

## SUBJECT AREA CONTENT

[\[Add to Favorites\]](#)

[\[Introduction\]](#) [\[Contents\]](#) [\[Forms/Exhibits\]](#) [\[References\]](#) [\[Definitions\]](#) [\[Instructions\]](#) [\[Keywords\]](#) [\[Changes\]](#)

<b>Management System: <a href="#">Worker Safety and Health</a></b>			
<b>Subject Area: Compressed Gas Cylinders and Related Systems</b>			
<input type="checkbox"/> <b><a href="#">VIEW/PRINT ALL (No Exhibits and Forms)</a></b>			
Effective Date: <b>Apr 15, 2015</b> <a href="#">(Rev 2.4)</a> Periodic Review Due: <b>Apr 15, 2018</b>	Subject Matter Expert: <a href="#">Michael Gaffney</a>	Management System Executive: <a href="#">Ed Nowak</a>	Management System Steward: <a href="#">Gail Mattson</a>

### Introduction

This subject area provides the requirements for working with compressed gas in industrial, research, and construction activities at Brookhaven National Laboratory. This includes the planning, procuring, identifying, handling, transporting, installing, using, storing, and disposing of compressed gas cylinders and related equipment. It describes the minimum safety requirements; more stringent safety precautions may be applied based on the work or the staff member's experience. It applies to compressed gas cylinders, their regulators and attached manifolds, and localized piping. It does not include building distribution systems and pressure systems (see the [Pressure Safety](#) Subject Area). It does not cover chemical (see the [Chemical Safety](#) Subject Area), radiological, or cryogenic hazards associated with compressed gas. Supplemental information, including industry safety recommendations regarding compressed gases, is provided on the Safety and Health Services [ESH Guide: Compressed Gas Safety](#).

### Contents

Section	Overview of Content (see section for full process)
<a href="#">1. Planning to Use Compressed Gases/Systems</a>	<ul style="list-style-type: none"> <li>• Ensure work planning is performed.</li> <li>• Evaluate if the compressed gas can be safely used in the area and its impact to the FUA.</li> <li>• Determine if system conforms to Pressure Safety Subject Area.</li> </ul>
<a href="#">2. Procuring Compressed Gas Cylinders and Related Equipment</a>	<ul style="list-style-type: none"> <li>• Determine if the compressed gas is stock or special order.</li> <li>• Procure compressed gas and enter information into CMS.</li> <li>• Inspect cylinders.</li> <li>• Ensure cylinders are labeled and bar coded.</li> <li>• Distribute cylinder to user.</li> </ul>

### [3. Installing and Using Compressed Gas Systems](#)

- Ensure work planning is performed.
- Establish a new static inventory or revise existing one.
- Install system following requirements for type of gas being used.
- Pressurize the system.
- Secure the system.

### [4. Transfilling Compressed Gas Cylinders](#)

- Ensure transfilling of compressed gases is performed by gas supplier, or by personnel with special training.
- Ensure the supplier of the transfill equipment provides detailed written operating instructions.
- Allow transfilling of oxygen for respiration in accordance with CGA standards.

### [5. Storing Compressed Gas Cylinders](#)

- Store compressed gases according to requirements for type of gas.
  - Inert gases
  - Flammable gases
  - Oxidizing gases
  - Corrosive gases
  - Toxic gases
  - Highly toxic gases
  - Pyrophoric gases
  - Gases in lecture bottles.

### [6. Handling Compressed Gas Cylinders](#)

- Visually inspect cylinder before moving.
- Move and secure cylinder according to instructions.

### [7. Disposition of Compressed Gas Cylinders](#)

- Identify cylinders that require disposition.
- Update CMS.
- PPM picks up returnable cylinders.
- Dispose of non-returnable cylinders as hazardous waste.

### [Definitions](#)

#### **Exhibits**

None

#### **Forms**

None

## **Training Requirements and Reporting Obligations**

This subject area contains the following training requirements (see the [BNL Training and Qualifications](#) website):

- Compressed Gas Safety (TQ-COMPGAS1).

This subject area does not contain reporting obligations.

## External/Internal Requirements

Requirement Number	Requirement Title
<a href="#">10 CFR 851</a>	Worker Safety and Health Program
<a href="#">29 CFR 1910</a>	Labor/Occupational Safety and Health Standards
<a href="#">29 CFR 1926</a>	Labor/Safety and Health Regulations for Construction
<a href="#">49 CFR 173</a>	Transportation/Shippers - General Requirements for Shipments and Packagings
<a href="#">49 CFR 397</a>	Transportation/Transportation of Hazardous Materials; Driving and Parking Rules
<a href="#">ANSI Z 49.1</a>	Safety in Welding, Cutting and Allied Processes
<a href="#">BSA Contract No. DE-SC0012704 - Clause C.4</a>	Statement Of Work
<a href="#">BSA Contract No. DE-SC0012704 - Clause H.27 (ACT)</a>	Non-Federal Agreements for Commercializing Technology (Pilot) (ACT)
<a href="#">BSA Contract No. DE-SC0012704 - Clause I.131 (DEAR 970.5223-1)</a>	INTEGRATION OF ENVIRONMENT, SAFETY, AND HEALTH INTO WORK PLANNING AND EXECUTION (DEC 2000)
<a href="#">CGA C-6 1968 [IBR 29 CFR 1910.101]</a>	Standards for Visual Inspection of Compressed Gas Cylinders [IBR 29 CFR 1910.101]
<a href="#">CGA E-11 1996</a>	Standard for Stationary Compressed Gas Cylinder Discharging Manifolds for Working Pressures up to 3000 psig
<a href="#">CGA G-4 1996</a>	Oxygen
<a href="#">CGA S-1.1 2005</a>	Pressure Relief Device Standards-Part 1-Cylinders for Compressed Gases
<a href="#">DOE-STD-1066-99</a>	Fire Protection Design Criteria
<a href="#">NFPA 55</a>	Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks
<a href="#">O 151.1C</a>	Comprehensive Emergency Management System

## References

ASME B31.3, Process Piping

[BNL Training and Qualifications](#) website

[Business Systems Division \(BSD\) Chemical Management System \(CMS\)](#) webpage

CGA P-1-2000, Safe Handling of Compressed Gases in Containers

CGA P-2.5, Transfilling of High Pressure Gaseous Oxygen to be Used for Respiration

CGA P-2.6, Transfilling of Liquid Oxygen to be Used for Respiration

CGA S-1.1 through S-1.3, Pressure Relief Device Standards

CGA V-1, Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections

[Chemical Management System \(CMS\)](#) website

[Chemical Safety](#) Subject Area

[Credit Cards, Procurement](#) Subject Area

[Cryogenics Safety](#) Subject Area

[ESH Guide: Compressed Gas Safety, Safety and Health Services](#) website

[Facility Use Agreements](#) Subject Area

[Fire-Rescue Runcard System](#)\*

[Fire Protection Engineering, Emergency Services Division](#) website

[Fire Safety](#) Subject Area

Gas and Equipment Reference Guide by Scott Specialty Gases, Inc., Plumsteadville, Pennsylvania, 1997

[Hazard Analysis](#) Subject Area

[Inventory Stores Catalog, Procurement & Property Management \(PPM\) Division](#) website

[Material Safety Data Sheets \(MSDS\)\\*, Safety and Health Services](#) website

[Movement by Vehicle of Hazardous and Radiological Materials On-site](#) Subject Area

New York State Building Code

[Oxygen Deficiency Hazards \(ODH\), System Classification and Controls](#) Subject Area

[PeopleSoft Financial](#)

[Pressure Safety](#) Subject Area

[Signs, Placards, and Labels for Environmental, Safety and Health \(ESH\) Hazards](#) Subject Area

[Work Planning and Control for Experiments and Operations](#) Subject Area

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## Standards of Performance

Managers shall analyze work for hazards, authorize work to proceed, and ensure that work is performed within established controls.

Before waste is generated, managers shall ensure that it has a funded and available disposition

pathway. Managers shall ensure that all hazardous materials and waste have an identified owner who is accountable for its proper disposition.

All staff and users shall identify, evaluate, and control hazards in order to ensure that work is conducted safely and in a manner that protects the environment and the public.

