UNIVERSITETET I BERGEN
Klinisk institutt 2

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Organizational placement:

Department of Clinical Science

Instructions for workplaces with risk of oxygen depletion or increased levels of carbon dioxide

These instructions are a part of the K2 internal **control system** to ensure safety in the laboratories. They should function as a guideline in the compilation of procedures for each research group.

1. Contents

2. General information

2.1 Scope

These instructions apply to employees and students in the laboratory.

2.2 Purpose

The purpose of these instructions is to give an overview of safety checks and maintenance routines. Each research group is responsible for compiling and implementing checks with regard to CO_2 and when using liquid nitrogen.

2.3 Changes from the previous version

This is the first version.

2.4 Risk assessment

These instructions are based on the risk assessment by the Medical Faculty of the University of Bergen. To ensure a safe workplace it is important that potential risks are prevented, and their effects kept to a minimum. High levels of CO_2 and N_2 can have many consequences, so the measures within this SOP should prevent these.

2.4.1 Carbon dioxide

An increased concentration of CO_2 can result in a reduced ability to work, an increased occurrence of ill health, poisoning and death, depending on the concentration and exposure time.

CO_2 is heavier than air and will lie close to the floor.

CO_2 concentration	Effect
0.036%	**Normal concentration in air**
0.1 %	**Long term exposure can affect concentration**
2%	**Increased breathing rate, tiredness and headache.**
3%	**Increased blood pressure and pulse. Hearing is affected.**
7-10 %	**Unconsciousness in a few minutes**
>10%	**Spasms, coma and death**

1% = 10 000 ppm.

2.4.2 Liquid nitrogen

The temperature of liquid nitrogen is -196 °C. When liquid nitrogen is poured into a cryotank some of the liquid is converted to vapour and with spillage all the liquid forms vapour. During the transition from liquid to gas, the vapour is white and looks like smoke, but at room-temperature nitrogen is invisible and odourless. It is not poisonous, but as the gas is lighter than air it mixes with the air in the room so when oxygen is depleted it can be fatal.

Depletion of O_2 due to increased N_2 level:

O_2 Concentration	Effect
21 – 17 %	**Normal level, no visible effect**
17 – 14 %	**In some people there will be marked reduction in their ability to work.**
14 – 11 %	**Most people will have reduced ability to work without realising it.**
11 – 8 %	**The first instances of unconsciousness occur**
8 – 6%	**Unconsciousness occurs after just a few minutes**

2.5 Ventilation

The buildings that make up the department have different controls for ventilation.
In the Laboratory building there is full ventilation in the laboratories 24 hours every day of the week.
Everyone must know how the ventilation is regulated in their place of work.

During a power outage the ventilation in HUS buildings is reduced to 60%. Every employee and student should know when there will be a power outage test and what it entails.

2.6 Abbreviations

HSE	Health Safety Environment
HUS	Haukeland University Hospital
K2	Department of Clinical Science

3. Roles and responsibility

Role	**Responsibility/Task**
Everyone	• Read and understand the HSE handbook
Employer/ Group leader	• Make available and follow up on this procedure
Employee responsible in each group	• Make local procedures based on this instruction

4. Internal control

Each research group is responsible for carrying out maintenance and yearly / regular controls of cryotanks, as well as equipment and instrumentation using CO_2. These control and maintenance tasks should be routine for all equipment and instrumentation in the laboratory.

4.1 Instructions for the prevention of CO_2 leaks

If there is a need for an extra control then an O_2 monitor may be borrowed. Contact the reception desk or the contact person on the 5. floor in the laboratory . building during normal working hours.

See 4.2

Each research group should have routines in place for:

- **Daily operation:**
  - Check for and document (suspected) non-conformities of O_2 / CO_2 levels in a room with potential injury.
  - Increased awareness of circumstances and injuries that could arise.
  - Training of new employees and students.
  - Check for possible leaks that may trigger the CO_2 alarm in an incubator - tubing, joints, valves and manometers. Possible leakages may be detected using the AGA TL4 spray or soap water spray.
  - Incubators that are not in use should be uncoupled from the main valve.
  - There are rules in place for working alone out of normal working hours.

