



SAFETY RULES FOR LABORATORY WORK – THE DEPARTMENT OF ENERGY TECHNOLOGY, AALBORG UNIVERSITY ESBJERG



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TABLE OF CONTENTS

PURPOSE	2
LABORATORY TYPES, WORKSHOPS, AND ACCESS	2
LABORATORY OPENING HOURS.....	2
EQUIPMENT.....	2
FIXED INSTALLATIONS	3
ELECTRICAL SETUPS.....	3
SETUPS WITH INFLAMMABLE FLUIDS, GASSES, AND ELECTROCHEMICAL CELLS	5
GENERAL SAFETY PRECAUTIONS.....	7
SPECIAL LABORATORIES	8
HYDRAULIC LAB (C2.019).....	8
FLOW LAB (C2.021).....	9
OFFSHORE ENERGY LAB (C2.025)	10
POWER ELECTRONIC LAB (C2.102) &	11
RENEWABLE ENERGY CONTROL LAB (C2.130)	11
ROBOT & DRONE LAB (C2.103).....	11
BIO ENERGY SYSTEMS LAB (C2.132)	11
ACCIDENTS AND NEAR-ACCIDENTS	12
PAY ATTENTION TO.....	12
IMPROVEMENTS.....	13
APPENDIX 1	14

Safety rules for work in laboratories at the Department of Energy Technology, Aalborg University Esbjerg

The guidelines and rules for the laboratories in C2-building, Niels Bohrs Vej 8
Safety rules can also be found at <http://www.et.aau.dk/department/safety-comittee/>

PURPOSE

The purpose of the safety rules is to make the laboratories safe places to work and to prevent accidents.

LABORATORY TYPES, WORKSHOPS, AND ACCESS

The laboratories are divided into two categories:

- Standard laboratories which are open to students, who have completed an approved safety course and have signed a work place permission form (WPP); see Appendix 1 for details.
- Specialized laboratories which are open to students who have obtained special permission and instruction from the laboratory supervisor and/or have completed a special safety course and have signed an WPP; see Appendix 1 for details.

LABORATORY OPENING HOURS

The normal opening hours of the laboratories are 08:00 to 15:30 on weekdays. Students are not allowed to access the laboratories outside of normal opening hours unless they have received special permission.

EQUIPMENT

Instruments and other equipment may only be removed from the laboratory if a special agreement has been made with the laboratory staff.

When an experiment has been completed, all equipment must be cleaned and returned to its proper place, unless other agreement has been made.

Instruments, equipment, components, and cords which are not being used in an experimental setup must be returned to their proper places. Instruments, equipment, components, and cords with defects or suspected defects must be handed over to laboratory staff together with a written description of the defects.

Defective equipment may only be repaired by laboratory staff.

Privately owned equipment and tools may only be used in laboratories if special permission has been given by the laboratory staff.

Private use of laboratory equipment may only take place if special permission has been given by the laboratory staff.

FIXED INSTALLATIONS

Any changes or modifications of fixed setups, deployment of cross-field switching, and operation of main switches must only be carried out by qualified members of staff. Observed defects and faults must be reported immediately to the laboratory supervisor/laboratory staff. The mounting of power supply cords on instruments/equipment may only be carried out by students after consultation with the laboratory supervisor/laboratory staff. Students must not make extension cords, neither single-phase nor three-phase.

ELECTRICAL SETUPS

- Turn off the power supply connected to the equipment before inspection.
- Use only tools and equipment with non-conductive grip, when working with electrical devices.
- All current transmitting parts of any electrical devices must be enclosed.
- When checking an operating circuit, keep one hand either in a pocket or behind your back to avoid making a closed circuit through the body.
- Maintain the works place free from unnecessary/unrelated objects such as mobiles, books, papers, and clothes.
- Never change wiring with circuit plugged into the power source.
- Never plug leads into power source unless they are connected to an established circuit.
- Avoid contacting circuits with wet hands or wet materials.
- Check circuits for proper grounding with respect to the power source.
- All devices should be equipped with schuko-plug. Consult with laboratory supervisor or staff if an exception should be given.
- Do not insert another fuse of larger capacity if an instrument keeps blowing fuses - this is a symptom requiring repairs. If a fuse blows, find the cause of the problem before putting in another one.
- Do not use or store highly flammable solvents near electrical equipment.
- Keep access to electrical panels and disconnect switches clear and unobstructed.
- Three phase electricity should not be experimented by students unless with approval of laboratory supervisor or staff.
- Table assigned facilities are strictly assigned to each specific table, do not move any facilities before permission from laboratory supervisor or staff.

