INERT GAS INDUCED O_2 DEFICIENCY

Inert gases are commonly used in laboratory settings to:

- Reduce opportunity for ignition or explosion
- Minimize oxidation reactions
- Promote other non-oxygen reactions
- Control oxidation during welding
- Enhance or stop biological processes
- Facilitate certain metallurgical processes
- Purge and blanket storage vessels
- Allow safe shipment of reactive materials including flammables

Helium, nitrogen, argon, and several other inert gases are commonly used on the Homewood campus. These gases are not poisonous, but they still present a risk to researchers if there released in an uncontrolled manner in an enclosed space, such as a poorly-ventilated laboratory,

A small 10 x 8 ft laboratory with 8 ft ceilings has 640 cubic ft volume. Uncontrolled release of N_2 from a small 20" tall type "G" cylinder holding 50 standard cubic feet (scf) into the lab can reduce oxygen levels to unsafe levels (<19.5% O_2).

A normal lab-size cylinder ("K bottle") holding 315 scf of N_2 venting into a 25 x 20 ft lab could also result in unsafe oxygen levels. Even worse, an uncontrolled release from a 160 liter liquid nitrogen Dewar flask holding 3600 scf of N_2 could reduce the oxygen levels to a dangerous 11%.

The table below shows the physiological effects of reduced O_2 levels, a condition called hypoxia. Hypoxia can be a silent hazard. Often, victims do not realize the source of the problem, attributing it to general fatigue. The impaired thinking characteristic of hypoxia also inhibits recognition of the danger.

Contact Dr. Dan Kuespert, Laboratory Safety Advocate,

at 410-516-5525 or dkuespert@jhu.edu for

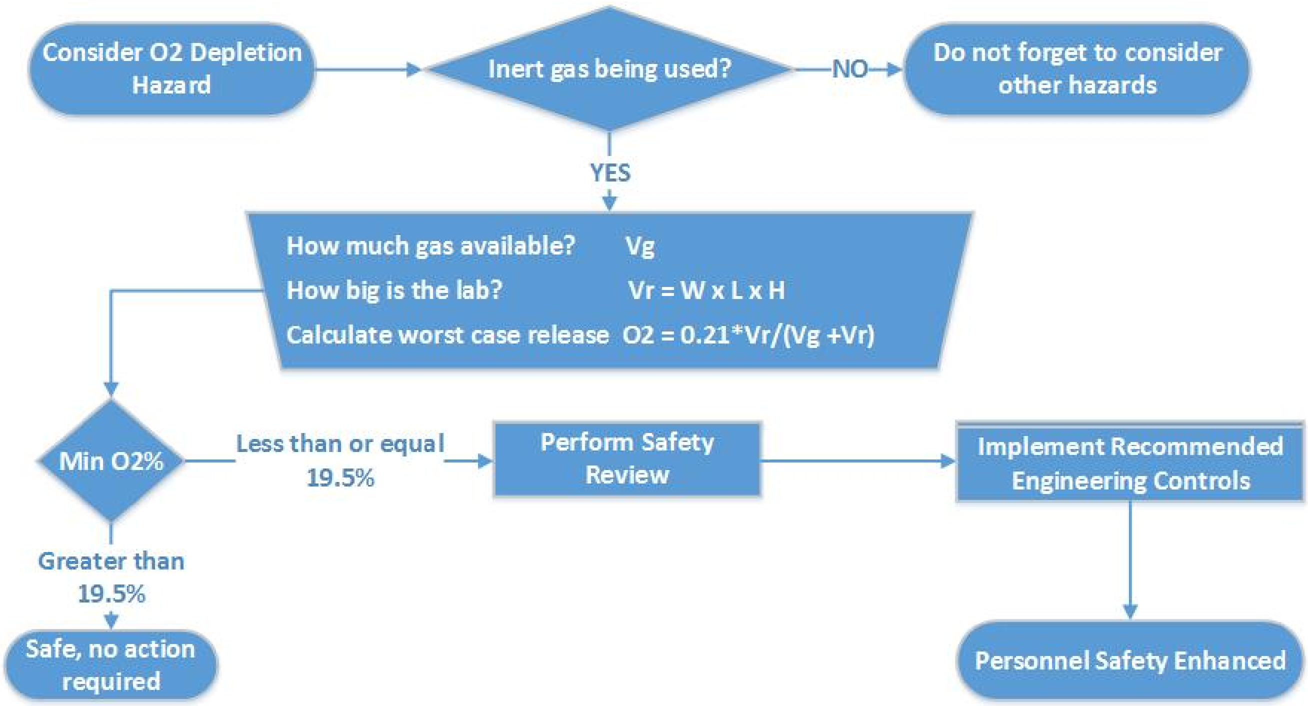
more information about this JHU Safety Note.

O_2 concentration (% vol)	Health effects on persons at rest
19	Some adverse physiological effects occur, but they may not be noticeable.
15–19	Impaired thinking and attention. Increased pulse and breathing rate. Reduced coordination. Decreased ability to work strenuously. Reduced physical and intellectual performance without awareness.
12–15	Poor judgment. Faulty coordination. Abnormal fatigue upon exertion.
10–12	Very poor judgment and coordination. Impaired respiration that may cause permanent heart damage. Possibility of fainting within a few minutes without warning. Nausea and vomiting.
<10	Mental failure. Impaired respiration that may cause permanent heart damage. Possibility of fainting within a few minutes without warning. Nausea and vomiting. Coma, Death.
Source: Air Product Safetygram17 http://www.airproducts.com/~/media/files/pdf/company/safetygram-17.pdf	

Recognizing the Hazard

Recognizing that a hazard may exist is the first step in ensuring that the risks are minimized. For an oxygen depletion hazard, the process is relatively straightforward. Use the flow chart below to analyze the hypoxia hazard potential in your lab.

This analysis assumes a worst case scenario of a sealed laboratory or enclosed space with little or no air exchange. This condition should never exist in a laboratory. It is used to conservatively evaluate risk level.



NEXT STEPS

The risks of this hazard can be mitigated one of two ways:

1. **Installing an oxygen gas sensor and alarm** to warn of unsafe breathing conditions. This costs between $500-1000 and requires annual maintenance and calibration.
2. **Adding or confirming ventilation.** Laboratories should have between 6 and 10 changes of air every hour. In all but the most catastrophic release, a lab should return to normal oxygen levels in minutes and never drop to unsafe levels. Ensure your ventilation is adequate. The required testing can be done by Facilities.

Contact the Homewood Laboratory Safety Advocate (dkuespert@jhu.edu; 410-516-5525) or the Department of Health, Safety & Environment (410-516-8798 or HSEInfo@jhmi.edu) with questions about this Safety Note or for assistance in ensuring your lab is protected against a catastrophic inert gas release.

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