Gas Safety

POLICY

A. Purpose

The Gas Safety program at Lawrence Berkeley National Laboratory (Berkeley Lab) identifies precautions to prevent injuries, property damage, and disruption to operations caused by leaks of compressed gas and over-pressurizations. Types of injuries and accidents that will be controlled include:

- Injuries caused by flying objects accelerated by an explosion or pressure release.
- Fires and injuries caused by flammable gas ignition.
- Injuries caused by inhalation of toxic or asphyxiating gases.

B. Persons Affected

This policy applies to all Berkeley Lab employees, affiliates, and subcontractors who order, handle, or dispose of gases.
C. Exceptions

None

D. Policy Statement

1. The Gas Safety program's inert gas, oxidizing gas, and general requirements at Berkeley Lab include (Work Process A):
   a. Emergency response.
   b. Work planning and controls.
   c. Training.
   d. Procurement.
   e. Installation and setup.
   f. Storage, use, and handling.
   g. Outdoor locations.
   h. Transportation.
   i. End-of-life: return and disposal.

2. The requirements of this section apply to the storage and use of compressed and liquefied flammable gas (Work Process B).

3. This section presents general requirements and guidelines for pyrophoric gas use. Additional requirements may apply to the storage and use of pyrophoric gas in quantities greater than 0.3 m³ (10 cf) for gas not in a gas cabinet and 0.6 m³ (20 cf) for gas in a gas cabinet (Work Process C).

4. Corrosive and health-hazard gases, for the purpose of this chapter, include gases that at lower concentrations may cause significant acute or chronic toxic health effects. These gases can, for example, poison someone and/or cause corrosion, irritation, and disease in human tissue (Work Process D).

5. In addition to these work Processes, there are four program-related appendices:
   a. Appendix A. Gas-Detection System Requirements
   b. Appendix B. Specific Health-Hazard Gas Classifications
   c. Appendix C. Gas System Component Information
   d. Appendix D. Additional Information: Mixed Gases, Toxic Gases

E. Roles and Responsibilities

See the Gas Safety program for information about roles and responsibilities related to this policy’s implementation.

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
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</table>
| Principal investigator/supervisor | The principal investigator or gas-use supervisor has primary responsibility for gas-use safety and implementation of all provisions of this chapter, including:  
  • Work Planning and Control (WPC).  
  • Safety Notes.  
  • Training.  
  • Equipment and controls implementation, maintenance, and inspections.  
  • Request for gas pre-purchase approval, when required.  
  • Self-assessment inspections. |
| EHS — Research Support Team | The Research Support Team provides an EHS hazard evaluation and code-compliance coordination related to fire, life-safety, pressure, health, and oxygen-deficiency gas hazards that include:  
  • Helping the gas user evaluate hazards and determine appropriate controls.  
  • Evaluating purchases of gases that require pre-purchase approval (e.g., toxic gases), and approving as appropriate.  
  • Reviewing new gas-use controls and designs, such as for WPC reviews, Facilities projects, and determining health-hazard classifications, required engineering controls, and/or physiological warning property ratings to previously unclassified health-hazard gases, dilute gases, and gas mixtures.  
  • Periodically auditing gas use(s) as one component of the EHS WPC activity reviews. |
| EHS — Waste Management      | • Administers and maintains the Gas Safety program and the Pressure System Safety program.  
  • Monitors gas cabinet and fume hood functionality on an annual basis.  
  • Provides guidance and assisting in the disposal of unwanted hazardous gases owned by Berkeley Lab that cannot be returned to the vendor. |
Facilities Division — Maintenance & Operations
- Assists in the selection, installation, and startup of maintainable and reliable safety systems that support gas use operations.
- Assists with or assembles gas systems and provides, inspects, repairs, and/or rebuilds certain commonly used gas system components in response to a work request.
- Manages gas detector maintenance services for detector users, per work requests.

Facilities Division — Protective Services, Fire Protection
- Monitors and responds to alarms transmitted via the fire alarm system or emergency telephone number system.
- Evaluates welding, cutting, and other hot work operations and issues hot work permits, as appropriate.
- Inspects facilities in accordance with Department of Energy (DOE) Order 420.1c and other applicable fire prevention codes.
- Provides formal interpretation of the California Fire Code (CFC) and applicable National Fire Protection Association (NFPA) codes and standards

Procurement Department
- Manages gas supplier subcontracts for all compressed or liquefied gases.
- Screens gas purchase requests and ensures that requests requiring pre-purchase approval are not ordered before the approval process is completed

F. Definitions/Acronyms

See the Gas Safety program for technical terms related to the details of this policy and its implementation.