- Open setups with charged parts to which voltages above 25 V AC or 60 V DC are applied, must be protected against direct contact by a shielding device, for instance a chain. The chain must be placed at a height of 1.1m to 1.3m, and the distance between the chain and the charged parts must be 20cm as a minimum. Students and staff working on the setup may work within the chained area, whereas everyone else must stay outside of the chained area. There must be a free walking area of a width of at least 70cm outside of the chained area. The chains are available from the laboratory staff.
- When leaving experimental setups to which voltage is applied, students must first obtain permission from the laboratory supervisor or staff and make sure the setups are completely screened of. Setups must be marked to make it apparent that voltage is applied to it.
- Any changes in experimental setup or circuit must only be made after the power has been turned off.
- Capacitors with an imprinted voltage above 60 V are placed in a cupboard marked with the sign “High Voltage Capacitors”; when they are not in used, they must always be returned to the cupboard to be discharged and fitted with a discharging device.
- In case of experimental setups which are not galvanic isolated from the grid, an isolation transformer must be used; this must be placed on the supply side in front of the oscilloscope or other measuring instrument, in case these are not fitted with integrated galvanic isolation.

When working with batteries, see section: “*Setup with Inflammable Fluids, Gasses, and Electrochemical Cells*”

SETUPS WITH INFLAMMABLE FLUIDS, GASSES, AND ELECTROCHEMICAL CELLS

If hazardous substances and chemicals are included in a project work, the workplace instructions (APB) for the substance(s) and chemical(s) must be studied, and the mandatory guidelines must be followed.

Workplace instructions may be found at www.kemibrug.dk; use the following login:

User name: ETAAU

Password: ETAAU

In setups including systems with fluids, electrical systems and pressurized constructions, the following guidelines should be observed to the extent possible:

- Electrically conductive fluids should, to the extent possible, be placed under the electrical installation in order to prevent accidental short circuits in case of leakage.
- When a setup is abandoned, care must be taken to shut off gas supplies and leave the setup in a safe condition.
- When using non-metal-based pipes, special care must be taken not to place these close to heat sources in order to prevent hose burst.
- Electrical circuits or components that might ignite or spark combustible gases and fluids should be placed outside of fume cupboards where combustible gases and fluids are used; examples of these are brushed DC-motors, electromechanical relays, fuses etc.
- Care must be taken to ensure that setups with gases and chemical reactors are primarily undertaken in well ventilated areas, e.g. fume cupboards, and with gas alarms that can detect any possible leakages or the presence of high concentrations of hazardous substances.
- In the case of a gas alarm, a visual and audible alarm will be activated, and if accidental high gas concentrations are detected, the fuel supply will be interrupted. The laboratory supervisor or any other designated persons must be contacted in case of gas alarms, and instructions must be given to all laboratory staff as regards any special action to be taken at the sounding of an alarm. The reason for the gas alarm must be entered in the log book located in the alarm box.
- Do not access a laboratory with an active alarm; contact the laboratory supervisor.
- Pressure bottles must be transported with care and must always be secured and protected when used to make sure they cannot fall over.

- Prolonged storage of flammable liquids and gases for laboratory setups must be agreed with the responsible laboratory staff.

Note: Typical signals of gas explosions are small bangs, crackling or sudden heat development. Remember that some combustible fluids and gases burn with an invisible flame, for instance hydrogen and some alcohols.

In setups using batteries, the following guidelines must be followed:

- Manuals, Material Safety Datasheet (MSDS) or the like must be accessible for the battery cells used; they must be entered in the APTs of the students, and laboratory staff must receive information as regards special safety requirements.
- Open conductors and connectors must be protected against accidental short circuits by the use of non-electricity conductive shielding and LAUS tools.
- Wires or electrodes of temporarily unused batteries must be secured against accidental short circuits by shielding or clear labeling.
- Some battery types may catch fire which is difficult to extinguish. When using battery types that are particularly flammable, explosive or gas emitting in the event of an accident, a setup must be planned in a way that enables the removal of batteries in case of an accident.
- Some batteries develop hydrogen, a flammable gas, when charging and must therefore be charged in specially ventilated spaces. Contact Henry Enevoldsen (C2.110) if this becomes necessary.
- Unused batteries of a capacity of more than 5Ah must be stored in dedicated battery charging rooms, contact Henry Enevoldsen (C2.110) if this becomes necessary. Major quantities of batteries or unused batteries must be clearly marked as regards ownership.
- If Li-ion batteries are used, a Battery Management System or other monitoring and safety device must be available in order to avoid overvoltage, under voltage, extreme temperatures etc., all of which may cause a fire.
- If major networks of supercapacitors and ultra-capacitors are used, a cell balancing system must be installed to ensure safe charging of individual capacitors. Storage of supercapacitors must take place by the mounting of a discharging device in dedicated battery charging rooms, see Appendix 1.

