Health and Safety Information for Quantum Circuits Group Laboratory
Rankine Building Rooms 114 and 116 on Level 1
Electronic & Nanoscale Engineering, School of Engineering, University of Glasgow

Risk Assessment and Potential Hazards
Prepared by Professor Martin Weides
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All Laboratory Users must read this document in full

Emergency Contacts

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The adoption and practice of good safety procedures is of paramount importance for both the health and safety of fellow workers, and for the integrity of the fabric of the Quantum Circuit Group.

A1. Lab Safety Management Responsibilities

- Everyone has a role in protecting the health and of safety of other lab users and themselves, and should thus be familiar with the School Safety Manual.
- Academic supervisors take full responsibility for the health and safety of the research group's activities and consequently must ensure that staff, students and visitors are familiar with the content of this Code of Practice and Risk Assessments plus the School Safety Manual and apply its requirements.
- No research activities shall be carried out in the Quantum Circuit laboratory Rankine 114 and 116 without the permission of Professor Martin Weides, the Lab Guardian.
- No work will be carried out unless it is covered by the Risk Assessment (Section B) on this form. New activities should be discussed with the supervisor, lab guardian and School Director of Safety. Section B should be updated accordingly after approval.
- An electronic copy of the current Code of Practice and Risk Assessment shall be sent to the Lab Responsible Person and shared with the School Director of Safety
- All lab users must familiarize themselves with the general safety procedures highlighted in the School's Safety Manual and location of safety equipment in the lab. In summary:
    - In case of emergency, dial telephone number 4444 (internal), 0141 330 4444(external)
    - Emergency Exits are located in the lab. To exit the Rankine building use the main stairwell (not lifts)
    - A Fire Extinguisher is located in the main stairwell on level 1
    - First Aid Kits are available in the lab and in the janitors office on level 4.
- Work outside of normal office hours (8am-5pm) and weekend working requires permission of your supervisor. The out of hours working book located in the lobby of the Rankine building must be signed, noting the name of the individual, location, time in and time out. Potentially dangerous operations must never be undertaken outwith normal 2 hours unless a second responsible person is present (please refer to the School's safety Manual).

A2. Best Practice in the Laboratory

- Use safety equipment provided appropriately
- Use equipment in accordance with manufacturer instructions.
- Report faulty equipment immediately to Prof Weides and lab members.
- The main door and the doors within the laboratory should be kept shut if not in use, for fire safety, security, and noise reduction.
- Do not store food or drink in the laboratory refrigerator. Chemicals only!
- Be aware of placement of fire extinguishers and fire alarms in the lab.
- Keep the lab tidy. Always return tools to their storage places, and do not leave workspaces messy.
- Lab members are responsible for ensuring that visitors follow appropriate safety protocols
- For out of hours working (evening after 5pm/weekend), sign the book at reception on the first floor.

B. Categories of Activity

1. He and N_2 gas cylinders for cryostat operation

   Potential Risks and Control Measures

   a) Asphyxiation:
   Cylinders are secured via chain in room 116, which is without ventilation. When occupying 116, the door must always remain open. Further, the oxygen sensor should be checked when entering the room. Only certified technicians and lab personnel should move or hook-up the gas cylinders.

   b) Topple of cylinder:
   The cylinders must always be secured to the wall by the chain to prevent it from falling over. Only certified technicians and lab personnel should move or hook-up the gas cylinders.

   c) Minimizing COVID-19 Exposure Risk:
   To fulfil social distancing guidelines, only one person should occupy 116 or handle gas cylinders at a time

2. Vacuum Pump Stations

   Potential Risks and Control Measures

   a) Electrical shock:
   Care should be taken when plugging in the pump station to a wall socket. All pumps will be PAT tested. If power supply wiring is damaged, request work from the electrical workshop.

   b) Moving pump stations:
   Care should be taken when moving pump stations. Always use both hands, and never place the station precariously (e.g. placement on a flimsy surface). Prepare placement area before attempting to move pump.

   c) Minimizing COVID-19 Exposure Risk:
   To fulfil social distancing guidelines, only one person should move the pump at a time. Before moving pump, wipe the handle surfaces with IPA.

