Emergency / Alarm 888 / Evacuation

Emergency Alarm (all types, 24 hours): Tel 888
(valid for all ETH internal telephones)

Alarm Center via cell phone or from outside (24 hours): 044 342 11 88

Save the Alarm Center in your cell phone with the QR code:

Look ➔ Think ➔ Act

1. Secure danger area, protect yourself
2. If possible, always leave the patient on site (the first aid team will come on site)

Where? Place of accident (building, floor, room)
What? Type of accident
Who? Name of alerting person and how to contact
When? Time of accident
How many? Count of patients (and their injuries)
Other? Additional potential risks

Additional emergency phone numbers:

Generally, always alert via 888 or 044 342 11 88. Use the following numbers only if communication with the Alarm Center is not possible. Enter the phone number exactly as indicated:

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<th>For all ETH internal telephones</th>
<th>Cell phone</th>
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<tr>
<td>Police</td>
<td>0117</td>
<td>117</td>
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<tr>
<td>Fire brigade</td>
<td>0118</td>
<td>118</td>
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<tr>
<td>First Aid</td>
<td>0144</td>
<td>144</td>
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<tr>
<td>Tox Info Suisse</td>
<td>0145</td>
<td>145</td>
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</table>
Building evacuation and assembly point

In an emergency, users can request an evacuation of the building via the Alarm Center based on their assessment. If a siren sounds over the loudspeaker system, or you receive a corresponding message (email SMS) via IAT (information and alarm tool) in connection with the call for building evacuation, immediately go to the assembly point via escape route (see illustration on the right).

Follow the instructions of the safety personnel.

Evacuation concept for the HCI building: See chapter 4.2

Note:

The safety and environment manual version 2020 applies to all employees and students in the HCI building. This manual replaces the previous versions.

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1. **Most important rules in workplace**

| Obligations! | All employees and students must behave in a way that the regulations on safety and environmental protection are complied with! All new entrants are personally instructed by the safety officers/assistants who are authorized to issue instructions in the area of safety and environment. New staff members are obligated to follow the safety and environmental guidelines. |
| Personal protection! | While working with chemicals and equipment, the use of personal protective materials (available in HCI-Shop) is mandatory; Priority 1: Properly fitted safety glasses on face! Wearing contact lenses is not allowed. Appropriate over-prescription goggles are prescribed for people who wear glasses. ETH employees can apply for optically adapted safety glasses via the SSHE. There is also a requirement for a laboratory coat over street clothing that is appropriate for the laboratory, consisting of flame-retardant and non-melting textiles. If necessary, personal protective equipment must be supplemented with protective gloves, respiratory protection, etc. |
| Workspace! | Generally, users must keep the workspaces and fume hoods clean. Everyone who works in a laboratory is responsible for good work hygiene. Workspaces and fume hoods may not be overfilled with large amounts of chemicals. The lab service may block unacceptable workspace. To place, store or handle chemicals or objects contaminated with chemicals is not allowed in desk-areas. |
| Forbidden! | It’s not allowed to store or consume foodstuff, cosmetics or medicine within laboratories or in close proximity to chemicals, biological materials or dangerous equipment. Smoking is strictly prohibited in the entire building. Writing zones not separated by glass walls or something similar are considered laboratory zone. |
| Contamination! | After working with protective gloves, always dispose them at the place of use! Never walk around the building with gloves or other utensils contaminated by chemicals! People wearing gloves are not served in the service areas! Lab coats may not be worn in offices, toilets, seminar rooms, cafeterias, etc. |
| Risk Analysis! | While working with chemicals or biological substances with an increased safety risk, the safety officers or assistants must be informed beforehand. During such work, students, apprentices, guests, service technicians etc., require the immediate presence of a competent supervisor. Before starting work at increased risk, a hazard/risk analysis must be carried out. Please consult the safety data sheets (MSDS), pictograms on the labels of chemicals, and the GHS H/-P-phrases (hazard/safety information). Weblinks: www.msds.com (registration required) www.reaxys.com If no MSDS data are available, it must be ensured that all possible risk factors in relation to the unknown chemical have been considered. Be aware of the general rule: the smaller the amounts of reactants and products used in the experiment, the smaller the possible risks and impacts of accidents. Special toxlabs are available for dangerous work after consultation of the safety officer or assistant. |
| Sources of Ignition! | Open fire or ignition sources (e.g. Bunsen burners with or without gas cartridges, heat guns) may only be used in rooms where there are no fire-hazardous substances in the immediate vicinity. Alkali metals and their hydrides can ignite spontaneously on contact with air or water. Enhanced caution is required with distillation residues that contain alkali metals. |
**Volatile!**