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# PROCEDURE: PLANNING TO USE COMPRESSED GASES/SYSTEMS

<b>Management System:</b> <a href="#">Worker Safety and Health</a>		
<b>Subject Area:</b> <a href="#">Compressed Gas Cylinders and Related Systems</a>		
<b>1. Planning to Use Compressed Gases/Systems</b>		
Effective Date: <b>Apr 15, 2015</b>	Subject Matter Expert: <a href="#">Michael Gaffney</a>	Management System Executive: <a href="#">Ed Nowak</a>

## Applicability

This information applies to BNL staff and non-BNL staff planning to use compressed gases and related equipment. Related equipment refers to valves, tubing, regulators, manifolds, and associated equipment to which compressed gas cylinders may be connected.

## Required Procedure

The user or the user's supervisor must:

<b>Step 1</b>	<p>Perform a Hazard Evaluation/Job Risk Assessment. See the <a href="#">Work Planning and Control for Experiments and Operations</a> Subject Area. Identify all applicable work, risks, hazards, and related control measures for desired use of compressed gases and related equipment.</p> <p>For mixed gases, evaluate the effective hazardous ratings using the methodology in CGA Publication P-20 (Standard for Classification of Toxic Gas Mixtures). For assistance, contact the <a href="#">Compressed Gas SME</a>.</p> <p><b>Note:</b> Information regarding the safe use of compressed gases is provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>, including material compatibility and safe work practices, and information specific to Oxygen, LPG Gases, Acetylene, Hydrogen, and Toxic and Highly Toxic Compressed Gases.</p>
<b>Step 2</b>	<p>Evaluate the following as part of Work Planning:</p> <ul style="list-style-type: none"> <li>• Storage/handling provisions; <ul style="list-style-type: none"> <li>○ If the gas is classified as toxic or highly toxic gas (see <a href="#">Definitions</a>), ventilation, monitoring, and fire suppression are required for storage and use; <b>Note:</b> Pyrophoric gases have specific requirements, such as a fully sprinklered building. For assistance, contact <a href="#">Fire Protection Engineering</a>.</li> <li><b>Note:</b> Contact the <a href="#">Compressed Gas SME</a> or <a href="#">Safety and Health Representative</a> for proper controls if the gas is not considered toxic but its LC50 is less than 5000 ppm.</li> <li>○ The maximum allowable quantities must comply with New York State Building Code requirements. For assistance, contact <a href="#">Fire Protection Engineering</a>, the <a href="#">Compressed Gas SME</a>, or <a href="#">Safety and Health Representative</a>.</li> </ul> </li> <li>• Material Safety Data Sheet (MSDS); <ul style="list-style-type: none"> <li>○ MSDS can be found on the Safety and Health Services <a href="#">Chemical Management System (CMS)</a>* website. For assistance, contact the CMS</li> </ul> </li> </ul>

Team or the gas manufacturer;

- Confined space limitations;
- Flammable storage provisions;
- Oxygen deficiency hazard (ODH) concerns. See the [Oxygen Deficiency Hazards \(ODH\), System Classification and Controls](#) Subject Area for information;
- Required personnel protection equipment (PPE);
  - For assistance, contact the Safety and Health Service Representative;
- The proximity to hot work (cutting and welding permitted) areas;
- If the Facility Use Agreement (FUA) for the appropriate building authorizes the use of the specific compressed gas; update as needed;
- The impact to [Fire-Rescue Runcard System](#)\*; update as needed;
- Inventory limits to minimize use and storage quantities of hazardous gases and the need to install new cylinders too often (for example, monthly cylinder changes).

**Note:** If compressed gases are used or store in the building, the FUA should at a minimum list this subject area for controls. The FUA should include, if applicable, any line organization controls/procedures to address specific issues (i.e., Highly Toxic Gases). The FUA does not have to list the specific gases or locations.

**Note:** For inert gas use/storage, Fire-Rescue Runcards do not have to list specific locations. Contact the Fire-Rescue Group for guidance on listing other hazardous gas types and locations.

**Note:** If applicable, ensure that the [Hazard Validation Tool](#), found on the Safety and Health Services' Safety Engineering website, has been updated.

**Note:** Exceptions may be given to the stowage and monitoring requirements for highly toxic and toxic compressed gases if work planning documents that no health hazard would result from a release. The Laboratory Fire Safety Committee (as the Authority Having Jurisdiction) concurrence to the exception process is required.

**Note:** Ensure toxic/highly toxic or pyrophoric gases are not order/received prior to the approved controls are implemented.

**Note:** If incompatible gases are going to be stored in the same location, ensure the separation distances required by NFPA 55 (Compressed Gases and Cryogenic Fluids Code) can be satisfied. For assistance, contact [Fire Protection Engineering](#), or the [Compressed Gas SME](#).

**Note:** Line Organizations are responsible for providing adequate storage for all compressed gas cylinder sizes and amounts. Compressed gas suppliers will not deliver gas if storage is inadequate.

### Step 3

Ensure users have completed training. See the [BNL Training and Qualifications](#) website.

- Users must be familiar with the hazardous properties of the gases and must understand how to safely use compressed gases.

For use of Hazardous gases, such as toxic, highly toxic, pyrophoric and corrosive gases, Standard Operating Procedures (SOPs) need to be approved and implemented as part of the Work Planning/Experimental Safety Review process.

## References

[BNL Training and Qualifications](#) website

[Chemical Management System \(CMS\)\\*](#) website

[ESH Guide: Compressed Gas Safety, Safety and Health Services](#) website

[Fire-Rescue Runcard System\\*](#)

[Fire Protection Engineering, Emergency Services Division](#) website

[Material Safety Data Sheets \(MSDS\)\\*, Safety and Health Services](#) website

[Oxygen Deficiency Hazards \(ODH\), System Classification and Controls](#) Subject Area

[Work Planning and Control for Experiments and Operations](#) Subject Area

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## PROCEDURE: PROCURING COMPRESSED GAS CYLINDERS AND RELATED EQUIPMENT

Management System: [Worker Safety and Health](#)

Subject Area: [Compressed Gas Cylinders and Related Systems](#)

### 2. Procuring Compressed Gas Cylinders and Related Equipment

Effective Date: **Apr 15, 2015**

Subject Matter Expert: [Michael Gaffney](#)

Management System Executive: [Ed Nowak](#)

### Applicability

This information applies to BNL staff procuring compressed gas cylinders and related equipment.

### Required Procedure

<p><b>Step 1</b></p>	<p>The requester determines if the compressed gas needed is part of the Laboratory's stock inventory or if a special purchase order is required.</p> <p>Check BNL inventory using the <a href="#">Inventory Stores Catalog</a> on the <a href="#">Procurement &amp; Property Management (PPM) Division</a> website.</p> <p>If the gas type/quantity is part of the Laboratory's stock gas inventory, then the requester generates a PICK Ticket and submits it to PPM (using <a href="#">PeopleSoft Financial</a>).</p> <p><b>Note:</b> When receiving gas cylinders from stock, please review the Chemical Management System (CMS) information on the cylinder. If the cylinder is bar coded, follow the instructions on the paperwork provided. If the CMS information on the cylinder indicates that the gas cylinder is to be covered by a Static Inventory, make sure that one exists at the location where the cylinder will be stored or used.</p> <p>If a tube trailer is needed, the requestor contacts PPM Inventory Control. PPM is responsible for arranging the movement/delivery of the trailer and prepares the PICK Ticket.</p> <p><b>Note:</b> Standard Cylinder Size information is provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>.</p> <p><b>Note:</b> If incompatible gases are going to be stored in the same location, ensure the separation distances required by NFPA 55 (Compressed Gases and Cryogenic Fluids Code) can be satisfied. For assistance, contact <a href="#">Fire Protection Engineering</a>, or the <a href="#">Compressed Gas SME</a>.</p> <p><b>Note:</b> Line Organizations are responsible for providing adequate storage for all compressed gas cylinder sizes and amount. Compressed Gas suppliers will not deliver gas if storage is inadequate.</p>
<p><b>Step 2</b></p>	<p>If the gas type/quantity is not part of the Laboratory's stock gas inventory, the requester generates a purchase order for the specialty gas. The requester must select the purpose category "CMS Trackable Chem/Fuels/Gases" and provide the CMS-related information. See the <a href="#">Chemical Management System (CMS)</a> website for chemical requisition information.</p> <p><b>Note:</b> Cylinders are critical application items and are on the <a href="#">Restricted Item List</a> in the <a href="#">Credit Cards, Procurement</a> Subject Area.</p>