3. Cryostats

   Entropy, GmbH adiabatic demagnetization refrigerator (ADR) in 114

   Potential Risks and Control Measures

   a) Rupture of compressed Helium lines:
   High pressure helium gas is supplied into the cryostat via compressed gas lines. High strain or sudden shocks to these lines may lead to violent rupture of the high-pressure gas lines. To prevent this, make sure that lines have minimal strain

and are not tightly bent, and never store heavy tools above gas lines. Sudden falls from these tools may shock the lines, causing damage.

b) Cold burns:
Ensure that the cryostat is fully warmed up before removing the vacuum canisters. Check the thermometers before venting the vacuum. Vent only when all thermometer readings are above 280 K. Wait until thermometers read 290 K before opening.

c) Ladder fall:
Ensure that the ladder is certified for use. Always place the ladder on a stable surface. Do not place ladder legs on cables, wires, etc. Use the ladders according to safety criteria labelled on the ladder itself.

d) Electrical Shock:
High currents are used for the ADR magnetization and experiments. Ensure that all wiring to and from the ADR are fully insulated. Ensure that the ADR and chassis is properly grounded to prevent electrostatic build-up.

e) Magnetic Field Exposure:
Strong magnetic fields are in use in the cryostat. Therefore, people with pacemakers should not enter the lab before seeking approval from lab personnel. Warning signs should be placed at entrances to 114.

f) Minimizing COVID-19 Exposure Risk:
Most procedures on the ADR can be performed by one single person. Unless there are specific circumstances requiring two persons, only one lab worker should operate the ADR. When possible, data acquisition should be carried out remotely.

Oxford Instruments dilution refrigeratora (DR) in 114

Potential Risks and Control Measures

a) Rupture of compressed Helium lines:
High pressure helium gas is supplied into the cryostat via compressed gas lines. High strain or sudden shocks to these lines may lead to violent rupture of the high-pressure gas lines. To prevent this, make sure that lines have minimal strain and are not tightly bent, and never store heavy tools above gas lines. Sudden falls from these tools may shock the lines, causing damage.

b) Cold burns:
Ensure that the cryostat is fully warmed up before removing the vacuum canisters. Check the thermometers before venting the vacuum. Vent only when all thermometer readings are above 280 K. Wait until thermometers read 290 K before opening.

c) Liquid Nitrogen (LN):
LN is used to cool down the nitrogen trap of the DR. It can cause severe cold burns and frostbite. Cryogenic gloves should always be worn when decanting LN or handling its container. Always use an approved container for storing and transporting LN. Safety glasses should be worn. Do not place LN into a sealed container: rapid evaporation will create a high-pressure environment.

d) Ladder fall:
Ensure that the ladder is certified for use. Always place the ladder on a stable surface. Do not place ladder legs on cables, wires, etc. Use the ladders according to safety criteria labelled on the ladder itself.

e) Electrical Shock:
High currents and voltages can be used for DR experiments and equipment.

Ensure that all wiring to and from the DR are fully insulated. Ensure that the DR and chassis is properly grounded to prevent electrostatic build-up.

f) Minimizing COVID-19 Exposure Risk:
Opening and closing the DR require two or more persons. This procedure should be pre-arranged and coordinated within the group to minimize COVID-19 exposure risk. When possible, data acquisition should be carried out remotely.

4. Tabletop Magnet for FMR

Potential Risks and Control Measures

a) Electric Shock:
The resistive FMR magnet uses high currents and voltages to create magnetic fields. Ensure that all wiring to and from the magnet are not exposed. Do not touch the connectors to the magnet while it is powered.

b) Magnetic Field Exposure:
Strong magnetic fields are present when the magnet is powered. Therefore, people with pacemakers should not enter the lab before seeking approval from lab personnel. Warning signs should be placed at entrances to 114.

c) Risk of Physical Harm:
The magnetic fields create strong forces between the magnetic poles. Never loosen the bolts securing the magnetic poles while the magnet is powered.

5. Chilled Water Supply

Potential Risks and Control Measures

a) Leaks and flooding:
The chilled water supply provides cooling for compressors, DR turbopump, and resistive magnets. Since there is a risk of flooding, chilled water supply lines should be locked when not in use and secured with two jubilee clamps when in use. Water supply lines should be checked for leak tightness before use.

b) Electrical Safety
Electrical devices should not be placed underneath chilled water supply fixtures or near water supply hoses. Electrical equipment should be elevated off from the floor to prevent electric shock in case of a flood.

c) Minimizing COVID-19 Exposure Risk:
COVID-19 procedures reduce the foot traffic in the building, and thus reduce detection of leaks and flooding. Rooms should be checked regularly for timely detection of leaks.

6. Electrical Apparatuses

Potential Risks and Control Measures

a) Electric Shock and Fire:
All electrical equipment is PAT tested. Instrument housing will not be removed when the equipment is connected to the power supply. A grounding strap and grounding mat should be used when handling or modifying electrostatically sensitive electronics.

