

OE-3: 2019-05

December 2019

Management of Old Compressed Gas Cylinders

PURPOSE

This Operating Experience Level 3 (OE-3) document provides information on the management of compressed gas cylinders. Longer term storage of gas cylinders (greater than two years) can lead to potential problems or incidents, increase the risks associated with cylinder movement, result in the degradation of cylinder condition, and add to the costs of compressed gas use and cylinder management. This OE-3 document includes steps for identifying old compressed gas cylinders, and recommendations for preventing and minimizing the accumulation of aging gas cylinders at storage locations.

BACKGROUND

Compressed gas cylinders are used across the U.S. Department of Energy (DOE) Complex in many applications including equipment maintenance, repair, machine shops, food services, and in experiments at research facilities. Types of gases involved include pure gases, standard mixtures, and special or calibration mixtures. Compressed gases can be toxic, flammable, oxidizing, corrosive or inert. In the event of a leak, inert gases can quickly displace air to create an oxygen-deficient atmosphere; toxic gases can create poison atmospheres; and flammable or reactive gases can result in fire or other hazardous conditions. Some compressed gases, such as Halon or sulfur hexafluoride (SF₆), are also ozone depleting substances that can have an adverse impact on the environment when released in large quantities.

While the Occupational Safety and Health Administration and Department of Transportation (DOT) specify requirements for use, storage and transport of compressed gas cylinders, there are a number of factors to consider with respect to properly managing compressed gases at DOE sites. The factors include environmental conditions, cylinder contents,

cylinder construction, handling, life expectancy, space constraints and cost associated with storing and disposing of old cylinders.

The longer a cylinder is kept, the more important it is to implement measures to protect the cylinder from the elements. Cylinders should not be exposed to continuous dampness and should not be stored near salt, corrosive chemicals or fumes. Rusting will damage cylinders and may cause valve protection caps to stick (see Compressed Gas Association [CGA] Pamphlet P-1-1965). If placed in outdoor storage, cylinders often begin to degrade after two to three years. Legitimate reasons for keeping cylinders past two years may include:

- Expensive or rare gases;
- Calibration mixtures, special mixtures for processes that may need to be batch ordered;
- Environmentally sensitive products;
- Foreign sourced cylinders;
- Disposable or "non-returnable" cylinders (such as lecture bottles); or
- Advance ordering due to budget constraints.

(NOTE: Some calibration gases degrade rapidly and have a recommended shelf-life that is much shorter than the cylinder's hydrostatic test date or inspection requirement.)

Non-legitimate reasons for keeping cylinders past two years may include:

- Vendor pickup undefined due to the manner the cylinder was brought to the site;
- Cylinder location inaccessible for normal vendor pickup;
- Vendor has changed and no longer makes scheduled pickups;
- Undefined empty/full cylinder storage locations;
- Cylinder may have been incorrectly delivered;

- Users forget the cylinder is in storage (or they retire) after the project is finished;
- Mislabeled cylinders with contradicting or missing information (for recent examples, see [NREL Lessons Learned on OPEXShare: Mislabeled Gas Cylinders Pose Potential Hazards, July 15, 2019](#)); or
- Misconception that the purchaser “owns” the cylinder.

All compressed gas cylinders are required to be in safe condition to the extent that this can be determined by visual inspection. Visual and other inspections must be conducted as prescribed in the Hazardous Materials Regulations of the DOT. Where those regulations are not applicable, visual and other inspections must be conducted in accordance with CGA Pamphlets C-6-1968 and C-8-1962. (Title 29 Code of Federal Regulations [CFR] 1910.101)

DISCUSSION

In August 2019, Sandia National Laboratory (SNL) had a near miss event when a gas cylinder’s manifold system failed, releasing about 45 cubic feet of Halon 1301 (bromotrifluoromethane). The cylinder was one of four cylinders that was in service for more than 10 years and subsequently placed in storage in 2012 after the decommissioning of a cooling system. Prior to the event, the cylinders were put in a process to transfer ownership and be removed offsite. The release was noticed when a worker heard a loud hissing sound. The worker immediately exited the warehouse and the building was evacuated. Compensatory actions included:

- Rotation of warehouse cylinders so that the gauges face out for inspection;
- Ensuring the roll-up door is open during working hours to allow for rapid ventilation in the event of another release;
- Notification of SNL Protective Force regarding the condition and potential hazard associated with a potential release during off hours; and
- Placement of hazard signs on entrance doors.