	<p><b>Note:</b> Ensure toxic/highly toxic or pyrophoric gases are not ordered/received prior to approved controls being implemented. Quantities should be consistent with inventory limits set by work planning.</p>
<p><b>Step 3</b></p>	<p>PPM receives cylinders delivered by a contracted vendor and performs the following (if cylinders are delivered directly to the user, see Step 4):</p> <ul style="list-style-type: none"> <li>• Checks upon receipt for obvious leaks and cylinder damage;</li> <li>• Verifies they are properly marked and labeled on the cylinder shoulder. <b>Note:</b> PPM does not verify gas quality;</li> <li>• Segregates/stores cylinders as required (flammable, oxidizers, etc.), see the section <a href="#">Storing Compressed Gas Cylinders</a>.</li> </ul> <p>Any cylinders that are unmarked, improperly marked, or marked in conflict with requirements are rejected and shipped back to the source.</p> <p>Detected leaking/defective cylinders are reported and handled according to applicable emergency/hazardous materials requirements.</p> <p><b>Note:</b> The contracted cylinder vendor verifies that the hydrostatic test date on the cylinder is current. The vendor is responsible for cylinder recertification if required and/or possible.</p>
<p><b>Step 4</b></p>	<p>When a specialty gas is received, CMS staff enters material into the CMS Inventory System and bar codes the cylinder as required. Please note that for very specific cases, specialty/non-stock gases are bar coded.</p> <p><b>Note:</b> CMS staff is notified by PPM when a specialty gas is received.</p> <p><b>Note:</b> If the gas needs specific controls for storage, such as highly toxic, pyrophoric, or corrosives gases, and is delivered directly to the approved storage location, then the user needs to notify the following groups to ensure the correct controls are in place and that the gas is properly recorded into the system:</p> <ul style="list-style-type: none"> <li>• PPM</li> <li>• CMS</li> <li>• Fire Rescue</li> <li>• Fire Protection Engineering.</li> </ul>
<p><b>Step 5</b></p>	<p>PPM attaches the Standard Cylinder Status Tag to the cylinder and delivers the properly secured and stored cylinder and/or related equipment to the requester.</p> <p>If a cylinder tag is missing upon receipt, the user is responsible for attaching a replacement. Contact the <a href="#">Distribution Group Supervisor</a> (PPM) for assistance.</p> <p><b>Note:</b> To minimize damage to the tag string, the tag should be connected to either the cylinder valve collar or bar code holder applied by the CMS Team.</p> <p>A Standard Cylinder Status Tag example is provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>.</p> <p><b>Note:</b> If line organizations have difficulty maintaining the Standard Cylinder Status Tag from damage (for example, exterior storage), line organizations can use alternate methods with <a href="#">Compressed Gas SME</a> concurrence, such as dedicated storage systems for segregation that</p>

identify full/empty/in use cylinders.

## References

[Chemical Management System \(CMS\)](#) website

[Credit Cards, Procurement](#) Subject Area

[ESH Guide: Compressed Gas Safety, Safety and Health Services](#) website

[Inventory Stores Catalog, Procurement & Property Management \(PPM\) Division](#) website

[PeopleSoft Financial](#)

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# PROCEDURE: INSTALLING AND USING COMPRESSED GAS SYSTEMS

Management System: [Worker Safety and Health](#)

Subject Area: [Compressed Gas Cylinders and Related Systems](#)

## 3. Installing and Using Compressed Gas Systems

Effective Date: **Apr 15, 2015**

Subject Matter Expert: [Michael Gaffney](#)

Management System Executive: [Ed Nowak](#)

### Applicability

This information applies to BNL staff and non-BNL staff who are responsible for installing compressed gas systems. This procedure is not applicable if inert compressed gas is used as part of standard operation procedure such as pressure leak checks.

### Required Procedure

Compressed gas systems are installed only by staff who are familiar with the hazardous properties of the contents and the necessary safeguards (e.g., change out of a cylinder or removal of a regulator) and who are experienced in using compressed gas systems.

<p><b>Step 1</b></p>	<p>The supervisor, or line management designee ensures that the system is installed as defined by the applicable work planning and specific hazard controls or mitigating actions are in place. See the section <a href="#">Planning to Use Compressed Gases/Systems</a> for design requirements and required safety controls (i.e., venting requirement, overpressure protection, personnel protective equipment, training, monitoring, etc.), and ensure that cylinder locations meet the requirements found in the section <a href="#">Storing Compressed Gas Cylinders</a>.</p> <p><b>Note:</b> Information regarding the safe use of compressed gases is provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>, including material compatibility and safe work practices, and information specific to Oxygen, LPG Gases, Acetylene, Hydrogen, and Toxic and Highly Toxic Gases.</p> <p><b>Note:</b> For related equipment that requires permanent installation, i.e., rigid piping/tubing or valves, contact the F&amp;O Facility Project Manager.</p>
<p><b>Step 2</b></p>	<p>The supervisor, line management designee, or installer ensures that</p> <ul style="list-style-type: none"> <li>• Shut-off valves are used instead of quick disconnects;</li> <li>• Teflon tape (or anything that could cause foreign object debris) is not used on cylinder valves, inlets of regulator components, and pressure relief devices;</li> <li>• The gas distribution system is made of compatible materials and is rated for the maximum applied pressures (including hose/tubing connections). Information regarding material compatibility and pressure ratings is provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>;</li> <li>• The gas distribution system is labeled as required by the section <a href="#">Piping Systems</a> in the <a href="#">Signs, Placards, and Labels for Environmental, Safety and Health (ESH) Hazards</a> Subject Area. Piping/tubing that is not in direct sight (such as through a wall</li> </ul>

penetration or bundled with other piping) of the compressed gas cylinder must be clearly labeled as gas contented;

- The gas distribution system is protected from damage (i.e., chafing) if penetrating openings (i.e., walls, floors, and ceiling);
- Suitable flexible piping or coiled tubing (pig tails) for cylinder connection points is used;
- While handling the cylinder, the regulator has been removed and the cylinder cap is installed (if the cylinder is configured for valve caps).

#### **CAUTION**

**The cylinder valve cap is removed only when the cylinder is properly secured  
Never attempt to pry off cylinder caps that may be stuck.**

### **Step 3**

The user or installer:

- Inspects compressed gas cylinders before and during use to determine they are in a safe condition. Never use cylinders that have dents or have arc/touch burns;
- Ensures that cylinder valves are closed when not in use;
- Installs cylinders that are properly and legibly labeled with the contents, and are the proper gases for use in that system. Labels must be legibly written, stamped, or stenciled identification of the cylinder contents before use. Labels applied by manufacturer or supplier/vendor to identify the cylinder contents are not to be defaced or removed. The stamped markings on the shoulder of the cylinder are in a legible condition and are not to be added, removed, or altered. No part of a cylinder has been modified, tampered with, painted, defaced, obstructed, removed or repaired, including the pressure relief devices, the container valve, or the valve protection devices;
- Updates the Chemical Management System (CMS) as necessary;
- On valves without hand wheels, uses only wrenches or tools that are provided or recommended by the gas manufacturer to operate a cylinder valve. When the cylinder is in use, the wrench/tool remains on the valve wheel. **Do not use wrenches, hammers, or other tools to operate valves with hand wheels;**
- Ensures cylinders are secured when in use. Use only equipment designed to secure gas cylinders (including small lecture bottles, if applicable). If using a bench/wall clamp or bracket, ensure the cylinder is supported between the middle and shoulder.
  - If a transport cylinder truck is used to secure the cylinder, ensure the truck is stable (must have 4-wheel non-collapsible design) and protected from inadvertent motion or damage. The cylinder valve cap must be installed unless the cylinder is in use and staffed. Oxygen/Acetylene systems may be stored with regulators installed, if in compliance with OSHA rules. See examples of acceptable use on Safety and Health Services [ESH Guide: Compressed Gas Safety](#);