Any work using or producing toxic, flammable, and malodorous chemicals, gases, aerosols, or vapors must be carried out in appropriate fume hoods. Additional absorption devices must be installed to trap any dangerous volatiles.

**Overpressure!**

Vacuum, overpressure, and agitation in unsuitable glass equipment pose a risk of bursting! Quality and wall thicknesses of the glass containers and equipment must be selected according to the intended use. Check them regularly for damage. Experimental autoclaves must be equipped with a pressure gauge and a rupture disc. Exceeding a pressure x volume product of 10 [bar x liter] requires the approval of the Dept. SSHE. Alternatively, experiments can be conducted in the high-pressure laboratory, depending on the space requirements.

**Prevention!**

Emergency plan: Always have an emergency plan ready to act safely and quickly in the event of an incident or malfunction. Before starting any experiment, all required protection measures must be taken in advance. Necessary emergency material must be organized in order to prevent any possible accidents and the spread of smelly compounds!

**Gas cylinder!**

Gas cylinders must always be secured with chains. Gas cylinders and pressurized gas outlets require appropriate pressure reducing valves. Corroded or damaged pressure reducers must not be used.

**Liquefied gases!**

In addition to the risk of suffocation and cold burns when using liquefied gases, attention must be paid to the following:

Caution with oxygen enrichment in liquid nitrogen, especially in cold traps of high vacuum systems. When air is supplied, cold traps being cooled with liquid nitrogen may be enriched in highly oxidizing liquid oxygen. This can react violently when thawed, together with condensed solvents.

Never close Schlenk flasks, ampoules (or similar vessels) with substances that are frozen out under argon with liquid nitrogen. There is a high risk of overpressure explosion when liquid condensed argon thaws in the closed vessel.

**Radioactivity!**

Working with ionizing radiation is subject to approval (BAG, SSHE). Experiments must be carried out in specially designated radioactivity laboratories. Experiments in the HCI building with radioactive material below the approval limit also require agreement with SSHE (sgu-umwelt@ethz.ch).

** Doors and Emergency exit!**

Laboratory-, emergency balcony-, escape- and entrance doors to the building may never be obstructed with objects, left open, or prevented from closing with a wedge. The latter ensures the building ventilation balance as well as a negative pressure in the laboratory area, which makes it easier to hold back and combat events.

In an emergency, work must be stopped, and the laboratory evacuated until the event that caused the emergency is eliminated.

Open escape doors on the ground floor and in the basement makes it easier for unauthorized persons and animals (insects, mice) to enter the building. Objects that are not allowed on the escape routes and balconies are removed and disposed of by the laboratory service.

Using headsets or sound systems blocking noise increase the risk of accidents. Sound/radio equipment may only be used with permission of the supervisors and must never be perceivable outside the personal area. In case of unacceptable noise or disco-like situations, the laboratory service will remove the equipment.

Persons unable to hear the alarm because of headsets or headphones act on their own responsibility.

**Respect!**

The use of mass-mail addresses for personal purposes is prohibited! There is a web market available for this purpose: www.marktplatz.ethz.ch

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**Important note:** More detailed explanations of the most important rules at the workplace as well as other important operating regulations can be found in the chapters of the safety and environmental manual for the HCI version 2020.
2. Responsibilities in the HCI building

2.1. ETH Zurich

The website www.ethz.ch presents an overview of ETH Zurich with its departments and research groups as well as all links to its service and administration groups.