7. Chemical Safety

Potential Risks and Control Measures

a) Solvents:
Both Acetone and Isopropanol (IPA) are flammable solvents and thus should be kept away from heat sources. Source bottles for these chemicals are kept within the ventilated storage cabinets located beneath the LAF cabinet. These

chemicals should always be decanted underneath the fume hood. Gloves and safety goggles are required when handling these chemicals. They should not be disposed down the sink drain and instead should be disposed into marked containers for solvent wastes.

b) Resins:
Stycast and GE Varnish are resins used for cryogenic environments. They are toxic and should not be ingested. Gloves and safety glasses should be worn when handling these chemicals. When possible, these resins should be allowed to dry either in the LAF cabinet or in a vacuum desiccator. When not in use, these chemicals should be stored in the lab refrigerator.

c) Silver paste:
The silver paste is used to make thermal and electrical contacts. The solvent for the paste is toxic, and thus it should not be ingested or inhaled. Gloves should be worn when handling the silver paste, and it should be left to dry under the LAF cabinet when possible. When not in use, it should be stored in the lab refrigerator.

d) Solder flux:
Solder flux is toxic and should not be ingested. Gloves and safety glasses should be worn when handling. If solder flux is H_3PO_4-based, perform soldering in the LAF cabinet if possible. When not soldering in the LAF cabinet, use the small fume extractor provided by the lab. Solder joints should be rinsed in water to neutralize the acid residues.

8. Other equipment

Batteries

Expired batteries will be replaced and disposed of in the electrical workshop. Do not throw away in trash.

Handheld Drill and Dremel Tool

Potential Risks and Control Measures

a) Injury:
Care will be taken when setting up and handling. Switch off power when changing tools. Wear safety glasses when operating to prevent debris from entering the eye. Securely grip the tool in hand and ensure that object being drilled/polished is secured. Ensure that hand and fingers do not touch drill/dremel tip when in use.

Heat Gun and Soldering Iron

Potential Risks and Control Measures

a) Burns:
Never touch soldering iron tip or nozzle of heat gun when they are turned on. Always wear safety glasses when soldering. Do not point air stream of the heat gun at face or body. Let objects cool before touching.

b) Fire: Do not leave soldering iron and heat gun unattended when they are turned on. Turn off these devices when use is finished. After turning off, wait five minutes or more to cool before storing them in tool cabinet. Do not allow these tools to heat flammable objects or electrically powered devices.

C. Protocols to address COVID-19 exposure risks

- Follow general guidelines provided by the University.
- Wipe down any surface that you would touch using disinfecting cloths.
- Guidance from the HSE, UK Government and Scottish Government to manage the risk related to the Covid-19 pandemic must be applied to the Quantum Circuit Lab. These include physical distancing, frequent hand washing and hygiene measures, cough etiquettes and face covering in enclosed shared public space. Considerations for Codes of Practice and Risk Assessment for the James Watt School of Engineering have been taken into account
- Demand to use the lab will be managed by the Lab Guardian liaising with the School Safety Coordinator. Collaboration and communication will be required between lab users, supervisors and the Lab Guardian to establish and adhere to an online working rota. Impact on the overall occupancy of the Rankine Building will be reviewed by the Technical Services Manager.
- Lab users must wash their hands regularly and wipe workstation surfaces, lab telephone, materials and equipment at the start of their work and before leaving.
- Lab users who feel they exhibit C-19 like symptoms or have been instructed self-isolate as a result of contact tracing should not use the lab and should inform their supervisor and the Lab Guardian.
- Emergency support (First Aiders and Fire Area Officer) may be constrained due to the Covid-19 restriction on building capacity. Task risk assessments need to be reviewed to include the above measures. These should take into account whether the work can be safely undertaken with reduced access to emergency support.
- Further information (updated as C-19 situation progresses):
    - https://www.gov.scot/collections/coronavirus-covid-19-guidance/
    - https://www.hse.gov.uk/news/assets/docs/working-safely-guide.pdf
    - https://www.gla.ac.uk/myglasgow/seps/az/loneworking/covid-19workingsafely/
    - https://www.gla.ac.uk/myglasgow/news/coronavirus/
    - https://www.gla.ac.uk/myglasgow/seps/az/sepscovid-19resourcecentre/#
- School of Engineering C-19 Code of Practice & Risk Assessment: https://www.gla.ac.uk/media/Media_724009_smxx.pdf
- Physical distancing in the Quantum Circuit Laboratory 114 and 116 means a maximum capacity of 5 persons. Only 1 person can work at a given time at each measurement setup. Only 1 person should enter the service area at one time.