#### **CAUTION**

**Do Not Tighten Connections or Attempt Repairs while the System is Under Pressure**

- Ensures connections to piping, regulators, and other apparatus are gas tight to prevent

	<p>leakage;</p> <ul style="list-style-type: none"> <li>• Inspects valves and regulators before connecting and ensures that they are free of foreign material (e.g., grease, dirt, oil). This is critical when handling/using oxygen due to the potential for a violent reaction with that gas and hydrocarbon materials;</li> <li>• Ensures cylinders are not placed where they become part of an electrical circuit, come into contact with an electrical energy source accidentally, or when used in conjunction with electric welding, become the grounding circuit or are used for grounding;</li> <li>• Ensures cylinders are not exposed to temperature extremes, do not come into direct contact with or close proximity to a radiant heat source, and that a flame or heat is never directly applied to any part of a compressed gas cylinder;</li> <li>• Ensures cylinders are not subjected to artificially created low temperatures without approval of the supplier;</li> <li>• Once the cylinder is connected to either a regulator or to piping, the cylinder status tag is designated as "In Use" by removing the "Full" portion of the tag;</li> </ul> <p style="text-align: center;"><b>CAUTION</b> <b>Do Not Use a flame to detect gas leaks</b></p> <ul style="list-style-type: none"> <li>• Leak checks connections.</li> </ul>
<p><b>Step 4</b></p>	<p>If gas is admitted to a system of a lower pressure rating than the supply pressure and where, due to the gas capacity of the supply source, the system rating can be exceeded (i.e., the distribution system design pressure rating is less than the cylinder pressure), installers ensure that</p> <ul style="list-style-type: none"> <li>• A suitable pressure-regulating device is used, regardless of the existence of a pressure relief device (PRD) protecting the lower pressure system;</li> <li>• The pressure regulator conforms with requirements; is compatible with the gases to be used; is rated for the pressure; is leak tight; is vented where applicable; meets the manufacturer's specifications where specified; is not defective; and has the proper CGA connections. Threads on regulator connections or other auxiliary equipment must match those on the cylinder valve outlet and valve outlet connections. Those that do not match must not be forced to fit. <b>Adapters must not be made or used to adapt a regulator to a gas cylinder;</b> <ul style="list-style-type: none"> <li>○ Install a regulator for which the normal system operating pressure is near the middle of the output pressure range of the regulator.</li> </ul> </li> <li>• A pressure relief is provided for any components in the system that have a pressure rating less than the maximum rated pressure of the regulator. For any glass components in the system, verify that the pressure limits for that relief device are set below the rated pressure for the glass components; and</li> <li>• There are no trapped volumes that can cause pressure increases (i.e., heating of cold gases, chemical reactions) without pressure relief.</li> </ul> <p><b>Note:</b> To ensure compliance with pressure safety requirements, record pressure systems using the Safety Engineering Hazard Evaluation Tools for Pressure System.</p> <p><b>Note:</b> Information regarding CGA Valve Outlet and Connections and regulator pressure relief devices is provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>.</p>
<p><b>Step 5</b></p>	<p>If a manifold header or multiple sources of pressure are used, installers ensure that</p> <ul style="list-style-type: none"> <li>• The manifold header is pneumatically leak tested with air or nitrogen at a pressure at</li> </ul>

least 80% of full cylinder pressure of the case at 70°F and is bubble tight to less than one (1) bubble per five (5) seconds (or alternate method with an equivalent sensitivity);

- If two or more gases are used on one system, valves and/or traps are installed to prevent contamination by a back flow of system or process materials. Install back flow prevention devices on systems where it may be possible that reactive gases can combine in the system. Verify that these check valves and/or traps have been installed in the proper orientation and are maintained. Cylinders are not to be cross-connected with house (plant) air lines;
- Parts subjected to full cylinder pressure, with the exception of seats and seals, are constructed of materials with a minimum melting temperature of 1000°F (538°C);
- Parts of the manifold subjected to delivery pressure use materials designed for the specified maximum delivery pressure. Manifolds are designed to be operated at ambient temperatures from -20°F to +150°F (-29°C to +66°C). The manifold's design (excluding regulators and gauges) should be able to withstand, without rupture, a hydrostatically applied test pressure of 10,000-psig or five (5) times the maximum cylinder gas pressure at 70°F (21.1°C), whichever is less (1000 psig minimum for fuel gases). Manifold headers (with the exception of acetylene) must be hydrostatically or pneumatically proof tested at a minimum of 1½ times maximum rated inlet pressure at the operating temperature. (Acetylene must be tested to a pressure of 4,200 psig minimum);
- In the parts of manifolds subjected to full cylinder pressure, cast iron or other castings of low ductile characteristics are not used;
- Each manifold is designed to attach one or more compressed gas regulators for the control of delivered gas pressure; and
- Shut-off valves are provided as necessary to allow isolation of individual cylinders.

### Step 6

If flammable or oxidizing gas is used, the supervisor, or line management designee, is responsible for implementing the following additional requirements:

- Using only non-sparking tools when working with flammable compressed gas;
- Cleaning oxygen systems with oxygen-compatible materials free from oils, greases, and other contaminants;
- Installing back flow/flash arrestor equipment where flammable and oxidizer gases are used in the same system;
- Ensuring flammable gas is separated from oxidizers by either (a) 20 ft, or (b) an approved non-combustible barrier (minimum of 5-ft high having a ½-hour fire resistance rating);
- Using acetylene cylinders valve-end up to minimize the possibility of solvent being discharged. Never use "Pure" copper pipe or fittings on acetylene systems, as dangerous oxides may form internally, causing an explosion;
- Ensuring flammable systems conform to ASME B31.3, Process Piping;
- Leak testing the system using inert gases prior to placing into service;
- Grounding and bonding all lines and equipment;
- Ensuring portable fire extinguishers or other fire protection or suppression systems are available;
- Posting areas as "NO SMOKING" areas. **Note:** If the building is properly posted as a No Smoking Facility as defined by NYS Building Code, individual "NO SMOKING" postings are not required in interior spaces. Exterior storage and use locations require "NO SMOKING" posting; and

	<ul style="list-style-type: none"> <li>When using cylinders for cutting and welding, follow the section <a href="#">Welding, Cutting, and Other Hot Work</a> in the <a href="#">Fire Safety</a> Subject Area.</li> </ul> <p><b>Note:</b> Information specific to Oxygen, LPG Gases, Acetylene, Hydrogen gases is provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>.</p> <p><b>Note:</b> Open flames/smoking is prohibited within 25 ft. of a gas storage unless a specific hot work permit is approved. For assistance, contact <a href="#">Fire Protection Engineering</a> or the <a href="#">Compressed Gas SME</a> for assistance.</p>
<b>Step 7</b>	<p>If corrosive, pyrophoric, toxic, or highly toxic gas is to be used, the supervisor, or line management designee, is responsible for implementing the following additional requirements:</p> <ul style="list-style-type: none"> <li>Systems conform to ASME B31.3, Process Piping;</li> <li>All piping and tubing use welded, threaded, or flanged connections throughout, except for connections located within a ventilated enclosure if the material is a gas; <ul style="list-style-type: none"> <li>For Highly toxic gases, flexible tubing is not used;</li> </ul> </li> <li>Piping and tubing must not be located within corridors, within any portion of a means of egress that is required to be enclosed in fire-resistance-rated construction, or in concealed spaces in areas not classified as Group H occupancies, unless specific requirements, defined by the Building Code of New York State are met and approved by Fire Protection Engineering. Pyrophoric gases need to be in fully sprinklered buildings. For assistance, contact Fire Protection Engineering; <ul style="list-style-type: none"> <li>All branch connections (i.e., "Tees") are in visible locations (i.e., not in ceiling, crawlspaces, or walls);</li> </ul> </li> <li>Leak test the system using inert gases prior to placing into service; perform a helium leak test for Highly toxic gases lines;</li> <li>Automatic shutoff of the gas source if a leak is detected unless the system operates at less than 15 psig, is constantly attended, and/or provided with rapidly accessible emergency shutoff valves. For assistance, contact Fire Protection Engineering, the Compressed Gas SME, or Safety and Health Representative;</li> <li>Instructing all staff working in the immediate area, where exposure to these types of gases could occur, as to the hazards of the gases in use;</li> <li>When using corrosive gases, ensure the cylinder valve stem is not stuck. Work the stem (1/4 turn and back) frequently (i.e., daily) to prevent sticking (never use oils or greases to prevent cylinder or related components corrosion); and</li> <li>When removing a regulator from flammable, toxic, or radioactive systems, vent hazardous gases (and purge, if required) from the entire system.</li> </ul>
<b>Step 8</b>	<p>If cryogenics are being used, the supervisor, or line management designee, ensures that the system is installed and used as required in the <a href="#">Cryogenics Safety</a> Subject Area.</p>

