must be well ventilated and rated for the hazard(s) posed by the contents. Cylinders must always be labeled with both the vendor label and a Cylinder Tag regardless of whether Full, Partially Full/Used, or Empty.

- Chains/Straps must be securely attached to a structure capable of supporting the weight of the cylinder(s).
- Cylinder Tags must display the Owner's Name, Department, and Date Received, and be firmly attached to the cylinder until it is returned to the vendor.
- Cylinder Tags must indicate the status of the cylinder; Full, In Use, or Empty.



The contents of compressed gas cylinders can pose numerous hazards including but not limited to flammability, toxicity, and asphyxiation. If a space is not properly ventilated or rated for the hazard(s), the atmosphere in a room could become dangerous in the event of a leak. Ideally, spaces storing bulk quantities of compressed or liquefied gases should be equipped with air monitoring devices to warn personnel of hazards such as oxygen depletion or explosive atmospheres.

As an example, a common Size 300 (DOT-3AA2400) cylinder is being kept in a small storage closet.

- A Size 300 cylinder has an internal volume of 49 Liters.
- The contents of the cylinder are compressed to 2000 psi, yielding approximately 235 cu. ft. of gas.
- The storage space has dimensions of 4'x6'x12', yielding a volume of 288 cu. ft.

If a cylinder containing Nitrogen were to be released into the space in this example, it could potentially cause an oxygen deficient atmosphere without adequate ventilation.

Transporting Cylinders:

Transporting cylinders can be dangerous when proper precautions and equipment are not utilized. All cylinders must be transported while secured in a suitable cylinder cart with the valve cap installed. Many cylinders are heavy and can lead to serious injuries if dropped. Cylinder valves are commonly made of brass alloys and are delicate compared to the cylinder body. Valves can be broken off without a cap, and the release of pressure can turn a cylinder into a dangerous projectile.

- Never transport a cylinder without the valve cap installed. The only exceptions would be for cylinders that do not use caps and those with a non-removeable valve guard welded to the cylinder body.
- Cylinders must never be moved with regulators installed or while connected to equipment.

Safely Working with Cylinders:

During use, all cylinders must be secured against moving or falling regardless of size. Large cylinders must have their base resting on the floor and be strapped or chained at or slightly above the midpoint. Cylinder mounting brackets must be installed in all laboratories where cylinders will be regularly used. Rooms where compressed gases are in use must be well ventilated.

- For short-term operations, cylinder mounting brackets designed to clamp securely to a lab bench may be used.
- Smaller cylinders such as lecture bottles, need to be secured by placing them inside a cylinder stand.
- Do not secure multiple cylinders to mounting brackets designed to hold a single cylinder.
- Only after properly secured may the valve cap be removed, and a regulator installed and/or connected to equipment.
- Never use a cylinder while it is still in a cylinder cart or other transport device unless designed for that purpose (such as a welding cart).
- When attaching regulators, fully thread connections by hand before using tools. This prevents damage from cross-threading. If you feel unusual resistance, stop, and check the threads of the fittings for damage. Replace any damaged components before placing the cylinder into operation.
- Always perform a leak test of all connections prior to beginning operations. Use either a soapy water solution or a commercial test solution. Any bubbles that appear indicate a leak that needs to be corrected.



Acetylene Gas:

Cylinders containing acetylene are unique in that they do not directly contain pure compressed acetylene for use due to the inherent instability of the gas. Acetylene cylinders contain a porous media along with a solvent, typically acetone or dimethylformamide. The gas supplier then adds acetylene to the cylinder by dissolving it in the solvent. This process stabilizes the acetylene and reduces the risk of fire or explosion. Acetylene must always be stored, transported, and used with the cylinder in the upright position. If an acetylene cylinder is allowed to rest on its side, pockets of pure acetylene gas can form causing a dangerous condition.

