Health and Safety Information for Quantum Sensors Laboratory Rankine Building Room 222b

Code of Practice and Risk Assessment

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

Prepared by Professor Robert Hadfield Version 11 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 of 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 222b.
- 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 current documents and guidance].

(ii) Physical distancing in the Quantum Sensors Laboratory 222b means a maximum capacity of **3 persons**. Up to 2 persons can be present in the front preparation area of the lab and

this large space should be used for distanced discussions. Up to 2 persons can be present in the back measurement area (1 on each side). Only 1 person should enter the service area at one time. Please make other lab users aware as you enter/exit new areas.

(iii) Lab users must wash their hands regularly. Lab users should wipe work surfaces, door handles, door push plates computer keyboards, lab telephone, materials and equipment at the start of their work and before leaving. Dispose of used cleaning materials in bins provided.

(iv) 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 an online working rota. Impact on the overall occupancy of the Rankine Building will be reviewed by the Technical Services Manager.

(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. Risk Assessment: Categories of Activity and Potential Hazards

1. Lasers

KPhotonics ring laser 1mW at 1550 nm 50 MHz rep rate ps pulses Class IIIb fibre coupled
830 nm laser diode 10 mW Class I (CW or gain switched) fibre coupled
940 nm laser diode 10 mW Class I (CW or gain switched) fibre coupled
1310 nm laser diode 10 mW Class I (CW or gain switched) fibre coupled
1550 nm laser diode 10 mW Class I (CW or gain switched) fibre coupled
1550 nm laser diode 50 mW Class II (CW or gain switched) fibre coupled
Yensita tunable laser CW 1340 - 1430 nm; 1560-1640 nm power 1mW Class I
HP tunable laser CW 1440 -1600 nm power 5mW Class IIIa fibre coupled
Superluminescent diode 0.75 mW at 1550 nm Class I fibre coupled
1550 nm CW laser source 1 mW Class I fibre coupled
White light source Class I fibre coupled
Fibre fault tester ~635 nm CW Class II – not fibre coupled

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 or safety glasses are therefore required. All lasers connected to an experimental setup will be turned off when using a fibre inspection scope or direct viewing microscope. Digital camera attachments or IR viewing cards should be used for registration of laser spots. Users should consider their own safety and that of other lab users when connecting lasers to optical setups; possibility of direct or scattered laser beams should be minimized. All users will have undergone laser safety training.

2. Use of Optical Fibre

Fibre splicing

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.

Fibre Inspection

Potential Risks

Electric Shock, Cuts and splinters from fibre

Control Measures

PAT testing of splicer and maintenance of electrodes. Sharps bin for Fibre fragments.

3. Gases

He gas cylinder for compressor recharge

Potential Risks

Asphyxiation. Failure of cylinder.

Control Measures

Cylinder is securely mounted to wall in 222b plant room. The plant room has its own air conditioning running 24/7 and maximum possible volume of gas release is 50 L at 1 atmosphere. A new gas regulator is installed (02/13). The main cylinder valve should be closed when not in use. All users will undergo gas safety training. Correct tools will be used for mounting or moving the gas cylinder.

He gas cylinder for leak testing (small capacity)

Potential Risks

Asphyxiation. Failure of cylinder.

Control Measures

Small He cylinder is used in the main lab for leak testing. This should be secured to the bench with the clamp provided. The main cylinder valve should be closed when not in use. Ordered in consultation with Denis Kearns & Colin Roberts.

4. Vacuum pumps

Oerlikon PT70 Turbo, Adixen ATP80 Turbo
(possible use of Leybold leak checker from JWNC)

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, DM 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.

5. Cryostats

Four SHI RDK 101D cold heads (Ekinator, Zephynator, JPL fridge [loan to HWU] one to be built), One Cryomech PT403 Cold Head (Kelvinator), One Cryomech PT 405 Cold Head + Chase Cryogenics ^{3}He stage (Rankinator) One Sumitomo cold head RP-082B2**, + One Chase Cryogenics continuous ^{4}He stage (Photon1K fridge).**

Potential Risks

Explosion due to gas overpressure inside cryostat. Cold burns.

Control Measures

All cryostats will be leak tested prior to operation. All cryostats are securely mounted. 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 0ºC.

6. Use of He Compressors and Cooling Water

Two Cryomech Compressor, Three SHI CNA 11C compressors. Lab cooling water in 222b Plant Room.

Potential Risks

Compressor. Risk of explosion or electric shock.
Cooling water. Risk of flooding leading to electric shock. Trip hazard.

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. Robust cooling water pipes will be secured with jubilee chips and place to minimize trip hazards. 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.

7. 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. amplfiers).

8. 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).

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 googles 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).

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.

GE Varnish

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.

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.

Wirebonder

Potential Risks

Electric shock. Cuts from fine wire and tweezers.

Control Measures

All users undergo training from RHH, AC or DM. Only clean tweezers and tools will be used. Fine wire will be disposed of carefully to avoid shorting of electrical parts. The instrument is PAT tested. Any faults will be recorded in the log book. In the event of a serious fault, an outside service company will be engaged (e.g. PDP).

Dremel Tool

Potential Risks

Electric shock. Injury

Control Measures

Care will be taken when setting up and handling. The tool is PAT tested. The power will switch off when changing tools. Safety googles will be worn. Samples will be securely clamped. A pillar drill stand is provided for drilling.

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 switched off when changing tools. Safety googles will be worn. Samples will be securely clamped.

Soldering Iron

Potential Risks

Electric shock. Burns. Fire

Control Measures

Care will be taken when setting up and handling. The tool is PAT tested. The power will switched off when changing tips. The soldering iron will not be left on unattended. The extractor fan will be used to mitigate fumes.

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.

C. Laboratory Users

All users of laboratory 222b are required to read, date and sign this document (by hand or electronically) before using the laboratory. This document was reviewed and discussed by all current Group Members via Zoom meetings on 10/6/2020 & 17/6/2020.

By signing below I state that I have read and understood the code of practice, risk assessment and potential hazards in room 222b 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 PI, Supervisor	Robert Hadfield	17/6/2020	RHH	17/6/2020
Dr Alessandro Casaburi	PI, Supervisor	Alessandro Casaburi	17/6/2020	RHH	17/6/2020
Dr Dmitry Morozov	PDRA	Dmitry Morozov	17/6/2020	RHH	17/6/2020
Weikang Zhang	PDRA	Weikang Zhang	17/6/2020	RHH	17/6/2020
Jonathan Collins	PDRA	Jonathan Collins	17/6/2020	RHH	17/6/2020
Gregor Taylor	PGR	Gregor Taylor	17/6/2020	RHH	17/6/2020
Koran Jackson	PGR	Koran Jackson	17/6/2020	RHH	17/6/2020
Mahmoud Ahtaiba	PGR	Mahmoud Ahtaiba	17/6/2020	RHH	17/6/2020
Ciaran Lennon	PGR	Ciaran Lennon	17/6/2020	RHH	17/6/2020
Robert Graham	PGR	Robert Graham	17/6/2020	RHH	17/6/2020

Visitors and Project Students

Name (Print)	Role/Institution	Signed	Date	Countersigned	Date