<b>Step 9</b>	<p>If the system is depressurized, the user pressurizes the system by doing the following:</p> <p style="text-align: center;"><b>WARNING</b></p> <p style="text-align: center;"><b>Eye protection must be worn when pressurizing the system. Do not stand in front of the cylinder outlet and do not look directly at the pressure gauges when first pressurizing the system.</b></p> <ul style="list-style-type: none"> <li>• Ensuring pressure gauges are not isolated;</li> <li>• Ensuring that the regulator outlet valve is closed;</li> <li>• Slowly opening the cylinder valve to prevent damage to the regulator;</li> <li>• Slowly opening the regulator valve to bring system to the desired pressure; and</li> <li>• Checking for leaks.</li> </ul> <p><b>Note:</b> For fuel gas application, the cylinder valves should only be opened no more than 1½ turns to allow for quick closing. Use only non-sparking tools when working with flammable compressed gas.</p>
<b>Step 10</b>	<p>Once work is finished, secure the source of pressure safely by</p> <ul style="list-style-type: none"> <li>• Closing the valve on top of the cylinder; and</li> <li>• Venting off safely any residual pressure, if possible.</li> </ul> <p><b>Note:</b> Prior to removing the regulator, ensure that the cylinder valve is closed and the regulator relieved of internal pressure.</p>
<b>Step 11</b>	<p>The user must notify the supervisor or line management designee if any problem with a gas cylinder is discovered. In the event that contamination (foreign substances entering the container or valve) is suspected, identify and clearly mark the container and notify PPM of the details of the contamination, including the container serial number so that PPM can notify the gas supplier. Contact the Distribution Group Supervisor (PPM) for assistance.</p>

## References

ASME B31.3, Process Piping

[Chemical Safety](#) Subject Area

[Cryogenics Safety](#) Subject Area

[ESH Guide: Compressed Gas Safety, Safety and Health Services](#) website

[Fire Safety](#) Subject Area

[Oxygen Deficiency Hazards \(ODH\), System Classification and Controls](#) Subject Area

[Signs, Placards, and Labels for Environmental, Safety and Health \(ESH\) Hazards](#) Subject Area

[Work Planning and Control for Experiments and Operations](#) Subject Area

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| [SBMS Home Page](#) | [Top of Subject Area](#) | [Instructions](#) | [Changes](#) |

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# PROCEDURE: TRANSFILLING COMPRESSED GAS CYLINDERS

<b>Management System:</b> <a href="#">Worker Safety and Health</a>		
<b>Subject Area:</b> <a href="#">Compressed Gas Cylinders and Related Systems</a>		
<b>4. Transfilling Compressed Gas Cylinders</b>		
Effective Date: <b>Apr 15, 2015</b>	Subject Matter Expert: <a href="#">Michael Gaffney</a>	Management System Executive: <a href="#">Ed Nowak</a>

## Applicability

This information applies to BNL staff and non-BNL staff who are responsible for transfilling compressed gas cylinders.

## Required Procedure

<b>Step 1</b>	<p>Ensure transfilling of compressed gases from one container to the other is performed by the gas supplier, or by personnel who are</p> <ul style="list-style-type: none"> <li>• Trained and qualified with the proper transfill equipment and written operating procedures; and</li> <li>• Familiar with the precautions necessary to avoid the hazards of the product being transfilled and with the procedures necessary to comply with all government standards and regulations.</li> </ul>
<b>Step 2</b>	<p style="text-align: center;"><b>WARNING</b></p> <p style="text-align: center;"><b>Verbatim compliance of the operating procedure must be followed</b></p> <p>Ensure the supplier of the transfill equipment provides detailed written operating instructions (including the equipment inspection and maintenance procedures).</p>
<b>Step 3</b>	<p>Allow the transfilling of gaseous and liquid oxygen for respiration when permitted by the container owner and in accordance with CGA P-2.5, Transfilling of High Pressure Gaseous Oxygen to be Used for Respiration, and CGA P-2.6, Transfilling of Liquid Oxygen to be Used for Respiration.</p>

## References

CGA P-2.5, Transfilling of High Pressure Gaseous Oxygen to be Used for Respiration

CGA P-2.6, Transfilling of Liquid Oxygen to be Used for Respiration

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| [SBMS Home Page](#) | [Top of Subject Area](#) | [Instructions](#) | [Changes](#) |

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## PROCEDURE: STORING COMPRESSED GAS CYLINDERS

<b>Management System: <a href="#">Worker Safety and Health</a></b>		
<b>Subject Area: <a href="#">Compressed Gas Cylinders and Related Systems</a></b>		
<b>5. Storing Compressed Gas Cylinders</b>		
Effective Date: <b>Apr 15, 2015</b>	Subject Matter Expert: <a href="#">Michael Gaffney</a>	Management System Executive: <a href="#">Ed Nowak</a>

### Applicability

This information applies to all BNL staff and non-BNL staff who store compressed gas cylinders at BNL facilities.

### Required Procedure

This procedure is for compressed gases that are **"in use"** and **"not in use."** Cylinders are considered **"in use"** when connected to a regulator and/or distribution system, or when they are part of a current process run and are controlled by Work Planning. Compressed gas cylinders that are **"not in use"** must be stored in prominently posted areas that are designated for the type of gas. The F&O Facility Complex Manager or designee must ensure the building's local emergency plan addresses compressed gas storage areas. See the [Emergency Preparedness](#) Subject Area and the Fire/Rescue Response Plan and identify the hazards and precautions for the present inventory. Minimize the amount of hazardous gas as evaluated in the section [Planning to Use Compressed Gases/Systems](#).

<b>Step 1</b>	Line Managers must designate properly trained personnel as responsible for properly storing compressed gas cylinders in storage areas.
<b>Step 2</b>	<p>Line Managers ensure storage areas</p> <ul style="list-style-type: none"> <li>• Are identified in the Facility Use Agreement (FUA) and the <a href="#">Fire-Rescue Runcard System</a>* (updating as necessary).</li> <li>• Can accommodate the cylinders/gases required by the user with adequate spacing, segregation, and partitioning provided according to gas hazard classification.</li> <li>• Are ventilated with temperatures that do not exceed 125°F (51.7°C); if temperature extremes are exceeded, cylinders must be stored in the shade.</li> <li>• Are prominently posted with the hazard class or the name of the gases stored, updating the <a href="#">Hazard Validation Tool</a> found on the Safety and Health Services webpage (<b>Note:</b> CMS Postings or Hazard Validation Tool Placards can be used to meet this requirement);</li> <li>• Are not obstructing facility exit routes or other routes intended for safe exit when cylinders are stored (inside or outside);</li> <li>• Are free from open flames. Do not permit smoking and open flames within 25 ft (7.6 m) of gas cylinder storage areas. Post "No Smoking" signs outside storage areas;</li> <li>• Are not located in stairways, elevators, dead-end corridors, or other areas specifically defined in the NFPA Life Safety Code;</li> <li>• Are not near readily ignitable substances, such as gasoline, oil, scrap, or other combustible materials, including vegetation. Keep at least 15 ft (5 m) from combustible</li> </ul>

material storage.