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<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CFC</td>
<td>California Fire Code</td>
</tr>
<tr>
<td>CMS</td>
<td>Chemical Management System</td>
</tr>
<tr>
<td>Compressed gas</td>
<td>A material or mixture of materials that 1) is a gas at 68°F (F) or less at 14.7 psia of pressure and 2) has a boiling point of 68°F or less at 14.7 psia, and which is either non-liquefied or in solution, except those gases that have no other health- or physical-hazard properties and that are not considered to be compressed until the pressure in the packaging exceeds 41 psia at 68°F.</td>
</tr>
<tr>
<td>Control area</td>
<td>A space within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, used, or handled. The space is bounded by not less than a one-hour fire-resistive assembly.</td>
</tr>
<tr>
<td>Corrosive gas</td>
<td>A gas that can cause visible destruction of, or irreversible alterations in, living tissue (e.g., skin, eyes, or the respiratory system) by chemical action.</td>
</tr>
<tr>
<td>DOT</td>
<td>U.S. Department of Transportation</td>
</tr>
<tr>
<td>Exhausted enclosure</td>
<td>An appliance or piece of equipment that consists of a top, a back, and two sides providing a means of containing, capturing, and exhausting gases, fumes, vapors, and mists. Such enclosures include laboratory hoods, exhaust fume hoods, and similar appliances and equipment. Rooms or areas provided with general ventilation are not exhausted enclosures.</td>
</tr>
<tr>
<td>EFV</td>
<td>Excess flow valve</td>
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<tr>
<td>Flammable gas</td>
<td>A material that is a gas at 68°F or less and 14.7 pounds per square inch (actual psia of pressure) and which 1) is ignitable at 14.7 psia when in a mixture of 13 percent or less by volume with air or 2) has a flammability range at 14.7 psia with air of at least 12 percent, regardless of the lower limit.</td>
</tr>
<tr>
<td>Gas cabinet</td>
<td>A fully enclosed, ventilated, noncombustible enclosure used to provide an isolated environment for compressed gas cylinders that are in storage or use. Doors and access ports for exchanging cylinders and accessing pressure-regulating controls are allowed to be included as part of the cabinet.</td>
</tr>
<tr>
<td>Hazardous gas</td>
<td>A gas that is included in one or more of the following hazard categories: corrosive, flammable, health hazard, oxidizer, pyrophoric, reactive, highly toxic, or toxic.</td>
</tr>
<tr>
<td>Hazardous-gas detection system</td>
<td>A fixed system used to detect the presence of hazardous gas at potentially unsafe levels.</td>
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</table>
### Health hazard (gas classification)

A classification that indicates statistically significant evidence that acute or chronic health effects are capable of occurring in a person exposed to this chemical. The term "health hazard" includes gases that are toxic, highly toxic, and corrosive. See Work Process D, Health-Hazard Gases.

### Immediately Dangerous to Life and Health (IDLH)

The concentration of airborne contaminants that poses a threat of death, immediate or delayed permanent adverse health effects, or effects that could prevent escape from such an environment. This contaminant concentration level is established by the National Institute of Occupational Safety and Health (NIOSH) based on both toxicity and flammability.

### Liquefied gas

A liquid contained in a compressed-gas cylinder that has a vapor pressure exceeding 276 kPa at 38°C (40 psi at 100°F)

### Lower Flammability Limit (LFL)

The minimum concentration of vapor in air at which propagation of flame will occur in the presence of an ignition source. The LFL is sometimes referred to as the lower explosive limit (LEL).

### NFPA

National Fire Protection Association

### NTP

Normal Temperature and Pressure

### Oxidizing gas

A gas that can support and accelerate combustion of other materials more than air does

### Oxygen deficiency

A condition that occurs when a breathable atmosphere contains less than 19.5% oxygen. (Normal air contains 20.9% oxygen.)

### Permissible exposure limit (PEL) and threshold limit value (TLV)

Airborne exposure limits established for particular chemicals by the Federal Occupational Safety and Health Administration (Fed/OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH), respectively. DOE requires that employee exposures not exceed PELs or TLVs.

### Pyrophoric gases

Gases with an auto-ignition temperature in air at or below 54°C (130°F). Specific gases may not ignite in all circumstances or may explosively decompose.

