Compressed Oxygen Greater than 25%

Standard Operating Procedure

Revision Date: 02/20/23

# Description [Provide additional information as it pertains to your research protocol]

Describe the process, type and grade of oxygen, quantity and/or flow rate(s) required, and approximate frequency of use. *All laboratory workers must read and understand the*[*Laboratory Emergencies SOP*](https://ehs.umich.edu/wp-content/uploads/2022/05/LaboratoryEmergencyProceduresSOP.docx)*prior to commencing any work in a laboratory.*

## Process [Write the steps for using the chemical in your research protocol]

# Potential Hazards [Provide additional information as it pertains to your research protocol]

The air we breathe contains about 21% oxygen, but even a small increase in the oxygen level in the air can create a dangerous situation. Oxygen is nonflammable but it vigorously accelerates and supports combustion. In an oxygen-enriched atmosphere, i.e., an atmosphere containing > 23% oxygen, it becomes easier to start a fire, which will then burn hotter and more fiercely than in normal air. A leaking valve or hose in a poorly ventilated room or confined space can quickly increase the oxygen concentration to a dangerous level. The main danger to people from an oxygen-enriched atmosphere is that clothing and hair can easily catch fire, resulting in serious and sometimes fatal burns.

Oxygen is very reactive, and can react explosively with oils and greases. Other materials in contact with pure oxygen may catch fire spontaneously. Nearly all materials including textiles, rubber and even metals will burn more vigorously in an oxygen-enriched atmosphere.

The main causes of fires and explosions when using oxygen are:

* Oxygen enrichment from leaking equipment.
* Use of materials not compatible with oxygen.
* Use of oxygen in equipment not designed for oxygen service.
* Incorrect or careless operation of oxygen equipment.

Equipment designed for oxygen service is made from materials and components that have been tested and proved to be compatible, and are safe for the purpose. Equipment considerations include the following:

* Regulator, tubing and other equipment are compatible and not contaminated.
* Copper and stainless values, tubing and other components are compatible.
* Lubricants should be avoided. Only lubricants that are made for oxygen service, and are specified by the equipment supplier, should be used.
* Only thread seal tape that is marked as suitable for oxygen service, and is specified by the equipment supplier, should be used.

*The large amount of potential energy contained in a compressed gas cylinder makes it a potential rocket or bomb if the pressure is released through rupture of the valve or container failure.*

# Engineering Controls [Provide additional information as it pertains to your research protocol]

Storage of compressed gas cylinders requires sturdy chains secured to a wall or cabinet, and/or a cylinder stand. If the process does not permit gas use and/or storage in well-ventilated areas, i.e., lab ventilation having a minimum of 6 air changes per hour, contact Occupational Safety and Environmental Health (EHS) at (734) 647-1143 to determine the necessity of an oxygen monitor or other alarm devices.

Flash arrestors must be installed on all oxygen regulators and torches that are using a spark or flame. A flash arrestor stops the flame or reverse flow of gas back up into the equipment or supply line and it prevents the researcher and equipment damage or explosions.

A flash arrestor is recommended for other types of research using oxygen that do not generate a spark or flame.

Flashback arrestors help prevent:

* Further gas flow in the case of pressure shocks.
* The entry of air or oxygen into the distribution line or single cylinders.
* Flashbacks, which are the rapid propagation of a flame down the hose.
* Further gas flow in the event of a burn back.

**NOTE**: A flash arrestor is required when an oxygen cylinder is used for welding or cutting. It is recommended as a best practice to install them on all regulators when oxygen is used.

# Work Practice Controls [Provide additional information as it pertains to your research protocol]

Only use equipment designed for oxygen service. This includes O-rings and gaskets, metal components, pressure regulators, and gas delivery tubing. Never use anything but “Snoop” or equivalent to check fittings and connections for leaks.

Open valves slowly; rapid opening can result in momentarily high oxygen velocities, pushing any particles through the system very quickly and resulting in frictional heat. Alternatively, if the system has a dead end such as where a pressure regulator is connected to an oxygen cylinder, heat can be generated through compression of oxygen. Both cases can result in a fire.

Before removing the regulator, close the container valve and drain the gas pressure from the regulator.

Whenever work is stopped, close cylinder valves. Do not try to cut off the supply of oxygen by kinking flexible hose when changing equipment.

Keep all oxygen containers, valves, regulators, hoses and other oxygen apparatus clean and free from oil and grease. Ensure hands or gloves are clean and free of grease when handling or assembling oxygen equipment.

Oxygen cylinders must be stored 20 feet from ignition sources, flammable gases or combustible materials unless separated by a noncombustible barrier not less than 5 feet high, having a fire-resistance rating of ½-hour.

All compressed gas cylinders shall be legibly marked by stenciling, stamping, or label with at least the chemical name or commonly accepted name of the material contained. In addition, cylinders should bear the approved markings of the Department of Transportation stamped in the metal at the top of the cylinder.

* Replace valve caps when cylinders are not in use or before moving.
* Remove damaged or defective cylinders from service (contact the cylinder vendor for assistance).
* Remove unused or empty cylinders from lab space.
* Refer to the [EHS Compressed Gas Guideline](http://ehs.umich.edu/wp-content/uploads/2016/03/Compressed_Gas_Use.pdf) or consult with your EHS representative regarding maximum allowable quantities of compressed oxygen.

Restricted hazardous gas use ***must*** be approved by EHS for purchase. Refer to the hazard guideline for compressed gas use on the EHS website or contact your EHS representative for more information. This [form](https://docs.google.com/forms/d/e/1FAIpQLSflBGaF3LedmhouKl3Hd4_JGCd6nX-bk_ZYDfDEuqDvjLw2-A/viewform?vc=0&c=0&w=1) can be used to submit a request for approval of the purchase of a restricted gas.

# Personal Protective Equipment [Provide additional information as it pertains to your research protocol]

# Transportation and Storage [Provide additional information as it pertains to your research protocol]

A cylinder cart must be used when transporting any compressed gas cylinder. The cylinder must never be lifted by the cap, and must be secured in an upright position at all times.

# Waste Disposal [Provide additional information as it pertains to your research protocol]

Provide guidance on how empty cylinders are to be returned to the vendor. For empty lecture bottles that cannot be returned to the vendor, write “empty” on the outside of each cylinder. Complete a hazardous waste manifest and contact EHS Hazardous Materials Management (HMM) at (734) 763-4568 to schedule a pickup.

Contact EHS-HMM at (734) 763-4568 for waste containers, labels, manifests, waste collection and for any questions regarding proper waste disposal. Also refer to the EHS [Hazardous Waste](http://ehs.umich.edu/haz-waste/) Web page for more information.

# Training of Personnel

All personnel shall read and fully adhere to this SOP when handling compressed oxygen >25%.

# Certification

I have read and understand the above SOP. I agree to contact my Lab Director if I plan to modify this procedure.

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### Major Revisions (Tracking purposes only -- Do not print as part of SOP)

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| Date | Revision |
| 09-13-18 | EHS name and logo were added, updated the formatting, and revised the content under Exposure/Unintended Content (AKJ). |
| 03-04-19 | Reviewed and updated. |
| 05-15-20 | Updated editing rights to headings (RSH) |
| 02-20-23 | Removed emergency information sections, duplicate of new Laboratory Emergencies SOP. (DML) |