School of Engineering
University of Glasgow

Water Engineering Laboratory

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CODE OF PRACTICE

The adoption and practice of good safety procedures is of paramount importance both for the health and safety of fellow workers as well as for the integrity of the fabric of the laboratories.

1. Lab Safety Management Responsibilities

1) This code of practice is **intended to give guidance** on the safe use of the equipment and facilities within the laboratory, and to ensure that technical staff, other staff, students and visitors will **not be harmed** by any of the processes, materials or tools used in day to day operations.

2) An overriding principle: If you find yourself about to carry out work or deal with **equipment or procedures that are new or unfamiliar to you**, and you are in any doubt about your experience and knowledge being adequate to safely carry out the work – **STOP**. Seek expert advice and guidance.

3) Only technical staff, or persons (typically research students or staff) **approved** by the Laboratory Manager, may use the facility and/or equipment within it. This should be typically documented by a **Risk Assessment** form (accompanied by a detailed experimental protocol describing the experiments to be undertaken at the lab and outlining specific safety considerations for each of the process involved), signed by the person requiring lab access and pre-approved by the Laboratory Manager.

4) All users of the Laboratory should make themselves familiar with all safety documentation applicable (including the **electrical safety at Appendix B** and the **School's Safety Manual**), in general, and any specific **safety documentation** relating to the tools or process they intend to use. Users should familiarize themselves with **emergency exit** routes and positions of safety equipment such as mains isolators, **fire extinguishers and first aid kits**. In the event of a fire or the fire alarm sounding, laboratory users are instructed to leave the laboratory areas by the quickest escape route.

5) Be always cautious for any **electrical hazards** (due to electrical equipment in the vicinity of water tanks/flumes or any splashing water) and **physical hazards** (due to height restrictions), when working along or under the flume channels and walkways/platforms. There should be relevant warning hazard tapes on the side of the tanks and on the overhead obstructions, marking such dangers. The use of safety

headwear and labeling the space with proper signs is needed, if such hazards are identified.

6) In the event of an **accident** or mishap/**equipment failure** it is your duty to immediately inform the Laboratory Guardian or call 4444 in case of an emergency, if needed. In the case of failure of **computer equipment** notify the Lab Manager and IT services. All accidents, injuries and dangerous occurrences (a near miss) must be reported promptly to the Technical Services Manager who will write an incident report for submission to SEPS (within a specified time limit).

7) Work outside normal **working hours** (9am - 5pm) should only be undertaken with the written agreement of the Laboratory Manager. Access to **visitors** is not allowed, unless explicitly agreed with the Laboratory Manager, while taking appropriate provisions. Work outside normal working hours should not involve potentially hazardous activities, including heavy lifting, or emptying and filling flume channel tanks. During normal working hours such activities should not normally be undertaken whilst alone in a laboratory.

8) **ALL USERS AND VISITORS MUST SIGN IN AND SIGN OUT.** The sign in book is by the main entrance door.

9) **ACADEMIC SUPERVISORS take FULL RESPONSIBILITY** for the health and safety of their own group's research activities and for correct use of equipment, and consequently must ensure their staff and students are familiar with both the content of this **Code of Practice** and the **School's Safety Manual** and apply its requirements and that personnel have correct training, prior to the start of any lab activity.

10) No activities shall be carried out at the Water Engineering Lab without the prior permission of the **Lab Guardian**. No work shall be carried out until a **Risk Assessment** has been completed by the research staff/students, approved by their Supervisor and the Director of Safety, and acknowledged by the Lab Guardian. The final approved electronic copy of the Risk Assessment shall be sent to the Lab Guardian to be kept as record (note that this can be also done using the online risk assessment system). A hard copy of the approved risk assessment shall be displayed next to the relevant research rig and equipment for inspection. The procedures of the preparation of Risk Assessment are summarised in Appendix A.

11) **All lab users** should make themselves aware of the general safety procedures highlighted in the **School's Safety Manual**, and of the location of safety equipment in the lab, and of the safe operation procedures of the facility.

• In case of emergency, dial telephone number: **4444 (internal), 0141 330 4444 (external)**
• Signage showing Emergency exit routes from the Lab, is beside the entrance doors.
• Fire Extinguishers are located beside main entry doors (CO_2)
• First Aid kit: adjacent to the kitchen sink.