**Note:** Hazardous gases (flammable, toxic, highly toxic, pyrophoric, caustic or cryogenics) are not to be stored within 10 ft of an egress doorway. For assistance, contact [Fire Protection Engineering](#) or the [Compressed Gas SME](#);

- Are electrically safe. Do not permit cylinders to be placed where they might become part of an electrical circuit;
- Are reviewed against the chemical inventory system and the Chemical Management System is updated, as necessary. Typically large (A) cylinders from stock containing gases are controlled as static/revolving inventory. Cylinders that contain gases that are flammables, toxic, oxidizers, corrosive, etc. are bar coded. Each cylinder is either to be bar coded or have a plastic collar indicating that the gas is to be covered by Static/Revolving Inventory posting. Examples of collars can be found on the Safety and Health Services [ESH Guide: Compressed Gas Safety](#).

**Note:** If compressed gases are used or store in the building, the FUA should at a minimum list this subject area for controls. The FUA should include, if applicable, any line organization controls/procedures to address specific issues (i.e., Highly Toxic Gases). The FUA does not have to list the specific gases or locations.

**Note:** For inert gas use/storage, Fire-Rescue Runcards do not have to list specific locations. Contact the Fire-Rescue Group for guidance on listing other hazardous gas types and locations.

### Step 3

Designated personnel must ensure all compressed gas cylinders have a cylinder status tag (see example provided on the Safety and Health Services [ESH Guide: Compressed Gas Safety](#)) and are:

- Labeled correctly;
  - Cylinders must have legible markings identifying the type of gas;
  - The labels applied by the gas supplier to identify the contents may not be defaced or removed until the cylinder is empty.
- Stored with a cylinder valve cap installed if the cylinder is designed for one. The valve protection cap is in place and hand-tight except when cylinders are secured, in use or connected for use. If valve outlet caps and/or plugs are provided by the gas supplier, they should be installed on the valve outlet at all times except when containers are secured and connected to dispensing equipment.
 

**Note:** To support in-process work, a cylinder may be stored on a cylinder cart that is approved for storage but must have a valve protection cap installed. Examples of acceptable cart storage is provided on the Safety and Health Services [ESH Guide: Compressed Gas Safety](#).
- Stored valve end up. (**Note:** Some LPG cylinders are designed to be installed horizontally. To ensure proper overpressure protection, the overprotection device located in the valve assembly must be exposed to the gas portion of the cylinder). Small cylinders having a capacity (water volume) less than or equal to 5 liters (1.3 gallons) may be stored horizontally ("lecture bottles" are considered small cylinders).
- Supported at all times by at a minimum of three (3) points of contact.
- Never secured by the cylinder valve.

Limits on total quantities established in work planning review must be followed to comply with New York State Building Code requirements. Ensure that all compressed gas cylinders do not exceed the maximum allowable quantity that can be safely stored. Keep total quantities as

small as practical. For additional information:

- Contact the [Safety and Health Representative](#) for assistance in health hazard classification;
- Contact [Fire Protection Engineering](#) for assistance in maximum allowable quantities.

#### **CAUTION**

**Used/empty cylinders may have residual gases.  
Use the same precautions for cylinder storage regardless if the cylinder is full or emptied.**

- Stored meeting all the requirements pertaining to the specific gas and associated hazard. Gases are grouped into the following categories that have additional storage requirements:
  - [Flammable Gases](#)
  - [Oxidizing Gases](#)
  - [Corrosive Gases](#)
  - [Toxic/Highly Toxic Gases](#)
  - [Pyrophoric Gases](#)
  - [Lecture Bottles](#)

**Note:** Inert gases may be stored with all other classes.

**Note:** Lecture bottles can be exempted from the requirement of segregating empty flammable containers from empty oxidizer containers.

**Note:** Further information concerning specific types/level of protective controls needed for toxic gases can be obtained by contacting the [Safety and Health Representative](#).

**Note:** If incompatible gases are going to be stored in the same location, ensure the separation distances required by NFPA 55 (Compressed Gases and Cryogenic Fluids Code) can be satisfied. For assistance, contact [Fire Protection Engineering](#), or the [Compressed Gas SME](#).

**Note:** If line organizations have difficulty maintaining the Standard Cylinder Status Tag from damage (for example, exterior storage), line organizations can use alternate methods with [Compressed Gas SME](#) concurrence, such as dedicated storage systems for segregation that identify full/empty/in use cylinders.

#### **Step 4**

If flammable compressed gases are stored, then the following is required

- Store in well-ventilated areas.

	<ul style="list-style-type: none"> <li>Do not store near open flames, sources of heat or ignition, or ungrounded electrical equipment.</li> <li>Separate stored oxygen (or other oxidizers) from flammable compressed gas cylinders by a minimum of 20 feet (6 m), or by suitable fire-resistive partitions at least 5 feet high with a ½ hour rating.</li> <li>Store acetylene cylinders valve-end up to minimize the possibility of solvent being discharged.</li> <li>Never lay a cylinder of liquefied flammable gas on its side unless it is so designed (and so marked) to allow that positioning, as in the case of propane cylinders for forklift trucks.</li> <li>Portable fire extinguishers or other fire protection or suppression systems or devices must be available for fire emergencies at storage installations.</li> </ul>
<b>Step 5</b>	If oxidizing compressed gases are stored, separate stored oxygen (or other oxidizers) from flammable compressed gas cylinders by a minimum of 20 feet (6 m), or by suitable fire-resistive partitions at least 5 feet high with a ½ hour rating.
<b>Step 6</b>	<p>If corrosive compressed gases are stored, ensure the area has the appropriate levels of ventilation for storage and use.</p> <p><b>Note:</b> It is not recommended that corrosive compressed gases be stored for longer than 6 months because of possible corrosion to the valves.</p> <p><b>Note:</b> Corrosive compressed gases can be stored with all other classes unless they have additional hazards (e.g., flammable, oxidizers).</p>
<b>Step 7</b>	<p>If toxic compressed gases are stored, ensure the area has the appropriate levels of ventilation for storage and use. If more than 40 cubic feet* of gas is in storage in one fire zone, ensure continuous monitoring as defined in the <a href="#">Work Planning and Control for Experiments and Operations</a> Subject Area is provided.</p> <p><b>Note:</b> Toxic compressed gases can be stored with all other classes unless they have additional hazards (e.g., flammable, oxidizers).</p> <p>* Volume of gas at standard temperature/pressure.</p>
<b>Step 8</b>	<p>If toxic/highly toxic compressed gases are stored, then the following is required:</p> <ul style="list-style-type: none"> <li>Ensure continuous monitoring, as defined in the <a href="#">Work Planning and Control for Experiments and Operations</a> Subject Area, is in place if more than 40 cubic feet* of gas is in storage in one fire zone;</li> <li>Store in a ventilated enclosure;</li> <li>Separate from flammable and pyrophoric gases by a minimum of 20 feet (6 m), or by suitable fire-resistive partitions at least 5 feet high with a ½ hour rating;</li> <li>For highly toxic gases, keep outlet caps and plugs in place at all times except when the cylinder is connected.</li> </ul> <p>* Volume of gas at standard temperature/pressure.</p>
<b>Step 9</b>	If pyrophoric compressed gases are stored, separate pyrophoric gases from oxidizers and highly toxic gas by a minimum of 20 feet (6 m), or by suitable fire-resistive partitions at least 5

	feet high with a ½ hour rating. Buildings storing pyrophoric gases need to be fully sprinklered. Contact Fire Protection Engineering for assistance
<b>Step 10</b>	<p>If compressed gases are stored in lecture bottles/small cylinders, then the following is required:</p> <ul style="list-style-type: none"> <li>• Store lecture bottles or small propane cylinders (hand-torch size) separately from ordinary combustibles and from flammable and combustible liquids;</li> <li>• Do not store lecture bottles or small propane cylinders in flammable liquid cabinets;</li> <li>• Store lecture bottles using racks, boxes, drawers, or other arrangements so the lecture bottle does not roll and fall.</li> </ul> <p><b>Note:</b> Lecture bottles may be stored in the laboratory; however, it is recommended that lecture bottles be stored in the designated compressed gas cylinder storage area of the facility (exception to the general requirements).</p>

## Guidelines

Gas cylinders should be stowed using a “First In - First Out” system to prevent the storage of old inventory.