- If an acetylene cylinder was stored on its side, it must be returned to an upright position for a period of 24 hours to allow the contents to restabilize before the cylinder can be used again.
- When working with acetylene where the gas will be ignited, flashback arrestors must be used. Connections to the cylinder must be inspected and checked for leaks with a soapy water solution.

Compressed Gas Cylinder Service Cycle and Disposal:

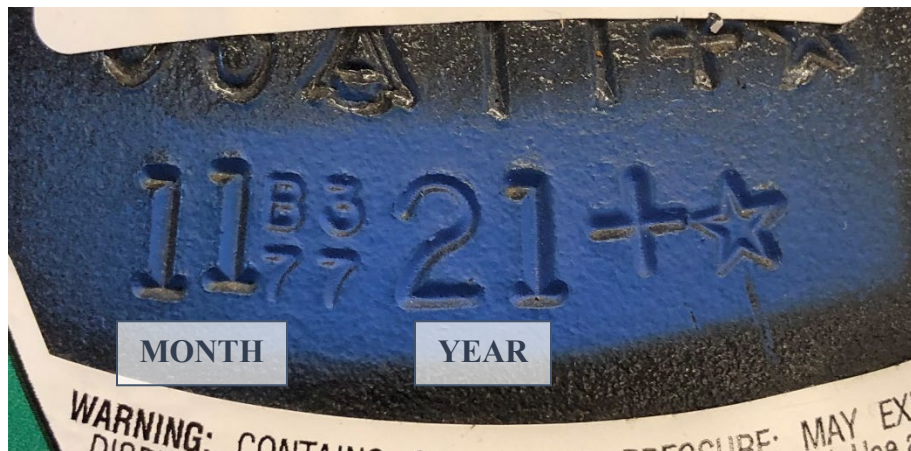
Whenever possible, cylinders should be purchased from suppliers who can take them back when they are empty or no longer needed. Always contact the original supplier for assistance when you no longer need a particular cylinder. While convenient, small lecture bottles are difficult and costly to dispose of even when completely empty. The disposal of a single lecture bottle is normally substantially greater than the cost of buying a slightly larger returnable cylinder. If you purchase a lecture bottle, keep in mind that your department may be required to cover future hazardous waste disposal costs.

- Some small cylinders used for calibration gases and some non-toxic substances are designed for easy disposal when empty. These have features such as removeable valves or a knock-out with special instructions on how to prepare them for disposal. Once open to the atmosphere, these cylinders are considered scrap metal.
- If you have a non-returnable cylinder, contact Laboratory Safety for assistance with arranging disposal. If the cylinder contains a RCRA Hazardous Material even if “empty”, it must be disposed of as a Hazardous Waste.

- Do not keep cylinders in storage that you do not plan to use within a reasonable time. The Department of Transportation requires that cylinders undergo periodic hydrostatic testing and be certified to transport them on public roadways. If this certification lapses, the cylinder will not be able to be returned to the supplier and it will need to be disposed of as hazardous waste.

Each cylinder is stamped near the valve with the date code from the most recent hydrostatic test. As long as a cylinder passes hydrostatic testing it can be placed back into service, typically in intervals of 5 years. Older cylinders will have many date codes stamped into the wall. When checking a cylinder, always go by the most recent date code.

The image below shows a typical hydrostatic test date code:



Reading the date code on the cylinder in the above image, it was last tested in November 2021. Because it also has a Star, it will not require hydrostatic testing again until November of 2031.

- The first set of bold digits are the test Month.
- The second set of bold digits is the test Year.
- The symbol or code between the sets of digits (in this example B377) is the identification mark of the tester.
- Some cylinders may have a Plus Sign. This means that this cylinder can be safely overfilled by the gas supplier by up to 10%.
- Some cylinders may also have a Star marking. If this is present, the cylinder may be kept in service for up to 10 years before being re-tested. If there is no Star, the cylinder may only be kept in service for up to 5 years before it must be re-tested.

Please contact Laboratory Safety at 856-256-5105 or LabSafety@Rowan.edu with any questions related to compressed gases or cylinders.