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2. Practice of General Activities

1) Laboratory doors should remain locked at all times to ensure **security** (with the exception of procedures requiring continuous lab access). If equipment is required to leave the lab, permission is required from the Lab Guardian and if necessary seek assistance. Any **concerns** about safety and/or security within the laboratory should in the first instance be raised with technical and academic staff in the area.

2) **Storage bins for sediment** should be kept under the various channels when in use. When sediments are not in use, they should be stored in wheelie bins. Sediment bin forms can be made available (typically beside the main entrance door). Two copies have to be completed. Tape one copy to the outside of the bin and leave one copy loose inside the bin. Remember not to over fill bins with material (25kg maximum). Remember not to over fill wheelie bins with material (75kg maximum).

3) Take care when **lifting or moving sediment** bins or trays. Anything above 25kg should only be moved by one or more persons using a wheelie bin or sack barrow. If you have any doubt on your ability to move heavy items please ask for assistance. For working at heights use only properly designed step-ladders or self assembly scaffolding that has current safety audit labeling and ensure another person is present to look after your safety. Where unusual or hazardous circumstances dictate, carry out a risk assessment. Where a lift or move is judged to be out-with commonplace size or weight, or involves height, a risk assessment must be done and consideration given to the need for training, specialist advice/help or equipment. If it is necessary to remove equipment from the lab, permission must be given by your supervisor and the Lab Guardian.

4) Never leave hose pipes unattended when **filling a water tank** at any time. Please ensure that all taps and hoses are turned off when not needed or when leaving the lab space. Please be aware that there is in excess of 20,000 litres of water within the storage tanks in the room, so please be careful.

5) The Water Engineering Laboratory has a waterproof membrane floor, several large drain points and bunds placed across doors to prevent flooding entering and exiting the room. In case of a major **flood, leak or burst pipe**, water should therefore be trapped inside the room and drain away safely. There is however always a risk of water damage to equipment in the laboratory. It is therefore essential that if you have any type of significant leak, flood or burst pipe you must **inform laboratory staff immediately**. Any leaks must be cleared up as quickly as possible and laboratory staff will need to check that there has been no damage to equipment within the lab. Any faults 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/.

6) Flume pumps are powered from a 3-phase supply via power inverters. Switching power on and off for flume channels is done by means of electrical isolators, which are fixed to the walls near the flume channels and marked with a label. Attached to each channel is a set of instructions on the general **operation of the pump controller**. Noninvasive **ultrasonic sensors**, attached to the flumes' pipework, allows for estimating the flow rates fed into the flumes. If you require more instruction or assistance with the setup and/or operation of these controllers/sensors, please speak to laboratory staff, before using them.

7) Use of the particle image velocimeter or topographic displacement laser equipment involves a class 4 or class 2a laser respectively. Anyone wishing to use these pieces of equipment will require specific permission from the Laboratory Guardian and will have to comply with specific health and safety requirements for use of lasers, which can be found at: http://www.gla.ac.uk/media/media_217873_en.pdf. No one is allowed to use the equipment until specific **laser safety training** has been undertaken.

8) Lab coats or other protective clothing and/or safety spectacles, may be worn as required. If anyone wishes to use new or **additional procedures** (biological or chemical) they MUST inform their supervisor or lab staff of this BEFORE ordering any chemicals, biochemicals, cell lines etc., or starting the practical work. A COSHH Form or risk assessment must be completed using the School web based database and approved by their supervisor and the laboratory manager. **Also, people should inform/e-mail others in the group of lab users, if performing a new and particularly hazardous procedure.**

9) You can use the fridge, sink and **kitchen area** as appropriate. Do not place anything hazardous in the fridge. No food or drink should be stored in the fridge beyond its expiry date. Ensure that anything that you place in the fridge is labelled with your name. Unlabelled/expired items will be thrown away. Food or drinks should not be consumed in the laboratory, if alternative options exist. If you do consume any food or drinks, please do not leave any leftover food waste/trash in the lab bin (instead take it with you in a small trash bag and discard in a bin outside the lab).