For inventory control, it is recommended that full cylinders are separated from used cylinders. Use cylinder status tags to identify cylinders as empty, in use, or full. Identify empty (used) cylinders with tags that are marked empty and place them in a designated (posted sign) area that is segregated from unused cylinders. If line organizations have difficulty maintaining the Standard Cylinder Status Tag from damage (for example, exterior storage), line organizations can use alternate methods with [Compressed Gas SME](#) concurrence, such as dedicated storage systems for segregation that identify full/empty/in use cylinders.

If a cylinder was exposed to fire, contact the gas supplier for instructions as soon as possible.

Store cylinders on paved surfaces (i.e., asphalt or concrete) that have been graded to prevent accumulation of water.

Cylinders may be stored in the open, but should be protected against weather extremes such as continuous rays of the sun, or snow and ice.

Cylinders should not be exposed to extremely low temperature without the approval of the supplier. If ice or snow accumulates on the container, thaw at room temperature or with water at a temperature not exceeding 125°F (51.7°C).

Do not expose cylinders to continuous dampness and do not store them near salt or other corrosive chemicals or fumes. Corrosion may cause valve protection caps to stick, or damage cylinders. Protect cylinders from any object that will produce a cut or other abrasion in the surface of the metal. Do not store cylinders near elevators or gangways, or in locations where heavy moving objects may fall upon them.

Compressed Gas Association (CGA) pamphlet P-1, “Safe Handling of Compressed Gases in Containers” states that compressed gas cylinders may be nested for safe storage. For examples of properly nesting compressed gas cylinders, see the nesting section on the Safety and Health Services [ESH Guide: Compressed Gas Safety](#).

## References

[Emergency Preparedness](#) Subject Area

[ESH Guide: Compressed Gas Safety, Safety and Health Services](#) website

[Fire Protection Engineering, Emergency Services Division](#) website

[Fire-Rescue Runcard System](#)\*

New York State Building Code

[Work Planning and Control for Experiments and Operations](#) Subject Area

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## PROCEDURE: HANDLING COMPRESSED GAS CYLINDERS

<b>Management System:</b> <a href="#">Worker Safety and Health</a>		
<b>Subject Area:</b> <a href="#">Compressed Gas Cylinders and Related Systems</a>		
<b>6. Handling Compressed Gas Cylinders</b>		
Effective Date: <b>Apr 15, 2015</b>	Subject Matter Expert: <a href="#">Michael Gaffney</a>	Management System Executive: <a href="#">Ed Nowak</a>

### Applicability

This information applies to BNL staff and non-BNL staff who move compressed gas cylinders and related equipment.

### Required Procedure

Only staff familiar with the hazardous properties contained within the cylinder may handle the compressed gas cylinders. The person responsible for handling the cylinder movement verifies that it is the correct cylinder, is clearly labeled, and informs the Chemical Management System (CMS) Team that the cylinder was moved to a new location. See the [Chemical Management System \(CMS\)](#) website for more information.

<b>Step 1</b>	<p>Visually inspect the cylinder for dents, gouges, burn marks, or corrosion.</p> <p><b>Note:</b> Do not attempt to repair compressed gas cylinders. If the cylinder is damaged, do not move it. Contact your supervisor and the <a href="#">ESH Coordinator</a> immediately.</p>
<b>Step 2</b>	<p>If the cylinder is not damaged, ensure protective valve cap is securely in place (if applicable) and remove the cylinder and load it onto an approved lifting/carrying device (i.e., hand cart) and secure it as required.</p> <p><b>Note:</b> Cautiously rolling the cylinder upright a short distance (e.g., an arms length) is permitted from its storage/use location into the carrying device. Do not move your feet and cylinder at the same time.</p> <p><b>Note:</b> Cylinder hand carts are designed to be used on firm, smooth surfaces and are not to be used on roadways.</p>
<b>Step 3</b>	<p>If material handling is needed, ensure the following:</p> <p>Use ropes, chains, or slings to suspend cylinders only if appropriate lifting attachments (such as lugs) were built into the cylinder by the cylinder manufacturer. If appropriate lifting attachments are not provided, use suitable cradles or platforms that are approved for use to hold the containers for lifting and ensure that the device has been inspected as required by the <a href="#">Lifting Safety</a> Subject Area.</p> <p><b>Do not</b></p> <ul style="list-style-type: none"> <li>• Drop, drag, slide, or roll horizontally the cylinders.</li> <li>• Permit cylinders to strike against each other or other surfaces violently, or otherwise be roughly handled.</li> <li>• Use magnets nor the protective cap to lift the cylinder.</li> </ul>

<b>Step 4</b>	<p>If an elevator is used while moving cylinders, two qualified individuals, as a minimum, are required to do the following:</p> <ul style="list-style-type: none"> <li>• One person clears the elevator of personnel and rides it to the appropriate floor.</li> <li>• Once the elevator is clear and a qualified person is waiting to receive the cylinder, secure the cylinder in the elevator. Place a posting in the elevator to caution personnel that they may not use it while transporting the cylinder (see the <a href="#">ESH Coordinator</a> for postings).</li> <li>• Return the elevator to unrestricted service once the cylinder is safely removed.</li> </ul>
<b>Step 5</b>	<p>If moving cylinders between buildings and disposal is required, contact Procurement and Property Management (PPM), or the Environmental and Waste Management Services Division (EWMSD). Only PPM or EWMSD staff are permitted to move cylinders that have an internal water volume greater than 220 lbs, or permanently mounted tanks &gt;70 gallons in motor vehicles.</p> <p><b>Note:</b> Compressed gases cylinders &lt;220 lbs or permanently mounted tanks &lt;70 gal may be moved as Material of Trade (MOT) in government vehicles, secured upright with cylinder cap installed. See the <a href="#">Movement by Vehicle of Hazardous and Radiological Materials On-site</a> Subject Area and compressed gas cylinder sizes provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>.</p> <p><b>Note:</b> PPM is allowed to use Powered Industrial Trucks to move inert compressed gas cylinders on BNL roadways when following approved Standard Operating Procedures.</p>
<b>Step 6</b>	<p>Remove the cylinder from the carrying device and store it in an approved storage area or place it in service, as appropriate. Secure the cylinder using a strap, chain, or cylinder stand.</p>
<b>Step 7</b>	<p>Make appropriate entries into the CMS, if required.</p>

## Guidelines

Good practices for handling gas cylinders include the following:

- Avoid dragging or sliding cylinders over long distances;
- Avoid tilting the cylinder to roll it along its bottom edge (especially on slippery surfaces);
- Move cylinders in the upright position; do not lay cylinders on their side or invert them;
- Take extra care to protect the valve on lecture bottles because most do not have protective caps, and other cylinders do not have provisions for protective caps;
- Treat all cylinders no longer in use as though residual gas is contained within even if the label indicates empty;
- Transport vertically. Cylinders containing nonflammable gases or nonliquefied flammable gases may be transported in the horizontal position if secured to a pallet for transportation purposes.

## References

[Chemical Management System \(CMS\)](#) website

[ESH Guide: Compressed Gas Safety](#), [Safety and Health Services](#) website

[Lifting Safety](#) Subject Area

[Movement by Vehicle of Hazardous and Radiological Materials On-site](#) Subject Area

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| [SBMS Home Page](#) | [Top of Subject Area](#) | [Instructions](#) | [Changes](#) |

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## PROCEDURE: DISPOSITION OF COMPRESSED GAS CYLINDERS

<b>Management System:</b> <a href="#">Worker Safety and Health</a>		
<b>Subject Area:</b> <a href="#">Compressed Gas Cylinders and Related Systems</a>		
<b>7. Disposition of Compressed Gas Cylinders</b>		
Effective Date: <b>Apr 15, 2015</b>	Subject Matter Expert: <a href="#">Michael Gaffney</a>	Management System Executive: <a href="#">Ed Nowak</a>

### Applicability

This information applies to BNL staff and non-BNL staff who return or dispose of compressed gas cylinders. It does not apply to BNL staff and non-BNL staff off-site, if there is a local procedure in place.

