

Health and Safety Information for Quantum Sensors Laboratory

Rankine Building Room 222c

Code of Practice and Risk Assessment

Electronic & Nanoscale Engineering, James Watt School of Engineering, University of Glasgow

Revised by Prof. Robert Hadfield 17/6/2020

All Laboratory Users must read this document in full and sign off in Section C

A. Code of Practice

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 Sensors Laboratory.

A1 Lab Safety Management Responsibilities

- (i) **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**.
- (ii) **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.
- (iii) No research activities shall be carried out in the Quantum Sensors laboratory Rankine 222b without the permission of **Professor Robert Hadfield**, the **Lab Guardian**.
- (iv) 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.
- (v) 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. A printed copy of the current Code of Practice and Risk Assessment, signed and dated (electronically or physically) by all current users (Section C) is displayed in the Orange Folder on the wall inside the entrance to the lab.
- (vi) 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 2
 - **First Aid Kits** are available in the lab and in the janitors office on level 4.
- (vii) 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

hours unless a **second responsible** person is present (please refer to the School's safety Manual).

A2 Best practice in the laboratory

- The lab must be kept tidy.
- No food and drink will be brought into lab 222c.
- Safety equipment provided will be used appropriately.
- First aid boxes are available next to the sink. All users should be aware of the qualified building first aiders.
- Use equipment in accordance with manufacturer instructions.
- Inventories of equipment and specific lab procedures are detailed on the Group Wiki: <https://sites.google.com/site/quantumsensorsglasgow/>
- Avoid trailing cables and fibres across lab.
- Consider your own safety and that of other lab users when operating lasers.
- Do not stack equipment; use racks and shelves appropriately.
- Report any faulty equipment immediately to the Lab Guardian Prof Hadfield and coworkers.
- A fault with the fabric of the room, such as a lighting failure, should be reported through the Maintenance Request portal found on the Estates and Commercial Services webpage, <http://www.gla.ac.uk/services/estates/>.
- The main door and the doors within the laboratory should be kept shut if not in use, for fire safety, security, and noise reduction.
- Keep access to doorways and pathways to exits clear of equipment and obstructions.
- Dispose of packaging materials and empty the bins regularly. A dongle for the back door Level 2 to access the main recycling bins can be obtained from the Janitors on Level 4.
- Store chemicals and solvents in the containers provided and store in the chemical cabinet. Waste chemical collection should be arranged as required (with Shona Ballantyne).
- Visitors as well as long term research group members need to adhere to these guidelines
- For out of hours working (evening after 5pm/weekend), please sign the book at reception on the first floor. Do not work in the building alone.
- Good communication with other group members is essential. Group members are in regular contact via the Quantum Sensors mailing list eng-qsg@glasgow.ac.uk and are expected to attend weekly group meetings 11am Wednesdays.

A3 Covid-19 Measures

- (i) 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 Sensors 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 [See (vii) below for links to online guidance and documents].
- (ii) Physical distancing in the Quantum Sensors Laboratory 222c Lab1 means a maximum capacity of **2 persons**. Only 1 person can work at a given time at each optical table. Please use the doorbell to announce your arrival. Only 1 person should enter the service area at one time.

- (iii) Demand to use the lab will be managed by the Lab Guardian liaising with the School Safety Co-ordinator. Collaboration and communication will be required between lab users, supervisors and the Lab Guardian to establish and adhere to a online working rota. Impact on the overall occupancy of the Rankine Building will be reviewed by the Technical Services Manager.
- (iv) 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.
- (v) 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.
- (vi) 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. A Covid-19 Risk Assessment template can be found here:
https://www.gla.ac.uk/media/Media_723618_smxx.docx
- (vii) 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/>
 School of Engineering C-19 Code of Practice & Risk Assessment
https://www.gla.ac.uk/media/Media_724009_smxx.pdf

B. Categories of Activity: Risk Assessment and Potential Hazards

1. Lasers

HP tuneable laser CW 1440 -1600 nm power 5mW Class IIIa fibre coupled
 Supercontinuum NKT SuperK compact 400nm-2400 nm 110mW Class IIIb fibre coupled
 Chromacity OPO pulsed 1400 – 3900 nm 500mW Class IV fibre coupled
 KPhotonics CNT-1560 nm 50MHz 2mW pulsed Class IIIb fibre coupled
 Santec tuneable laser CW 1500-1630 nm power 30mW Class 1M fibre coupled

See also 9. Keopsys EDFA

Potential Risks

Eye safety
 Electric shock

Control Measures

All commercial lasers and controllers will be PAT tested. All of the above are fibre coupled in normal use. No interlocks are therefore required. All lasers connected to an experimental setup will be turned off when using a fibre inspection scope. All users will have undergone laser safety training.