10) Due to the restricted space in the area, it is very important that all **walkway areas** are kept clean and tidy. This will help to minimize the risk of **trips and falls**. Good **housekeeping** is essential. Equipment, tools, etc. should be cleaned and returned to their proper place of **storage** as soon as you have finished using them. Waste material should be **disposed** of in an appropriate fashion. Any contaminated samples may need specific considerations for safe disposal – please discuss this in advance with the Laboratory Manager.

11) **Personal belongings** such as bags and coats should be stored on the coat hooks behind the main door or under/near your working bench – never left on the open floor. Books and paper in the lab should be kept to a minimum. **At the end of your experiment/lab visit, you should aim to leave the lab as tidy or more tidy than you found it!**

3. Covid-19 measures

1) **Guidance** from the HSE, UK Government and Scottish Government to manage the risk related to Covid-19 pandemic must be applied to the Water Engineering Lab. These include physical distancing, frequent hand washing and hygiene measures, cough etiquettes, and face covering in enclosed public space. Users should refer to the general School of Engineering standard for covid-19 and the code of practice.

2) **Physical distancing** within the Water Engineering Lab limits the max allowed occupancy of the site. This means that it will not be possible to conduct certain types of activity where physical distancing is encroached upon. Priority will be given to access according to nature of the work, contract funding, timeliness of work, and level of experience. Inexperienced researchers are not permitted to work at the lab during this period, less experienced researchers should not gain access to the site until later in the covid-19 relief effort.

3) During phase 2 lockdown relief, no more than 4 people are to be present at the Water Engineering Lab. This will comprise of up to 2 people for the area of the next to or at the Reynolds and Shield's flume and up to 2 people for the other side of the lab (Kelvin flume side and platform).

4) Total occupancy of the lab in phase 3 is to not exceed 6 people, and this depends upon the distribution of personnel in the working areas as follows: 2 around the Reynolds flume and platform, 2 at the Shields flume/tanks, 2 around the Kelvin flume and platform.

5) Access to the lab is through the main lab entrance. No-one other than a user with a valid reason to attend/visit the lab and with relevant approvals, or support personnel is allowed on site.

6) All personnel must sign in and sign out. Use your own pen, pencil to do this. When you enter the building you will need to increment the personnel counter in the main entrance log by 1. When you leave you should decrement by one. This is so that the number of personnel on site is clear and well monitored at all times, while observing the above limits.

7) All site deliveries and maintenance operations are to be conducted with the full knowledge of the lab guardians.

8) Inexperienced researchers or others requiring close supervision are not allowed to start or continue any work at lab during this period.

9) Specific laboratory area and office occupancy limits that permit physical distancing are as follows: Reynolds channel 1, Reynolds desk/platform 1; Shields channel area/desk 1; Kelvin platform 1; Kelvin flume 1.

10) Demand to use the lab will be managed by the laboratory guardian. Collaboration will be required between lab users, supervisors, PIs and the Lab Guardian to establish a rota where necessary. Impact on the overall capacity of the site will be reviewed by the Technical Services Manager.

11) Lab users must wash their hands regularly and wipe workstation surfaces, materials, and equipment at the start of their work and before leaving. On entry use the hand gel station at the entrance (or the kitchen area) if it is available.

12) Limit your movements to your own designated lab area, as much as you can.

13) Phased arrival and departure will be used dependent upon the occupancy level.

14) The kitchen area can only support one person at a time. In the initial phase 2 of lockdown relief, bring your own food and drink and avoid use of the kitchen. As higher phases of lockdown relief are reached, do not prepare food or drink for anyone other than yourself, and keep your utensils separate and in your own possession.

15) Check that stairs or narrow corridors are clear of anybody else before going up or down or along them. Call out to ask if anybody is at the other end, advise of your presence.

16) In the event of multiple facility users on site, personnel should restrict their movements to specific areas. There are two toilets on site.

17) Ensure that you have your own supply of hand tools to do your work. Do not take hand tools from any other laboratory area. Clean all tools with disinfectants before putting them back in tool-boxes.

18) Share mobile phone numbers and use MS Teams or another utility/app (eg WhatsApp/Wechat/Zoom) for when you need to communicate on site. Ensure your contact details are available to the Lab Guardian in case you need to be reached for a lab emergency.

