## Standard Operating Procedure

# **OXYGEN GAS SENSOR ALARMS**

## Overview

Normal oxygen levels range between 19.5% and 23% (normal 20.8%). Serious health

effects, fires or death by asphyxiation can occur quickly when oxygen levels are unsafe

(below 16% or above 21%). Liquefied cryogens and inert gases can displace oxygen and

create low oxygen levels in confined spaces or poorly ventilated areas. Sources of liquid

cryogens and inert gases including MRI or NMR magnets, cylinders of carbon dioxide,

helium, argon and nitrogen, anaerobic incubators, -80oC freezers, and analytical

instruments. Any room or space containing inert gas or other sources of oxygen

depletion should be evaluated by EH&S for appropriate engineering controls to safeguard

personnel and those entering these spaces. These guidelines address installation criteria,

maintenance and response to oxygen gas sensor alarms.

## Special Handling

1. **Identification of Sites for Oxygen Gas sensors**

1.1 Cylinder, tank and dewar failures, magnet quenches or sudden releases from pressure relief valves can overwhelm standard ventilation systems. In most research environments, gas volumes are limited and potentially asphyxiating gases quickly dissipate.

1.2 Air exchange rates in many labs are relatively high (6-15 ACH) further minimizing the risk of low oxygen levels. Cryogen tanks and compressed gas systems are designed as “fail safe,” venting slowly rather than rupturing. All of these features reduce the need for detection equipment.

1.3 Oxygen monitors should be placed in areas that are poorly ventilated or where confined spaces allow the build-up of asphyxiating gases to reach dangerous levels. The entry to the area should be posted for “oxygen deficiency potential.”

1.4 Oxygen monitors must be equipped with local alarms that can be heard and/or observed both inside and outside the room. It is recommended that oxygen alarms be connected to monitoring stations or command centers where automated ventilation controls can be activated to restore safe atmospheric conditions.

1.5 The installation, testing and maintenance costs for oxygen monitors and associated engineering controls must be the responsibility of the department or responsibility center using cryogens or asphyxiant gases.

**2. Maintenance/Calibration:**

2.1 All oxygen monitors should be calibrated and tested every six months at a minimum. Required maintenance will vary by manufacturer and may involve electronic checks, challenge tests using known gas concentrations, or full instrument calibration.

2.2 Device owners must make arrangements with personnel such as a departmental technician, a trained research staff member, or with third party technicians, consultants or manufacturer representatives to maintain oxygen monitors per specifications.

2.3 Oxygen monitors should be replaced every 2 years, unless specified otherwise by the manufacturer. Oxygen monitors or replacement sensors should not be purchased in advance, as they deteriorate in storage.

2.4 Challenge tests should always be performed when new monitors are installed or after sensor replacement to assure proper response.

2.5 All sensor changes and meter calibrations must be documented by the individual servicing the device, and the responsibility center should maintain service logs and test results for each instrument.

3. **Alarm Response**

3.1 For identifiable oxygen alarm causes, such as a magnet quench or a leak of carbon dioxide gas, the individual must stop work, control the leak source if safe and possible, and leave the room. The oxygen alarm should return to normal in minutes.

3.2 If the alarm continues, contact 911. Indicate the type of sensor and any potential or known leak sources.

3.3 If a faulty sensor is suspected, user departments must have the room tested and the oxygen sensor replaced or checked by service personnel as soon as possible. Use of potential asphyxiant gases or cryogens should be avoided until the sensor is replaced.

4. **Emergency Response**

Oxygen monitors will go into alarm mode at readings below 19%. All alarm activations must be investigated. Humans will not detect ill effects for short duration exposures until oxygen levels reach 14-16 %, but caution is required. If an oxygen meter detects levels at or below 14%, an extreme emergency condition exists. If people are unconscious or the condition cannot be resolved immediately, call Fire 911

The following response actions should be followed by each group.

4.1 Laboratory Personnel Response to Oxygen Alarm:

4.1.1 Evacuate the room immediately and close door.

4.1.2 Do not enter the room while the alarm is sounding.

4.1.3 Immediately inform others in potential danger and notify your supervisor.

4.1.4 Contact Emergency 911

4.1.5 Wait for the emergency responders at the building entrance and inform them of situation.

4.1.6 If a faulty oxygen sensor is suspected after the emergency has been abated, relocate   
 cryogenic processes to another laboratory where oxygen deficiency monitoring is available until the defective sensor is replaced.

4.2 Public Safety Response to an Oxygen Alarm:

4.2.1 **Do not enter room**

4.2.2 Ascertain if anyone is inside the room.

4.2.2.1 If an unconscious person is present, immediately contact 911. Do not enter room. No one

should attempt a rescue without a self-contained breathing apparatus (SCBA).

4.3 Environmental Health and Safety Response to Oxygen Alarm:

4.3.1 Assess any oxygen monitor and alarm condition as requested.

## Laboratory Specific Information

**Prior Approval Required**

**NO**

**YES (describe):**

**Designated Area**

**Entire Laboratory Area**

**Other (describe):**

**Experimental Conditions of Use**

**Temperature Range:**

**Pressure Range:**

**Scale Range:**

**Other Relevant Details:**

**Other Relevant Details:**

1. List the hazards and symptoms associated with oxygen-deficient atmosphere: <https://www.energy.gov/sites/default/files/2021-10/OE-3_2021-05_Oxygen_Deficient_Atmosphere_Hazards_at_DOE_Facilities.pdf>