2.2. SSHE (Safety, Security, Health and Environment) staff unit of ETH

SSHE and the workgroup ‘Koordination für Arbeitssicherheit’ (KOORAS, coordination for occupational safety) are responsible for all safety, health, and environmental issues at ETH.

Website: www.sicherheit.ethz.ch

In case of personal injury or damage of property, fill in the official form and report it as soon as possible (email to: sgu_schaden@ethz.ch). The SSHE team and the respective representatives are responsible for handling such cases.

For any questions regarding laboratory or occupational safety, contact the CABS team (First chemical intervention, occupational safety, biosafety, hazardous waste disposal), a section within SSHE: cabs@ethz.ch

2.3. Safety and environmental management in the departments

Note: The following organizational structure (militia system) analogously applies to other departments and service platforms in the HCI building.

2.3.1. Organisation D-CHAB

Website SE management: www.chab.ethz.ch/das-departement/services/su-management.html
Email hotline: chab-safety@chem.ethz.ch
2.3.2. Services of the SE management for HCI

- **Hotline operation** in HCI: Users in HCI may address all security concerns and technical defects in writing to the e-mail hotline address in the table below. A short comprehensible description of the situation or defect is required. The hotline will inform the HCI staff about maintenance and upkeep work (building services, laboratories, and offices), staff will also be contacted in the event of sudden malfunctions, such as a power or ventilation failure.

**Hotline contacts**

E-mail hotline: chab-safety@chem.ethz.ch

During ETH opening hours:

Phone hotline: 044 63 3 48 12  
Pager PSA: *8034812

Outside of ETH opening hours (no guarantee):

Cell phone: 075 410 99 21

Alarm: internal 888 / external 044 342 11 88

- **Incidents statistic:** SE management carries out the incident statistics for HCI and, in consultation with the SSHE dpt., carries out the processing of accidents and incidents. The incident statistics include not only personal injuries or property damages, but also odor emissions, incidents, and all other special occurrences. The aim of the incident statistics is to identify the causes of the incidents (material deficiencies, missing infrastructure, missing or non-compliance with instructions/regulations) and to take preventative measures against them. The main goal is to steadily reduce the number of incidents.

### Annual overview of incidents and their resulting consequences in HCI

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<td>Seat accidents</td>
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*Note: One incident can cause more than one consequence. For example, an explosion can cause both health and property damage.*

Current as of: 27.12.19

Aim 2019: Total incidents: < 26 (Based on statistics from 2008); total for health: < 5 (Based on statistics from 2009)
Additional services of the SE management for HCI are

- Establishing and consulting risk and incident-risk assessments
- Advising on and supporting safety-relevant projects
- Providing and maintaining emergency equipment cabinets in HCI
- Chemical recycling service
- Executing laboratory service and safety inspections
- Testing and developing safety-relevant laboratory infrastructures

These services are detailed in the following chapters.

2.3.3. Service areas

Most of the service areas (see chapter 10 for details) have their own websites. Short overview:

- **Toxlab D312**: www.toxlab.ethz.ch
- **Special area in C174**: www.c174.ethz.ch contains
  - Bio security lab ‘Bio level 2’
  - Tox lab 2 (cytostatic agents)
- **Central distil lab D310**: www.distillation.ethz.ch
- **Safety parcours**: www.safetyparcours.ethz.ch
  - Safety parcours 1, Chemistry with seminar room
  - Safety parcours 2, biology
- **Storage room** (chemical storage of recycled chemicals)
- **Central filling system D379.1**: for liquid nitrogen
- **Central storage D486**: -80°C freezer belonging to IPW (D-CHAB) and IMB (D-BIOL)
- **Central storage D305**: -80°C freezer belonging to LOC

2.3.4. Training concepts of SE management

The **Safety Lecture** is currently divided into 6 topic sections and the Safety Lecture Practice Modules into 3 (see table below). The topic sections can be further subdivided and supplemented as required. The aim of the Safety Lecture is primarily to teach the methodology of creating risk assessments, to explain our emergency organization, to impart basic knowledge on safety and legal basis, and to explain the causes of accidents in relation to our incidence statistics. The Safety Lecture is held as a lecture shortly before the start of the semester, but is also available as a PowerPoint presentation, illustrated with video clips, online on our SE management website.