19) Emergency support (First Aiders and Fire Area Officer) might be constrained due to Covid-19 restriction on building capacity. Task risk assessments need to be revised to include the above measures and to review with personnel through the risk assessment, which 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).

4. Practice of Hazardous Activities

1) Electrical connections between different devices or equipment should be safe. See more important **information for Electrical safety on Appendix B**.

2) To minimise trip hazards, extension cables should be plugged into the closest socket and avoid crossing pathways. If crossing a pathway is totally unavoidable then, only as a temporary measure, the cable must be secured to the floor and covered with a suitable (commercially supplied) floor cable cover, cable protector, floor cable tidy to prevent tripping hazards. However, leads crossing pathways at the top or bottom of stairways is not allowed, even as a temporary measure – they should be routed at least 2 m (i.e. two paces) away from these areas.
    i. Once equipment is not in use, it must be turned off and any extension cables used should be tidied to a suitable location.
    ii. Leads and plugs should ONLY be used on the allocated item of equipment and should NOT be switched between equipment
    iii. All equipment plugged into university outlets must be PAT tested (contact the electrical workshop for testing).

3) To minimise the risk of falling objects, no equipment or lab materials should be kept on top of cupboards and file cabinets, particularly those next to the edge of a platform or flume.

4) Fire hazards:
    i. All flammable materials (gases, liquid and solids) should be stored and handled in accordance to the School's Safety Manual and relevant SEPS guidelines.
    ii. All equipment or experimental rigs using flammable materials should be certified and have adequate measures for preventing fire hazards.
    iii. All users of flammable gases should be trained.

5) Explosion hazards (eg when using compressed gases):
    i. All gas cylinders should be secured to prevent falling.
    ii. All pressure vessels should be certified by a professional manufacturer.
    iii. All pressure vessels should have measures to preventing over-charging, such as relief valves.
    iv. You should seek support from technicians when moving gas cylinders.
    v. All users of compressed gases should be trained.

6) Ear protection and laser safety spectacles should be used when appropriate.

7) NEVER USE EQUIPMENT WITHOUT PRIOR TRAINING. THIS IS NOT SIMPLY A CASE OF READING A USER MANUAL, YOU MUST HAVE A THOROUGH UNDERSTANDING OF THE TECHNIQUE YOU ARE USING. If you are unsure how to correctly use an item of equipment, seek assistance from your Supervisor. If you have any doubts about the safety and integrity of a component of any equipment, stop using it immediately, inform other users not to use it, and e-mail your supervisor and the Lab Guardian.

Appendix A: Procedures of the preparation of the Risk Assessment

1. PDRAs and PG/UG students are responsible for formulating Risk Assessments as needed. For potentially hazardous activities, in addition to assessing the risks, the risk assessment form should include a standard operating procedure/method statement (and/or instrument manual) as an appended document.

2. Whilst the preference is for the persons undertaking the practical work to make their own risk assessments, it is permissible to use or consult existing on-line single-/multi-user risk assessment forms for activities that will be undertaken by individuals/groups of people. However, in this case, each person involved in the practical work must sign the relevant form online and a strict regime of user training should be in place that encompasses both the risks associated with the work as well as the practicalities of undertaking it.

3. Academic supervisors should assist the PDRAs and PG/UG students in preparing the risk assessment (this would typically be the case for less experienced PDRAs and PG/UG students). They should ensure foreseeable risks have been identified and adequate mitigation measures have been provided to reduce them as far as possible.

4. The academic supervisors should then approve the risk assessment form online (or ask for further information to be added); the Lab Guardian should also acknowledge (on-line) that the risk assessment has been completed, to indicate that as far as they can see, this activity does not conflict (in safety terms) with other activities in the lab. The Lab Guardian can also ask for further clarifications/additions concerning the procedures involved to be made, if necessary.

5. After the risk assessment has been approved/acknowledged by the supervisor and the Lab Guardian, the School's Director of Safety approves, seeks further clarifications, or (exceptionally) rejects the risk assessment if there are clearly hazards that cannot be sufficiently mitigated.

