

**UNIVERSITY OF ROCHESTER
ENVIRONMENTAL HEALTH & SAFETY**

Policy No.: LS009	Approved by: Mike Liberty
Title: Life Safety Sensors and Alarms for Compressed Gas	Date: 8/3/2022
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Prepared by: Carolyn Place & Sarah Briggs	

I. PURPOSE

This policy establishes requirements for area/room life safety sensors and alarms for compressed gases that could pose a significant hazard to the occupants.

Employees who use compressed gases must understand the health and safety hazards of the compressed gas cylinders. The gas contents in a cylinder can present physical and/or health hazards to users. Gases may be classified as flammable, toxic, corrosive, pyrophoric, oxidative, an asphyxiant, and/or may present a combination of these dangers. Because gas cylinder contents are under high pressure, any uncontrolled release can create a hazardous situation in the area in a very short period of time.

Therefore, an assessment shall be performed by Environmental Health and Safety where gas cylinders are used and stored for evaluation of whether oxygen and/or other gas sensors are warranted. The assessment must be documented by EH&S and kept with either the Principal Investigator or Supervisor of the area, and with the Project Manager/Coordinator for construction and/or renovation projects.

The scope of this document is not intended to cover the use of oxygen sensors for confined spaces, hot work (welding, grinding, abrading), or emergency response.

Additional information is available by contacting Environmental Health & Safety.

II. PERSONNEL AFFECTED

The policy affects all those using compressed gases in quantities to potentially create a hazardous environment to the occupant. All personnel must meet all other University requirements established by EH&S Policy LS004 Compressed Gas Safety Policy. All training must be completed BEFORE an employee is allowed to handle compressed gases.

III. DEFINITIONS

Asphyxiant Gas: A gas or mixture of gases that displaces oxygen in the ambient atmosphere, and can thus cause oxygen deprivation in those who are exposed, leading to unconsciousness and/or death.

Breathing Zone: The breathing zone is the 6 to 9-inch area surrounding a worker's nose and mouth where the majority of air is drawn into the lungs.

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Competent User: A user who has successfully completed compressed gas cylinder training and received site-specific training for the hazards from their area supervisor.

Compressed Gas: Any material or mixture having in a container either an absolute pressure exceeding 40 pounds per square inch at 70°F (21.1°C), or an absolute pressure exceeding 104 pounds per square inch at 130°F (54.4°C), or both, regardless of the pressure at 70°F (21.1°C); or, a liquid having a vapor pressure exceeding 40 psi at 100°F (37.8 °C) as determined by ASTM D-323-72.

Continuous Gas Monitoring: The process and technology used to detect atmospheric conditions at all times.

Cryogenic Liquid: A cryogenic liquid is any liquid with a boiling point less than -238°F (-150°C). The most common cryogenic liquids at the University of Rochester include oxygen, nitrogen, helium, and argon.

Monitored Area: Any area where any gas detection sensors are installed.

Permanent Installation: An installation that is connected to a permanent power supply, tied into the building automation system, and cannot be removed or relocated without permission from EH&S.

Point of egress: Standard doorway into and out of the area.

Standard Temperature and Pressure (STP): the temperature of 0°C and pressure of 1 atmosphere, usually taken as the conditions when stating properties of gases.

Temporary Work: Work that will last for less than six (6) months, is regularly mobile, or at the discretion of EH&S.

IV. RESPONSIBILITIES

Principal Investigators/Supervisors of the area are responsible for the maintenance and continual good working order of all gas sensors in the area, as gas sensors are life safety devices.

If gas sensors are not functioning properly, it is the responsibility of the Principal Investigator or Supervisor to get it repaired and/or replaced as soon as possible, due to

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life safety concerns. Interim measures, such as personal oxygen monitors must be used until the permanent sensor can be restored, if operations of the gases in the area cannot be halted.

All gas sensors must be calibrated **annually**. The Principal Investigator or Supervisor is responsible for ensuring this annual calibration by a competent individual or vendor and to be able to produce those records when requested.

All laboratory personnel must be properly trained by the Principal Investigator or Supervisor to evacuate the affected space in the event of a gas sensor alarm or cylinder failure.

It is the responsibility of all Principal Investigators and Supervisors, Trainers, and Managers to ensure that all employees who work with compressed gases are properly trained in their knowledge, duties, and the standard operating procedures surrounding compressed gases.

It is the responsibility of those approved and deemed competent by their supervisors to transport, store, and use gas cylinders to the standard operating procedures established for their location.

V. PROCEDURES

- A. Continuous gas sensors shall be installed to monitor areas where gases can accumulate and displace oxygen and or pose a hazard. Sensors shall be installed to indicate airborne levels at each point of use and may be required by EH&S in each storage area/room, depending on the design of the system,
- B. Sensors shall be:
 - 1. EH&S approved devices – Pure Air Model 99016 (10 year) or similar
 - 2. Permanently mounted
 - 3. Installed at a height of between 4 – 6 feet above the floor or as indicted by the manufacturer’s instructions
 - 4. Free of obstructions with a clearance area of 2 – 3 feet
 - 5. Directly connected to a building’s electrical and Building Automation System (BAS) and/or Focus Panel
 - 6. Protected from accidental disconnection or damage
 - 7. Located within manufacturer’s specified detection range for each point of use and storage location
 - 8. Located close to each point of use and at the discretion of EH&S