Dispensation from the above rules may be obtained in writing from the security officer of the laboratory in question. The setup must be clearly labeled with the information that dispensation was granted from the general guidelines and a description of the content of the dispensation.

GENERAL SAFETY PRECAUTIONS

- Only students that have completed an approved safety course and have signed a form WPP are allowed to use all tools and aids in the workshops and laboratories, within opening hours.
- No tools are allowed to leave or enter other workshops or laboratories. If tools are required from other workshops or laboratories a toolbox can be borrowed at Henry Enevoldsen (C2.110).
- When students are working on a setup to which voltage is applied or a setup in operation, a minimum of two students must be present in the laboratory. Members of staff are also encouraged to comply with this rule, and to inform colleagues if they are working alone with laboratory setups. In special circumstances, where no safety risks are associated with student setups, the laboratory staff can allow an exclusion from this rule.
- Students must always prepare a WPP describing the setup and the experiments to be carried out. Students must plan and organize practical experiments so that they are performed in a way which complies with both safety rules and health regulations. Students must check if personal protective equipment should be used - such as ear protection, eye protection, respirator, gloves, safety shoes, safety helmet, lab coat, local exhaust ventilation etc. Ear protection, eye protection, safety shoes, and safety helmet can be found under the stairwell in the C2-building.
- Students must read the manuals and instructions for the equipment to be used thoroughly before a new experiment is initiated. If the experimental setup is used together with fixed setups or installations or in a specialized laboratory, students must study instructions and guidelines for the equipment or laboratory in question carefully. If these are not sufficient, or if queries arise, students must contact their laboratory supervisor or laboratory staff.
- Students must pay attention to the location of emergency stops and other switches of the experimental setup. The students must also pay attention to the location of escape routes, powder extinguisher, first aid kit, eye wash, and shower.
- Students must not apply voltage to test setups or set them in operation until the laboratory supervisor or the laboratory staff has approved the setup. This approval must be given on basis of the WPP.
- Students must keep the test area and its surroundings tidy. The setup must be labeled with project group name, group number, group room, email address, and name of supervisor.
- After each work session, the laboratory must be cleaned, and tools should be delivered at its rightful place.
- Running is not allowed in workshops and laboratories.
- Food and beverages are not permitted in laboratories.

- The student/group is responsible for any damage, malfunction, and missing materials. Complaints, about other students' compliance with the written rules, are given to the laboratory staff.
- Students may only dismantle and open equipment if this has been allowed by the laboratory supervisor, including a description of the procedure to be followed by the students.

IF THE RULES, FOR USING THE WORKSHOPS AND LABORATORIES, ARE NOT FULFILLED, STUDENTS/GROUPS' ACCESS CAN BE REVOKED.

The general safety rules apply in all laboratories and workshops. Please note that additional rules may apply to specialized laboratories; these will be described in the section; "*Special Laboratories*".

SPECIAL LABORATORIES

Access to special laboratories requires a special safety course for each laboratory by laboratory staff and an assigned WPP. Rules for each special laboratory at The Department of Energy Technology in Esbjerg are written in the following sections.

HYDRAULIC LAB (C2.019)

- Guards must be placed on all pressurized setups. It is not permitted to be inside of the screen enclosure while experiments are in progress in the setup, or when this is in a pressurized condition.
- Guards must always be placed on rotating machine parts and shafts in operation.
- Always check that equipment, components, fittings and hydraulic hoses, etc., are dimensioned to match the desired pressure, flow and temperature.
- Drip trays and skid proof mats must be used under and around setups in which oil spill may occur.
- In case of skin contact with hydraulic oil, wash the affected area with soap as the oil may provoke allergy.
- Unless otherwise specified, only instructed laboratory staff are permitted to make changes in experimental setups.
- When experimental setups are abandoned, they must be relieved of pressure if possible, and must always be placed in safe positions. The above applies to cranes etc., which must be placed in the lowest position.

Safety equipment is not required in this laboratory unless the laboratory supervisor or staff demands it. Safety equipment requirements may be due to temporary changes in the current test setup or other experimental setups is temporarily installed in the laboratory.