6. An e-copy of the approved Risk Assessment should be sent to the Lab Guardian by the PDRA or PG/UG student that originated the assessment (n.b. pdf's of the online form can be made by using the Print to PDF option available in most browsers) and the Lab Guardian should acknowledge receipt of this (the PDRA or PG/UG student should repeat this step until they have received confirmation their form has been received).

7. A hard copy of the approved Risk Assessment and standard operating procedure should be kept or displayed next to the relevant experimental rig or equipment.

8. The Lab Guardian approves the start of activity, after receiving the approved Risk Assessment.

9. If there is any substantial change to the people or research activity as stated in the Risk Assessment, it MUST be revised accordingly, and pass procedures 1-7 as above.

Appendix B: Electrical risk assessment and recommendations for safe use of Electrical equipment in this room.

Background Information

This document is written from an electrical point of view only. There may be other hazards in this laboratory environment, such as laser, biological or mechanical, which are not considered in this document. Seek appropriate advice about other hazards identified.

The water lab uses tanks of flowing water to study water flow in the environment. A significant amount of mains powered electrical equipment is used close to the flowing water.

The fixed electrical installation (which is maintained by the Estates & Buildings department) is appropriate for the location. Wall socket outlets and other fixed electrical equipment is installed in accordance with BS7671. Overhead lighting is splash proof. All electrical socket outlets are protected by an RCD (aka earth leakage circuit breaker or ground fault circuit interrupter) to help to protect against the most common way of receiving an electric shock. Note that an RCD cannot and will not protect against all ways of getting an electric shock – the user must still take care. Exposed extraneous metalwork (such as tanks and frames) will be/are connected to electrical earth to from an equipotential zone to minimise the risk of electric shock from faulty equipment.

The risk of electric shock in this room is much greater than a normal room because of the large amount of open water used in close proximity to electrical equipment which is intended for dry use. A human body will be harmed by a small electric current flowing through the body. A wet human body will be harmed by a considerably smaller electric current due to significantly reduced skin resistance. The human body is particularly susceptible to harm if a very small electric current flows through the chest area (such as arm-arm or arm-leg). Harm can include death in this context.

People using the lab and facilities are generally not from an electrical background and will have minimal training or experience in using mains powered electrical equipment in an area where there is significantly greater than normal risk of harm from electric shock. There are three main groups of lab users. 1- Taught laboratory classes where there are a group of unskilled people working under supervision. 2- Research projects where people are working individually with minimal supervision. 3- Visitors such as technical and cleaning staff who will not operate any equipment and have no knowledge of the specific hazards of this laboratory when equipment is operating.

There is a telephone located close to the entrance of the laboratory. Please make sure you know where it is. In an emergency call Extension 4444. If using a mobile phone call 0141-330-4444. There is no first aid box available in this laboratory. The nearest first aid box is in room 201A or the Janitor's office at the main entrance to the building. A poster showing the first aid treatment of electric shock is/will be on the wall beside the telephone.

When you are working in this lab the main entrance door must remain unlocked, but may remain closed. This is so that others can check on your well-being. This is very important when working alone or out of normal working hours.

Actions to be considered to mitigate risks

- Lone working is not encouraged. If you have to work alone, limit your work to low hazard activities such as routine data gathering or equipment setup.
- Never put any part of your body (hand, arm) into water whilst directly mains powered equipment is operating in the water (such as a submersible pump) because of the electric shock hazard. Any mains powered equipment in the

water must be completely unplugged from the power source before reaching into the water for any reason.