2. Use and Inspection of Optical Fibre

Potential Risks

Electric Shock, Cuts and splinters from fibre.

Control Measures

PAT testing of splicer and maintenance of electrodes. Sharps bin for Fibre fragments. No open toed shoes or sandals should be worn in lab.

Laser interlock

3. Vacuum pump (Oerlikon PT70 Turbo)

Potential Risks

Electrical shock. Damage to pump though exposure to atmospheric pressure. Physical damage to pump leading to personal injury.

Control Measures

All pumps will be PAT tested and robustly mounted. All users will be trained by RHH, AC, NRG or RMH. Vacuum gauges and rotation speed readout will be used to avoid damage to the turbo through overpressure. Accessories such as clamps, O-rings and bellows will be checked regularly and discarded in case of leaks.

4. Cryostats (Sumitomo SRDK 101D cold head)

Potential Risks

Explosion due to gas overpressure inside cryostat. Cold burns.

Control Measures

All cryostats will be leak tested prior to operation. During operation after pump out the main clamp will be removed in order to enable pressure release in the event of rapid warmup. All cryostats have thermometers installed. These will be used to monitor internal temperature. The cryostats will not be opened unless the internal temperature is above 0°C.

5. Use of He compressors (Sumitomo air-cooled CNA11-C)

Potential Risks

Compressor. Risk of explosion or electric shock.

Cooling water. Risk of flooding leading to electric shock.

Control Measures

All compressors will be securely mounted on casters, preferably in the Plant Room. Water cooled compressors will be connected to the cooling water with flow rate and temperature set according to manufacturer specifications. Air cooled compressors will adequate clearance from walls and neighbouring apparatus to allow air flow. Cooling water system will be monitored regularly for flow rates and leaks. All users will be given basic instruction in starting and restarting the cooling water.

6. Electrical apparatus (General guidelines)

Potential Risks

Electric Shock, Fire.

Control Measures

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 delicate electronics (e.g. amplifiers).

7. Chemicals

Isopropanol

Potential Risks

Flammable.

Control Measures

Less than 200 ml to be kept in lab. IPA will be kept away from soldering irons and other heat sources. Will be stored in chemical cabinet when not in use. Disposal will be carried out according to building chemical disposal procedures (not to be poured down the sink). Liaise with Shona Ballantyne for Chemical Disposal.

Acetone

Potential Risks

Flammable, irritant.

Control Measures

Less than 200 ml to be kept in lab. Acetone will be kept away from soldering irons and other heat sources. Gloves and safety goggles will be worn when handling. Will be stored in chemical cabinet when not in use. Disposal will be carried out according to building chemical disposal procedures (not to be poured down the sink).

Ethanol

Potential Risks

Highly Flammable, Eye irritation, not to be inhaled in high vapour concentrations, Not for human consumption.

Control Measures

Ethanol will be kept away from soldering irons and other heat sources. Will be stored in chemical cabinet when not in use. Disposal will be carried out according to building chemical disposal procedures (not to be poured down the sink).

Dimethyl sulfoxide (DMSO)

Potential Risks

Highly Flammable, Eye irritation, Slightly hazardous in case of inhalation and skin contact, Not for human consumption.

Control Measures

DMSO will be kept away from soldering irons and other heat sources. Will be stored in chemical cabinet when not in use, in a cool and well-ventilated area. Disposal will be carried out according to building chemical disposal procedures (not to be poured down the sink). Wear gloves, eye protection, lab coat and use of fume hood when handling.

Epoxy Resin

Potential Risks

Irritant, toxic if ingested.

Control Measures

Wear gloves when handling, use fume hood, dispose of according to building safety procedures.

Conductive Silver Paste

Potential Risks

Irritant, flammable, toxic if ingested.

Control Measures

Small quantities in use only (under 20ml). Wear gloves when handling.

Solder Flux

Potential Risks

Irritant, toxic if ingested.

Control Measures

Small quantities in use only (under 200ml). Wear gloves when handling. Direct away from eyes. Dispose of according to building chemical disposal guidelines.

Photosensitizer dyes

- **Rose Bengal** powder and water/organic solvent based solution. KT responsible for disposal.

Potential Risks

Staining, Eye irritation. Not for human consumption.

Control Measures

Wear gloves, eye protection and lab coat when handling solution.

- **Eosin Y** powder and water/organic solvent based solution. KT responsible for disposal.

Potential Risks

Staining, Eye and Skin irritation. Not for human consumption.

Control Measures

Wear gloves, eye protection and lab coat when handling solution.

- **Zinc Phthalocyanine** powder and water/organic solvent based solution. KT responsible for disposal.

Potential Risks

Staining, Eye and irritation. Not for human consumption.

Control Measures

Wear gloves, eye protection and lab coat when handling solution.