FLOW LAB (C2.021)

Setup with laser equipment:

In case laser equipment class 3a or above is used in a setup, the entire laboratory will classify as a specialized laser equipment laboratory.

At all laser equipment laboratories class 3a or above, all entrance doors must display/ give attention with use of laser in the laboratory.

- People working on the experimental setup must be instructed in the use of laser equipment. The instruction is given by the person who is responsible for the laboratory.
- If the laser is used outdoors, it must be ensured that BL 3-41 "provision on the use of laser light for outdoor purposes" is observed. Violation of this provision may be punished with a fine or in accordance with the rules stated in chapter five of the criminal code, cf section 149, subsection 14 of the Danish Aviation Act.
- The use of experimental setups that require class 3a lasers or higher must only take place by prior agreement with the laboratory supervisor.
- Setups in which laser equipment is used may only occur during laboratory opening hours. Dispensation may be given in connection with certain experiments in special cases where operations lasting beyond the normal opening hours of the laboratory are necessary. In such cases, special precautions must be taken to the extent possible to ensure that failure in setup subsystems does not cause damage to people, buildings or equipment.
- In connection with an experimental setup using laser equipment, a workspace and a measuring area must be defined in which a lightproof barrier must be established. In the work space, it must be possible for users to work at minimal risk; however, no-one is allowed to access the measuring area while laser equipment is in operation.
- An appointed Laser Safety Officer (LSO) must ensure that the measuring area of the experimental setup is shielded in a satisfactory manner to make sure that laser light or reflections do not pose a safety risk to people working in the designated area.
- Action must be taken to prevent laser beams from being seen outside of the workspace. Persons staying in the workspace while laser equipment is in operation are required to wear safety glasses protecting against light on the laser wavelength being used.
- In connection with the preparation of laser equipment (up lining etc.), where lightproof shielding may be difficult, the entire room must always be sealed off as described above. In addition, a Yellow flashing light will be present outside all entrance doors to the laboratory. An LSO must participate in

this part of the work. At all times, safety glasses must be worn during preparation. During preparation, the laser equipment must be set at the lowest possible light output.

- People who are working with laser equipment or are present in a work or measuring area where laser equipment is in operation must not wear jewelry, watches or other shiny objects as these may cause accidental uncontrolled reflection.
- In the construction of experimental setups, shiny surfaces must be avoided in areas exposed to laser light.
- People who are working in the laboratory must, without exception, follow all instructions given by the LSO or the laboratory staff supervising the experiment.

OFFSHORE ENERGY LAB (C2.025)

General:

- Ear protection must be used when the wind generator is in operation, this applies to ALL who is working in the laboratory. The group that is working with the wind generator, informs other people before tests are being performed by the wind generator.
- Ensure that there is no fluid leakage or other types of chemical leakage in the laboratory.
- In case of fluid leakage, contact the laboratory supervisors or staff immediately.
- Only authorized persons are allowed to change the fixed settings / installations. Permission must be stated in the WPP.
- Guests and students may only pass the yellow safety line if they have been instructed by the laboratory supervisor or staff and signed the WPP.

Wind & Wave:

- When working with the wind generator safety glasses are required.
- The basin must be secured with railings around it, if it is not completely covered by door plates.
- The wind generator must be secured with grid on both sides of the basin.
- No one is allowed to stay in the basin when the wave machine is in operation.
- Only laboratory staff must fill and empty the basin.
- Using the crane for moving the door plates must only be moved by laboratory staff.

Oil & Gas:

- If crossing the yellow safety line without safety helmet, all levels of offshore pilot plant must be cleared for loose objects and possible breakages.
- Safety helmet is required when crossing the yellow safety line, if the offshore pilot plant is in operation.
- When maintenance and rebuilding of the offshore pilot plant safety shoes are required.
- Only instructed laboratory assistants and students must configure circuit panels and computers.
- All operation (including; start-up and shutdown) of the offshore pilot plant must follow the rules and procedures that are described in the pilot plant manual. Contact the laboratory supervisor for manual hand out.

POWER ELECTRONIC LAB (C2.102) & RENEWABLE ENERGY CONTROL LAB (C2.130)

Power Electronic Lab (C2.102) and Renewable Energy Control Lab (C2.130) includes only the rules for “*General Safety Precautions*” and “*Electrical Setups*”, see each section. Working with batteries, follow the rules in section: “*Setup with Inflammable Fluids, Gasses, and Electrochemical Cells*”.

Safety equipment is not required in this laboratory unless the laboratory supervisor or staff demands it. Safety equipment requirements may be required due to temporary changes in the current test setup or other experimental setups is temporarily installed in the laboratory.