Corrective Actions of the SNL August 2019 event included:

- Coordination directly with the Department of Defense (DOD) to facilitate Halon transfers per Executive Order 13148, Section 505(c), which

requires Federal agencies to transfer excess Halon to DOD;

- Coordination with site planning, fire marshal, logistics, and other relevant stakeholders to identify Halon storage requirements, locations, timeframes, and other triggering points; and
- Formally documenting the procedure for safe Halon storage. (ORPS Report *NA--SS-SNL-8000-2019-0011*)

Potential problems that may result from keeping compressed gas cylinders for longer periods, include:

- Cylinder condition degradation due to corrosion or material fatigue;
- Cylinders still containing gas may be hazardous;
- Incorrect storage, e.g., exposing cylinders to the elements due to limited space;
- Valve may leak or fail;
- Cylinder caps may rust in place (Figure 1);
- Labels may become illegible;
- Safety hazards with animals or insects (Figure 2) and debris collecting on or near cylinders;
- Unnecessary/unknown hazard for emergency workers;
- Empty cylinders take up storage space
- Rental charges may accrue (sometimes for decades);
- Purchasing gas that already is on site due to improper inventory; and
- Inefficiencies due to workers having to re-verify empty status.



Figure 1: Small SF₆ cylinder last used 6 years prior, note rust creeping up from base of cylinder.



Figure 2: Both cylinder caps include wasp nests.

Other issues relating to the longer-term storage of compressed gas cylinders:

- The company that owns the cylinder loses money due to the cylinder being out of circulation;
- The company may need to fully refurbish the cylinder (new valve, paint, hydrostatic testing); and
- If the cylinder company goes out of business, the DOE site has to assume full responsibility for the cylinder.

These issues are important because poor inventory or maintenance of cylinders by the DOE site may affect future bid quotes with cylinder companies.

An old cylinder is an expensive cylinder and the management of such cylinders should be avoided or mitigated as much as possible. As a rule, when compressed gas cylinders are no longer needed, they should be promptly disposed of rather than allowed to accumulate and deteriorate.

ANALYSIS

Approaches for identifying old gas cylinders and potential items or conditions to look for:

1. Identify vendor and cylinder serial number or bar code sticker.
2. Identify contents - Is the label readable? Are the contents hazardous, environmentally sensitive, a standard product, or a mixture? If the label is not legible, contact workers that may have historical use knowledge or vendor information.
3. Does the cap come off easily, or with modest effort? The cap should not be forced.
4. If contents are still unknown, identifying the type of CGA fitting on the cylinder valve can provide insight to potential hazardous contents (flammable, inert, carbon dioxide, etc.).
5. Opening the valve to assess the gas quantity inside the cylinder is not recommended on cylinders dormant more than 15 years. If necessary, use extreme care when opening the valve on cylinders between 10 and 15 years old. **Do not open a cylinder if you are unsure of its contents.**

6. If the valve appears to be damaged, do not open it.
7. Limit investigative work if uncertain; refer to subject matter experts.
8. Contact local hazardous waste specialists for further guidance.

Old compressed gas cylinders may exhibit the following attributes:

- Rust (any rust at all) – companies don't sell gas in rusty cylinders;
- Out of place color scheme (faded, or unusual colors);
- Dusty or dirty cylinders, label may be covered in thick dust;
- Immediate area is cluttered, cylinder may be hidden behind debris;
- Unusual sized cylinder;
- Cap might not look right (different color or not attached properly);
- Unfamiliar vendor; and/or
- Located in obscure, uninhabited, or hard to reach locations.