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- C. Display panel shall be:
 - 1. Pure Air or similar
 - 2. Located immediately outside of monitored area, preferably in the nearest hallway or public space for easy visibility for first responders.
 - a) Have an annunciator and strobe
 - (1) Must use a different tone and light pattern from the area fire alarm or carbon monoxide alarm. Alarms must not use 3 or 4 temporal patterns, nor use white strobes.
 - (2) Tone shall be a minimum of 15 dBA above the ambient sound level. Dosimeter may be required to confirm ambient sound levels
 - 3. Mounted 4 – 5 feet above floor
- D. Areas that contain multiple gases may require multiple gas-specific-sensors. The EH&S Gas Sensor Assessment form will determine if additional sensors are needed.
- E. Signage shall be required adjacent to each horn/strobe within 4 inches of strobe/annunciator and read as follows:
 - “OXYGEN ALARM – EVACUATE IMMEDIATELY AND CALL PUBLIC SAFETY AT 275-3333” (Or similar, dependent upon gas.)
- F. No installation shall be completed without a formal EH&S review.

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H. Gas Sensor and Alarm Point Selection Table 1

Gas	Parameters for Use	Sensor	Sensor Alarm Range	Sensor Placement	Additional Requirements
Cryogenic Liquids (Liquid Nitrogen, Helium, Oxygen)	EH&S Hazard Assessment	Oxygen (O ₂) Sensor	>23.5%, <19.5%	4 – 5 feet above floor	
Carbon Dioxide	EH&S Hazard Assessment	Carbon Dioxide (CO ₂) Sensor	1%	12 - 24 inches above the floor	
All Toxic Gases (Ammonia, Carbon Monoxide, Hydrogen Sulfide, etc.)	All toxic gases are required to be in a ventilated gas cabinet.	Must be alarmed with a leak detection system – A specific gas sensor for each toxic gas.	Dependent upon gas	Dependent upon gas	Cabinet must be alarmed and equipped with a purge mode upon a leak detected within the cabinet. A University approved vendor (Airgas) must be used when installing these systems.
Flammable Gases: Hydrogen	EH&S Hazard Assessment to see if alarm sensor range and Lower Explosive Limit (LEL) can be reached given the amount of gas a room dimensions.	Hydrogen Sensor (H ₂)	2%	Dependent upon gas	May be required to be in a ventilated gas cabinet, depending on fire loading calculations for the floor and building.
Methane	EH&S Hazard Assessment to see if alarm sensor range and Lower Explosive Limit (LEL) can be reached given the amount of gas a room dimensions.	Methane Sensor (CH ₄)	2%	Dependent upon gas	May be required to be in a ventilated gas cabinet, depending on fire loading calculations for the floor and building.

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VI. REFERENCES

- University of Rochester Compressed Gas Safety Policy (LS004)
- NFPA – 101 Life Safety Code
- ACGIH TLV Booklet

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VII. APPENDICES/FORMS

Appendix I: EH&S Gas Sensor Assessment Form

Principal Investigator/Supervisor:
Building:

Room/Location:

Type of gas:	
Number of tanks:	
Total cubic feet of gas:	
Expansion ratio:	
Total volume of gas at STP:	
Total cubic feet of room:	
Ratio of volume of gas to volume of room at STP:	
Percentage of gas to room at STP:	

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Number of tanks:	
Total cubic feet of gas:	
Expansion ratio:	
Total volume of gas at STP:	
Total cubic feet of room:	
Ratio of volume of gas to volume of room at STP:	
Percentage of gas to room at STP:	

Note: Air changes per hour are not considered into these calculations for the purpose of catastrophic failures.

In addition to the table outlined above, compressed gases must meet all other University of Rochester requirements in the Compressed Gas Policy.

Is an oxygen sensor required for this room/location? (YES / NO)

Type of Sensor Recommended:

Name of EH&S personnel:

Date:

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Appendix II

Commissioning Form

Building:
Room:

REQUIREMENT	YES / NO
Project:	
Sensors located near each point of egress?	
Sensor 4 – 6 feet above floor or per manufacturer?	
Sensor free of obstruction (2-3 feet)?	
Panel located outside of monitored area?	
Panel mounted 4 – 5 feet above floor?	
Alarm points per Table 1?	
Strobe and annunciator outside point(s) of egress?	
Different than area fire alarm and CO?	
Alarm connected to bldg. mgmt. system?	
Signage is posted in the immediate area of panel/strobe?	

Comments:

Name of EH&S personnel:

Date:

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Appendix III

Temporary work

Work activities that meet the requirements of temporary work (see Definitions section of this policy), and once approved by the EH&S team, may utilize a portable oxygen sensor. This sensor should be located in the immediate work space in the breathing zone of affected employees. Similarly, to permanently installed oxygen sensors, should the portable unit alarm, vacate the area immediately and contact Public safety, or call 911 for offsite locations.

The EH&S suggested portable oxygen sensor is the BW Clip 2 Year O₂ Single Gas Detector or similar. It can be found at the link below.

<https://pksafety.com/bw-clip-2-year-o2-single-gas-detector-bwc2-x/>

Please note that personal oxygen sensors have a limited life-span of only 24 months.

VIII. REVISION HISTORY

Date	Revision No.	Description
6/6/2019	New	New procedure to identify requirements for compressed gas alarms
8/3/2022	1	Clarification on strobe and annunciator placement, update preferred Manufacturer and Model Number