- **Methylene Blue** powder and water/organic solvent based solution. KT responsible for disposal.

Potential Risks

Flammable, Staining, Eye and Skin irritation. Not for human consumption and inhalation.

Control Measures

Wear gloves, eye protection and lab coat when handling solution.

HgTe Quantum Dots in Toluene

Potential Risks

Highly flammable, Intense or continued exposure could cause temporary incapacitation or possible residual injury, toxic if ingested.

Control Measures

Small volumes (less than 1 cubic centimetre) in use only. Wear lab coat, safety goggles and nitrile gloves when handling. Dispose via Red List waste container (Level 8 BME lab).

8. Use of liquid nitrogen

Potential Risks

Cold burns. Asphyxiation due to displacement of oxygen in the air in confined work areas. Explosion due to gas overpressure inside inadequately vented equipment.

Control Measures

Wear safety goggles and loose-fitting thermal insulated/leather gloves along with long-sleeved tops for protection. To avoid any risk of asphyxiation, only a small quantity of liquid nitrogen may be brought into the lab (< 1 L) in a container designed for liquid nitrogen use. Liquid nitrogen will only be used with adequately vented equipment within the lab. All users should be fully trained in the local departmental procedures for usage and transportation before they engage in handling the substance.

9. Other equipment

Batteries

Potential Risks

Corrosion over time leading to failure => Damage to equipment and release of toxic chemicals.

Control Measures

Batteries are checked regularly via voltmeter. Batteries will be removed from equipment not in use. Expired batteries will be replaced and disposed of according to building procedures (Shona Ballantyne, Level 7)

Power Drill

Potential Risks

Electric shock. Injury

Control Measures

Care will be taken when setting up and handling. The tool is PAT tested. The power will be switched off when changing tools. Safety goggles will be worn. Samples will be securely clamped.

Heat Gun

Potential Risks

Electric shock. Burns. Fire

Control Measures

The heat gun will be PAT tested. It will not be left running unattended. It will not be operated in the vicinity of flammable solvents. It will not be directed at bare skin.

Soldering Iron

Potential Risks

Electric shock. Burns. Fire

Control Measures

The soldering iron will be PAT tested. It will not be left running unattended. It will not be operated in the vicinity of flammable solvents. It will not be directed at bare skin. A store of fresh, clean tips will be maintained (KTs)

Keopsys EDFA

Potential Risks

Eye safety

Electric Shock

Control Measure

PAT testing. Fibre coupled in normal use. No interlocks are therefore required. Erbium Doped Fibre Amplifier (EDFA) connected to an experimental setup will be turned off when using a fibre inspection scope. All users will have undergone laser safety training.

Agilent Optical Spectrum Analyzer

Potential Risks

Electric Shock

Control Measure

PAT testing.

Arroyo Instruments Laser Diode Controller/ Peltier

Potential Risks

Burns, Fire

Electric Shock

Control Measure

The controller will be PAT tested. The Peltier will not be left running unattended. It will not be operated in the vicinity of flammable solvents. It will not be directed at bare skin.

B. Best Practice in the Laboratory

- No Food and drink will be brought into lab 222c.
- Safety equipment provided will be used appropriately.
- First aid boxes are available at the end of the room. All users should be aware of the qualified building first aiders.
- Use equipment in accordance with manufacturer instructions.
- Avoid trailing cables and fibres across lab.
- Do not stack equipment; use racks and shelves appropriately.
- Report any faulty equipment immediately to Prof Hadfield and post-docs.
- The main door and the doors within the laboratory should be kept shut if not in use, for fire safety, security, and noise reduction.
- Visitors as well as long term research group members need to adhere to these guidelines.
- For out of hours working (evening after 5pm/weekend), please sign the book at reception on the first floor. Do not work in the building alone.

C. Laboratory Users (Members/Visitors/Project Students)

- All users of laboratory 222c are required to read and sign this document electronically or by hand before using the laboratory.
- The latest version of this document was reviewed at Zoom meetings on 10/6/2020 and 17/10/2020
- By signing below, I state that I have read and understood the risk assessment and potential hazards in room 222c and will at all times undertake safe practice.

Quantum Sensors Research Group Members

Name (Print)	Role	Signed	Date	Countersigned	Date
Prof Robert Hadfield	Lab Guardian/Supervisor	RHH	17/6/2020	RHH	17/6/2020
Dr Dmitry Morozov	PGR	DM	17/6/2020	RHH	17/6/2002
Gregor Taylor	PGR	GT	17/6/2020	RHH	17/6/2020
Mahmoud Ahtaiba	PGR	MA	17/6/2020	RHH	17/6/2020

Visitors and Project Students

Name (Print)	Role/Institution	Signed	Date	Countersigned	Date