RECOMMENDATIONS

Potential measures to minimize the accumulation or continued storage of old compressed gas cylinders include the following:

1. If vendor changes, inspect the site for old cylinders owned by that vendor before rent starts accruing.
2. Unused old cylinders should be grouped in designated areas, not distributed throughout the site. This facilitates both inventory efforts as well as pickup for non-contract vendors.
3. Consider establishing an internal site "oversupply inventory" so that others at the site can identify surplus compressed gas that may be available for use from other on-site sources. Apply the first in – first out rule.
4. The site should have convenient internal cylinder transport capability without having to rely on the vendor.
5. If possible, it is recommended to work through a vendor with a current contract, although specific products can be ordered from other vendors without major issues.



All cylinders have serial numbers, DOT specifications, and hydrostatic testing date(s) stamped into the metal that should be reviewed and followed. Under DOT regulations, compressed air cylinders must be tested every 3, 5, 10, or in exceptional cases, 12 years. The frequency with which a cylinder must be tested depends upon the age of a cylinder, the type of gas or chemical it contains, the particular material of the cylinder, and its rating.

If a cylinder is designated for a specific pressure limit, and it is determined that the cylinder is not equipped at its previously approved usage and pressure, then the cylinder cannot be certified for use. These guidelines should be followed as they are designed to help prevent disasters that may occur due to the transporting of faulty cylinders.

If cylinder information is obtained, the sites' compressed gas vendor will likely take the cylinder back. If not, the DOE site would be responsible for dispositioning the gas cylinder in accordance with all applicable regulations. The contents of cylinders destined for disposal are considered solid waste (under the Resource Conservation and Recovery Act [RCRA] regulations) and must be characterized to determine if RCRA hazardous waste management regulations apply. Disposal as a hazardous waste can be very costly. The less that is known about the contents, and the worse the condition of the cylinder, the more the disposition costs will likely be for such cylinders.

HOW TO PREVENT THIS FROM HAPPENING:

- Work with procurement to help inventory (track) both stock and special purchases from initial delivery to eventual pickup.
- Monitor all cylinders that enter the site through other means, and keep track of "owners," so cylinders are not abandoned after a project or experiment is completed.
- Designate/inventory specified cylinder storage locations, to eliminate hidden storage areas.
- Be aware of what is in storage area(s).
- Routinely review inventory against the Chemical Management System inventory.

REFERENCES

CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*

[NREL Lessons Learned on OPEXShare: Mislabeled Gas Cylinders Pose Potential Hazards, July 15, 2019](#)

CGA Pamphlet C-6-1968, *Standards for Visual Inspection of Steel Compressed Gas Cylinders*

CGA Pamphlet C-8-1962, *Standard for Requalification of DOT-3HT Cylinders*

[29 CFR 1910.101, Compressed Gases \(General Requirements\)](#)

ORPS Report: NA--SS-SNL-8000-2019-0011, *Halon Release from Cylinder in Storage*

[Executive Order 13148, Section 505\(c\), Reductions in Ozone-Depleting Substances](#)

ADDITIONAL SOURCES OF INFORMATION

49 CFR 171-179 and 14 CFR 103, *Hazardous Materials Regulations of the Department of Transportation*

10 CFR 851, *Worker Safety and Health Program*

[European Industrial Gases Association Technical Bulletin: Long Time Durability of Steel Gas Cylinders \(December 2016\)](#)

[Storing, Using and Handling Compressed Gases, Hanford Mission Support Contract, November 12, 2014](#)

Questions regarding this OE-3 document can be directed to Ashley L. Ruocco at (301) 903-7010 or e-mail Ashley.Ruocco@hq.doe.gov.

This OE-3 document requires no follow-up report or written response.



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