ROBOT & DRONE LAB (C2.103)

- Flying indoor with drones is strictly forbidden!
- It is not allowed to touch, use, or move setups and equipment without prior permission of the laboratory staff. This also applies to drones, cars, underwater-robots and inline-robots.
- Students, staffs, and guests must not operate equipment without thorough safety and operating instructions from the laboratory staff. In addition, a license, for operating a drone, is required: <http://dronetegn.dk/>.
- No experiments, with robots in the laboratory, should be performed without the laboratory staff approving it.
- Turn off the power supply to the equipment before an inspection is performed.

BIO ENERGY SYSTEMS LAB (C2.132)

- Lab coats and safety glasses must be worn at all times while being in the lab. Gloves, respirator or other protection measures must be used when appropriate.

- It is not allowed to touch, use, or move experimental setups without permission and guidance from the laboratory supervisor or staff. This also applies to heating ovens and incubators.
- No equipment must be used without initial demonstration from the laboratory supervisor or staff and/or reading the instruction.
- Before working with a chemical substance, its chemical properties must be investigated using www.kemibrug.dk and the necessary precautions made.
- Any chemical substances used must be returned to its rightful place, directly after use.
- When working with the fume hood, the sash must be lowered as much as possible without it obstructing the workflow in the hood.
 - **ATTENTION:** If the alarm only sounds in the fume hood, where work is being performed, it is most likely because the sash has been opened to high!

ACCIDENTS AND NEAR-ACCIDENTS

In case of personal injury, use the five first-aid key phrases

- 1. Stop the accident (press the emergency stop button and disconnect the power supply)**
- 2. Provide life-saving first aid**
- 3. Call for help - phone 112**
- 4. Provide normal first aid**
- 5. Call the responsible laboratory staff or a member of the Health and Security Group**

Specific guidelines for electrical accidents. If a person is affected by a voltage above 25 V AC or 60 V DC, help must always be called for on tel. 112; make sure you inform the Emergency Dispatch Centre that you are calling about an electrical accident.

Near-accidents; Contact the laboratory staff, who will assist you in registering the near-accident.

PAY ATTENTION TO

Students carrying out practical exercises or work-related experiments are covered by the Danish Work Environment Act; this means that the educational institution is responsible for ensuring that activities in the workshop (exercises and experiments) take place in a safe and healthy environment.

IMPROVEMENTS

It is the responsibility of the working environment committee to currently update safety regulations, and if YOU have any suggestions as to the improvement of the level of safety in laboratories or for additions to the present regulations, please submit these to a member of the safety committee.

Members of the Working Environment Committee Aalborg - Pontoppidanstræde 111				
Role	Name	Field	E-mail	Tel.
Chairman	John K. Pedersen	ET	jkp@et.aau.dk	+45 9940 9264
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Appointed supervisor	Henrik C. Pedersen	Hydraulic/Mechanic	hcp@et.aau.dk	+45 9940 9275
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January 2017

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April 2018

APPENDIX 1

Table of laboratories and special laboratories under the Department of Energy and Technology in Esbjerg

Aalborg University Esbjerg Niels Bohrs Vej 8:

Laboratory name	Lab type	Placement	Laboratory responsible
Electrical & Power Electronic Lab	Special lab	C2.102	Amin Hajizadeh: aha@et.aau.dk
Electronics Lab	Workshop	C2.106	Henry Enevoldsen: hen@et.aau.dk Akbar Hussain: akh@et.aau.dk
Bio Energy Systems Lab	Special lab	C2.123	Jens Bo Holm-Nielsen: jhn@et.aau.dk Kathrine Toft Hansen: kth@et.aau.dk Mette Hedegaard Thomsen: mht@et.aau.dk
Hydraulic Lab	Special lab	C2.019	Jesper Liniger: jel@et.aau.dk
Flow Lab	Special lab	C2.021	Matthias Mandø: mma@et.aau.dk
Robot & Drone Lab	Special lab	C2.103	Petar Durdevic: pdl@et.aau.dk
Student Workshop	Workshop	C2.023	Henry Enevoldsen: hen@et.aau.dk
Offshore Lab	Special lab	C2.025	Zhenyu Yang: yang@et.aau.dk Mohsen Soltani: sms@et.aau.dk
Renewable Energy Control Lab	Special lab	C2.132	Mohsen Soltani: sms@et.aau.dk

No dispensation is given to these safety rules without agreement from the head of the laboratory or his substitute in each case.

I understand and agree on the above safety rules

Date: _____ Name: _____