- Lone working near open water is not permitted where you have to make adjustments to electrically powered equipment or operating test setups in the flume. Never attempt to adjust sensors and other equipment in water whilst apparatus is in use without someone else present, even if the equipment operates from a low voltage. When adjusting sensors in the water do not try to adjust the sensor in the water and operate dry equipment at the same time. Always have a second person to assist when adjusting equipment in the water – one person working on the sensor in the water, and the other operating the dry measurement equipment.
- Portable electrical equipment is generally bought into the lab by users and may not be suitable for use in some areas of the lab. The user must always take additional care to ensure that portable mains powered electrical equipment is used appropriately and safely, taking into account the risk of splashing and the increased risks to users when working near water. All portable electrical equipment used MUST have a portable appliance tested sticker less than two years old – if in doubt always get the electronics workshop to check and test any equipment you wish to use in this lab. Most problems are caused by cracked plugtops, damaged power leads or insecure covers – please take the time to check any equipment you intend to use, your life may depend on it. If there is any doubt, ask the electronics workshop for further advice before you start to use the equipment.
- The floor of the lab will get wet. It is designed to. Never store or leave any electrical equipment on the floor because once it gets wet it will be damaged beyond repair.
- Extension socket strips and ‘lump in a cable’ type power adapters must never be used or left on the floor, even when unplugged from the supply. Once they become wet they are dangerous to handle. If in any doubt always remove the supply plug from the wall socket before handling any connected plugs.
- Splashed water will dribble along leads into equipment, ruining it. Always ensure that when stored or used, water cannot enter electrical equipment. If a cable is at risk of getting splashed, a method of reducing damage is to form a hanging loop of cable that hangs below the bottom of the equipment (often known as a ‘drip loop’) so that water cannot enter equipment by this route.
- Everyday mains powered electrical equipment must not be used near or above the water channels because of the risk of splashing. Such equipment may be used on the raised benches beside the channel, but no closer to the water. If any alternative platform is required for mains powered electrical equipment (for example on the opposite side of the water channel), then it should be designed and constructed in a similar manner to the existing platforms to ensure safe use of equipment.
- Mains powered electrical equipment and associated wiring used on the platform floor or over water must be designed to be splash proof. Mains powered electrical equipment must never be immersed in the water unless it is expressly designed for the purpose (such as a submersible pump).
- Equipment used over water must be secured so that it cannot accidentally fall into the water. If equipment does fall into the water, never touch anything wet or near the tank until ALL electrical equipment in use has been unplugged from wall sockets. Always verify that the power plug is removed from the wall socket before attempting to handle wet equipment. If equipment has got

wet, never attempt to use it until it has been checked by someone competent to verify that it is safe for further use.

- Connectors and trailing cables must be secured so that they cannot fall into the water unless they are designed to be submersible and are used correctly.
- Sensors and other equipment operating from a low voltage may be used directly in the flume interior or water provided that the power source is in a dry location. To minimise any electrical hazard the operating voltage should be less than 12V AC or 30V DC. The power source must be double insulated (marked ⧈ on case), 'CE' marked (marked CE on case) or otherwise compliant with EN60950 or a similar technical standard. A lab type bench power supply may be used, provided it is located in a dry area. Computer powered and operated USB devices may also be used, provided a desktop type computer in a dry location is used to operate them. Laptop type computers should not be used unless operating on batteries only because of the type of power adaptor commonly used with them.
- Sometimes it is necessary to use low voltage devices near the water that are not splash-proof. To try to prolong the useful life of this equipment, try to shield it from expected splashing. Position and route cables so that water drains away from (rather than into) the device. Secure and cover up connections to avoid splash and dribble damage.
- Try not to route cables or tubes across floors where they will form a trip hazard. Consider routing them overhead well above head height or around the perimeter of where people will want to move. If this is unavoidable, make sure that either a suitable cover or tape is used to secure the cable or tube to the floor. On work platforms, consider routing the cable or tube under the platform floor. Access and exit routes must be kept clear of clutter with no trip or entanglement hazards.
- Always leave your work in a state where other laboratory users who are not familiar with your equipment cannot be harmed. This includes cleaning and security staff who may have good reason to be in the laboratory when you are not present.

Additional Notes

Most of the advice given here is derived from section 702 of BS7671:2016 'Regulations for electrical installations in buildings'. This section describes the specific requirements for electrical installations in and around swimming pools and shower facilities where people will be wet or in the water. In this application, people will not be wet or in the water, so some of the requirements have been modified to take account of this. If there is any doubt, always seek advice from a competent person – in this case the Electronics Workshop or the Estates and Buildings Department will be able to help.

Parts which move under power or automatically must be suitably guarded – advice on guarding is beyond the scope of this document.

Where equipment is installed over water, the operating controls should be located away from water in a dry area.

Appropriate signage needs to be provided in any area where a hazard is present.

Appendix C: Layout of the Water Engineering Lab