### Required Procedure

Compressed gas cylinders must be safely returned or disposed according to the type and contents of the cylinder.

<b>Step 1</b>	<p>Determine the compressed gas cylinder is either empty or no longer used, remove "IN USE" so "EMPTY" is on the bottom of the tag, and check off the appropriate box (see the cylinder status tag example provided on the Safety and Health Services <a href="#">ESH Guide: Compressed Gas Safety</a>).</p> <p><b>Note:</b> Compressed gas cylinders usually have residual pressure (typically 100-500 psig). Cylinders that are in Radiological Controlled Areas require a radiation survey. Contact the Radiological Control Division for assistance.</p>
<b>Step 2</b>	<p>If the cylinder has a CMS bar code on it:</p> <ul style="list-style-type: none"> <li>For non-returnable cylinders remove the CMS bar code or bar code package from the cylinder and send it to the CMS Team. Forms to return the bar codes are found under <a href="#">Web Transactions/Forms, Chemical Management System (CMS)</a>.</li> <li>If the bar code cannot be removed from the cylinder, note the bar code number and forward it to the CMS Team on a deletion form, or delete the bar code online using the <a href="#">Web Transactions/Forms, Chemical Management System (CMS)</a>.</li> <li>For vendor returnable cylinders, complete the CMS paperwork attached to the cylinder and return it with the cylinder to the warehouse. The CMS Team will retrieve the information at the cylinder warehouse and process the deletion. If a deletion sheet is not included in the package, obtain one from the CMS website or delete the bar code online. Do not remove the bar code or the bar code package from the cylinder.</li> </ul>
<b>Step 3</b>	<p>If the cylinders are returnable, place them in the appropriate used storage area and follow the procedure in the section <a href="#">Storing Compressed Gas Cylinders</a> until they are removed.</p> <p><b>Note:</b> PPM regularly removes cylinders to be returned automatically and will make a special pick up, if requested.</p> <p><b>Note:</b> Demurrage charges, if applicable, can continue to accrue until the gas cylinder is</p>

	returned to the vendor. To avoid additional charges, promptly return cylinders that are empty or no longer used.
<b>Step 4</b>	<p>If the cylinders are not returnable, dispose of non-returnable cylinders as waste. Consult your <a href="#">ESH Coordinator</a>, or the Environmental Protection Division, for assistance.</p> <p><b>Note:</b> Lecture/small cylinders are not typically returnable and need to be disposed of as hazardous waste unless made safe using an approved procedure (i.e., removing the valve of an inert gas cylinder).</p>

## Guidelines

Follow the procedure in the section [Handling Compressed Gas Cylinders](#) whenever cylinders are moved.

## References

[Chemical Management System \(CMS\)](#) website

[ESH Guide: Compressed Gas Safety, Safety and Health Services](#) website

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| [SBMS Home Page](#) | [Top of Subject Area](#) | [Instructions](#) | [Changes](#) |

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## DEFINITIONS

### Definition: Compressed Gas Cylinders and Related Systems

Term	Definition
compressed gas	Any material or mixture that is a gas at 20°C (68°F) or less at an absolute pressure of 101 kPa (14.7 psia) and that has a boiling point of 20°C (68°F) or less at an absolute pressure of 101 kPa (14.7 psia) and that is liquefied, nonliquefied, or in solution, except those gases that have no other health or physical hazard properties are not considered to be compressed gases until the pressure in the packaging exceeds an absolute pressure of 280 kPa (40.6 psia) at 20°C (68°F).
Compressed Gas Association (CGA)	The organization provides for standardization of related equipment connections such as valves, relief valves, regulators, manifolds, and other auxiliary equipment.
compressed gas system	A compressed gas cylinder, its regulator and attached manifolds, and localized piping.
cryogenic liquid	A liquefied gas having a boiling point lower than -150° F (-101° C) at 14.7 psia (an absolute pressure of 101 kPa).
cylinder	<p>A cylinder includes the following types of containers:</p> <ul style="list-style-type: none"> <li>• Standard Department of Transportation (DOT) compressed gas cylinders (such as DOT-3A, DOT-3AA, DOT-3B, DOT-3E);</li> <li>• Lecture bottles and sample cylinders;</li> <li>• Acetylene cylinders (such as DOT-8, DOT-8AL);</li> <li>• Portable liquefied petroleum gas (LPG) cylinders.</li> </ul> <p>For purposes of this subject area, this term does not apply to ASME and research and development vessels (see the <a href="#">Pressure Safety</a> Subject Area), fire extinguishers, self-contained breathing apparatus (SCBA and SCUBA), cryogenic apparatus, or butane torch cylinders used for routine maintenance work.</p>
empty	A cylinder is considered empty when it has only a slight positive pressure in the cylinder. General guidelines suggest leaving at least 25 psig in a cylinder to keep out contaminants such as moisture.
F&O Facility Project Manager	<p>Manages and operates specific facility(s) within a designated complex area, related equipment and systems; ensuring resolution of problems, maintaining safe and reliable operations. Serves as the single point of contact for the execution of the obligations agreed to between the approving parties of the Facility Use Agreements (FUA).</p> <p><b>Note:</b> This is not a one to one replacement of all the responsibilities of the former Building Manager, but contains many of the Building Managers' responsibilities as described in the Building Manager R2A2.</p>
fire wall	A wall of non-combustible material that is at least 1.5 m (5 ft) high and that has a minimum fire resistance rating of 30 minutes.

flammable gas	A gas that is ignitable in a mixture of 13% or less (by volume) with air, or the flammable range with air is at least 12%, regardless of the lower limit, at atmospheric temperature and pressure.
hazard analysis	During work planning, the staff member or user thoroughly evaluates operation's hazards, properties of the gases to be used, and the methods involved in the handling and use of the compressed gas.
highly toxic gas	A gas having an LC50 of 200 parts per million or less by volume. Special requirements apply to highly toxic materials.
installed, in use	A cylinder is considered "installed" or "in use" when connected to a regulator and/or distribution system, or when they are part of a current process run. Cylinders not intended for current processes are considered not in use and their cylinder cap (if so configured) installed and stored in an approved storage area.
job risk assessment	In compliance with BNL's OHSAS 18001 Program, individuals involved in using compressed gases must assess the potential risks to the worker, facility and environment presented by using the specific product.
LC50	Lethal Concentration (LC50) = concentration, usually represented in parts per million (ppm) by volume that kills 50% of standard albino rat test animals during a 1-hour exposure.
localized piping	A system that is neither 1) a building distribution system, nor 2) a pressure system. Contact the Building Manager for help in determining if a system is localized piping.
manifold	Components used to connect compressed gas cylinders together to supply a distribution system with a particular gas at a selected distribution pressure from the point of connection to the cylinder to connection to the pressure regulator or distribution system.
Material Safety Data Sheet (MSDS)	Written or printed materials, supplied by the manufacturer or BNL, containing information on chemical identity, physical and chemical properties, physical hazards, health hazards, protective safety methods, and emergency procedures.
not in use (cylinder)	Cylinders not intended for current processes or not connected to a regulator and/or distribution system are considered not in use; it is recommended not to keep these cylinders in the laboratory/building and to place them in storage.
oxygen deficiency hazards (ODH)	The release of compressed gases or cryogenic liquids may cause localized oxygen concentrations to decrease to less than 19%, causing a health hazard. Specific hazards and controls are provided in the <a href="#">Oxygen Deficiency Hazards (ODH), System Classification and Controls</a> Subject Area.
pressure relief device (PRD)	Required if any of the system's components have a pressure rating less than the maximum rated pressure of the pressure source (i.e., cylinder or regulator). PRDs conform to the requirements of CGA S-1.1 through S-1.3, Pressure Relief Device Standards.
regulators	Designed for a specific pressure range and gas type, regulators allow for the safe reduction from high (cylinder) pressure to low (user) pressure.
toxic gas	A gas having an LC50 of 200 to 2000 parts per million by volume. Special requirements apply to highly toxic materials.

ventilated enclosure	Laboratory fume hood or specially designed gas cabinet (operating at negative pressure).
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