### RFO

Restrictive flow orifice

### Safety Note

A document that records engineering calculations or tests on specific equipment. A Safety Note may also specify operational requirements addressed in a WPC Activity or in operating instructions. See Pressure System Safety.

### STP

Standard temperature and pressure - 1 atm and 0°C (compare with NTP, above)

## G. Recordkeeping Requirements

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<tr>
<th>Role</th>
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<tr>
<td>EHS Division</td>
<td>Gas inventory (on Berkeley Lab Chemical Management System)</td>
</tr>
<tr>
<td>Facilities Division</td>
<td>Gas-detector inventory</td>
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## H. Implementing Documents

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<tr>
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<th>Title</th>
<th>Type</th>
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<tbody>
<tr>
<td>07.07.015.001</td>
<td>Gas Safety</td>
<td>Program</td>
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<td>07.07.015.003</td>
<td>Work Process B, Flammable Gases</td>
<td>Process</td>
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<td>General ES&amp;H Requirements, Responsibilities, and Work Practices</td>
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<td>Fire Prevention and Protection</td>
<td>Program</td>
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I. Contact Information

Gas Safety Subject Matter Expert
EHS Research Support Team

J. Revision History

<table>
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<tr>
<th>Date</th>
<th>Revision</th>
<th>By Whom</th>
<th>Revision Description</th>
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<td>K. Ettinger</td>
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Document Information

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<td>Publication date:</td>
<td>11/9/2017</td>
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<td>Prior reference information (optional)</td>
<td>PUB-3000 Chapter 13</td>
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Source Requirements Documents

- California Code of Regulations, Title 24, Part 9, California Fire Code
  - Chapter 35, Welding and Other Hot Work
  - Chapter 27, Semiconductor Fabrication Facilities
  - Chapter 53, Compressed Gases
  - Chapter 61, Liquefied Petroleum Gases
  - 1910.101, Compressed Gases
  - 1910.102, Acetylene
  - 1910.103, Hydrogen
  - 1910.105, Nitrous Oxide
  - 1910.110, Storage and Handling of Liquefied Petroleum Gases
  - 1910.111, Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910 Subpart Z — Toxic and Hazardous Substances
  - 1910.1000, Air Contaminants
  - 1910.1200, Hazard Communication
  - 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories.
- 49 CFR, Transportation, Parts 100–199
- DOE Order 430.1C, Real Property Asset Management
- DOE Order 5480.4, Environmental Protection, Safety, and Health Protection Standards, sections specified in Work Smart Standards set (current version)
- DOE Order 422.1, Admin Chg 2, Conduct of Operations

Reference Documents

Lawrence Berkeley National Laboratory. The official or current version is located in the online LBNL Requirements and Policies Manual. Printed or exported versions are not official. Users are responsible for working with the latest approved revision.
Non-Berkeley Lab References

- American Conference of Governmental Industrial Hygienists
- Industrial Ventilation, a Manual of Recommended Practice, current version
- Threshold Limit Values for Chemical Substances and Physical Agents (current version)
- American Industrial Hygiene Association, Odor Thresholds for Chemicals with Established Occupational Health Standards (1997)
- American Society of Mechanical Engineers (ASME)/ANSI A13.1 Scheme for the Identification of Piping Systems, 2013
- Compressed Gas Association
- Pamphlet P-1, Safe Handling of Compressed Gases in Containers
- Pamphlet P-12, Safe Handling of Cryogenic Liquids
- P-20-2009, Standard for the Classification of Toxic Gas Mixtures
- P-23 2008, Standard for Categorizing Gas Mixtures Containing Flammable and Non-Flammable Components
- P-58 2015 Safe Preparation of Compressed Oxidant — Fuel Gas Mixtures in Cylinders
- National Fire Protection Association
- NFPA 45, Fire Protection for Laboratories Using Chemicals
- NFPA 50A, Gaseous Hydrogen Systems at Consumer Sites
- NFPA 51, Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes
- NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
- NFPA 55, Compressed Gas and Cryogen Fluids Code
- NFPA 72, Installation, Maintenance, and Use of Protective Signaling Systems
- NFPA 704, Identification of the Fire Hazards of Materials
- National Institute of Occupational Safety and Health, Pocket Guide to Chemical Hazards, DHHS (NIOSH), Pub. No. 90-117
- University of California Lab Design Guide (2nd Edition)

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