- **Regular checks and maintenance:**
  - Oxygen levels in cell labs should be assessed weekly.
  - The level of CO_2 in incubators should be checked at least every 6 months, based on the recommended time period by the manufacturer and your own experience. (A CO_2 monitor may be borrowed from "Teknisk fellesavdeling" at the Department of Biomedicine).
  - If you do not already have an agreement to check valves and manometers with "Teknisk fellesavdeling" every 5 years, then do so.

- **Yearly checks and maintenance:**
  - Control of incubators, tubing and joints. Visual check of valves and manometers.
  - Thorough cleaning.
  - Calibration of O_2 and CO_2 detectors. For some detectors a 6-monthly check is recommended.
  - Service contract with Alf Lambrecths, alf@instrumentservices.no. Make the order using the ordering system (Unit4 ERP) and the groups lab account.

4.2 Instructions for lending out the handheld O_2 monitor

The purpose of lending out the handheld O_2 monitor is that it should primarily be used as a safety check when the O_2 level in a room is thought to be below normal. The rooms it especially applies to are laboratories with a CO_2 supply. e.g., cell labs, and room with cryotanks.

In order to borrow the O_2 monitor you can contact

- The administration on the 8th floor. Ask at the reception or someone in one of the offices
- The laboratory contact person on the 5th floor (Kjerstin Jacobsen)

Lending rules

1. Those borrowing the handheld O_2 monitor must write their e-mail address.
2. The handheld O_2 monitor should be returned on the same day after the O_2 level has been checked.
3. The handheld O_2 monitor may be borrowed over a longer period, but this must be agreed upon and noted on the lending form.
4. The handheld O_2 monitor may be borrowed to ensure your safety when working after hours or at the weekend but must be returned the next working day.

4.3 Instructions of the prevention of asphyxia from liquid nitrogen

As a rule, an O_2-monitor should be installed in rooms with cryotanks.
The number of tanks in each area should be calculated based on movability and air volume, especially in enclosed rooms.
Consider alternatives to cryotanks, such as -150°C freezers or space in Biobank Haukeland.

Each research group should have routines for the following:

Daily operation:

- Increased awareness of circumstances and injuries that could arise.
- Training of new employees and students.
- The necessary safety equipment required when using a cryotank.
- Cryotanks with liquid nitrogen should not be left unattended when filling.
- Transport of cryotanks in the lift; should be labelled with the name of the person responsible and be transported on their own. No-one should use the lift when transporting a cryotank. If more than one lift occupies the same liftshaft then the other lift(s) should also not be used.

Inspection and maintenance:

- Yearly check of cryotanks for wear and damage that may affect the vacuum. Especially the neck of the tank where the inner part of the tank is attached at the safety valve.
- Be aware of the amount of liquid nitrogen used as increased usage can lead to increased leakage.
- Alarms on cryotanks should be checked – level indicators should be checked once a year.
- Fixed oxygen detectors should be checked regularly (at least once a year) and if may be an error.

5. Appendix

5.1 Laws and regulations

The working environment act § 4–4	**States that the workplace is designed such that employees are guaranteed a fully clean indoor climate with air free from harmful, aggravating or irritating pollutants**
The working environment Act § 3–1	*The employer has a duty to plan, document and implement measures to ensure that the requirements comply to the law.*
Internal control regulations § 5 pkt.6	States that any dangers and problems should be documented and risks considered. Also prepare constituent plans and measures in order to reduce the risks.
Workplace regulation § 1–3	Requirement from the employer which applies to the design of premises with a view to its' actual use, cf. § 2.1, and to implement adequate climate and air quality cf. § 2–14.
regulation for limits and thresholds, attachment 1	A list of the limits for pollutants in the workplace atmosphere. These limits are related to exposure and should not be exceeded.
regulation for work performance § 3–1	A requirement for a special risk assessment and documentation for working with chemicals.

5.2 Links

Occupational healthcare, contact info	Only available in Norwegian **https://www.uib.no/hms-portalen/111462/kontakt-bedriftshelsetjenesten**
HSE non conformity	https://avvik.app.uib.no/apex/f?p=692:1:8580264067252::NO:::
K2 HSE-handbook	https://hmsk2.w.uib.no/en/hse-handbook-part-2/

5.3 Lending form for handheld O_2 monitor

Lending Form for Handheld O_2 Monitor

Date	Room	Reason for borrowing the monitor and requested period (if more than a quick control)	Email	Name, lender

This form is on a computer or in print at the 5th and 8th floor.