The **Safety Lecture Practice Modules** were developed in part as a preventive measure based on the incident statistics and their cause analytics. The Practice Modules focus on the work topics that lead to frequent work-related accidents.
Further **educational courses**, offered by the SE management and held regularly:

- Safety officer – educational course (= one-day course) focusing on specification book, emergency organization, laboratory techniques (detailed) and tour of the technical building services
- Safety-course for the administration and service staff (= half-day course) focusing on emergency organization, laboratory techniques (red.) and tour of the technical building services
- Safety parcours = theme parc for all interested
- Organization of various special seminars and symposia

2.3.5. **Safety-Test (via test platform Moodle)**

**Safety-Test**

The Safety-Test is mandatory for all (except for short practical courses such as 3.5 weeklong block courses). All new employees at the HCI (including administrative staff, service units and all students who have not yet completed a test as part of the practical course) must complete a version of the Safety-Test (either in German or English, see table). The Safety Test contains 40 multiple choice questions (randomly chosen), which must be answered in a maximum of 30 minutes. Only one answer is correct. Preparatory material is available on the website under the heading “GHS training”. The practical course coordinators and assistants organize the Safety-Test exams themselves with their students. They are trained by the SE management.

What if someone fails the test?

At the end of the safety test, everyone automatically receives feedback as to whether they have passed or failed. Those who did not pass the exam may retake it after a week. If someone fails both times, they must inform their responsible office. The supervising professor then decides on the further procedure. The controlling is usually carried out by the offices, for the students’ laboratories the practical course coordinator.

**Safety Lecture Exam**

The Safety Lecture Exam is mandatory for all who will work in laboratories as well as for all assistants in the practical course rooms at the HCI. The Safety Lecture Exam (either in German or English) must be taken and passed by all those working in laboratories and intending to deal with chemicals and biologically active substances, including doctoral students, post-docs, assistants, but also visiting scientists. The staff in administration and in the service units as well as all students are not affected by this. The Safety Lecture Exam is comprised of 10 questions (randomly chosen), which must be answered in free text within a maximum of 30 minutes. A correct answer awards 2 points. The safety manual and safety lecture are intended for preparation.
The finished Safety Lecture Exam, it will be examined by an expert and the examinee will be informed on their result. Those who have not passed the exam may retake the exam after one week.

What if someone fails the Safety Lecture Exam?

If someone fails both times, the responsible safety officer must be informed. The supervising professor then decides on the further procedure. Controlling is usually carried out by the safety officers.

2.4. Responsibility and specification book

2.4.1. Employers/Professors

- The employer and professors are responsible for occupational safety at the workplace or respectively in the laboratories (see www.suva.ch - rights and obligations).
- They must take appropriate safety measures to ensure that life and health of their employees are not endangered.
- The employer bears the costs for all safety measures.

2.4.2. Employees/students

- Employees and students (see www.suva.ch - rights and obligations) are obliged to follow the instructions of the employer and professors, to observe the safety regulations and to properly use safety equipment and personal protective equipment.

2.4.3. SE manager

- The SE manager oversees and manages the entire SE management administration and the safety work groups in the department; they also implement the decisions taken there. The SE manager organizes and maintains the management of safety training in teaching (assistants and students) and research (employees and safety officers).
- The SE manager forms a team with the SSHE dpt. for incident and accident investigations in the department.
- The SE manager is responsible for the operation of the assigned service rooms including the safety infrastructures.
- The SE manager ensures that the intervention material in the emergency cabinets is updated and on standby fully equipped.

2.4.4. Security representatives & practical course coordinator of the institutes and department

The departments, institutes and the technology and service platforms need contact persons for safety and environment. The responsible superiors and supervisors appoint safety representatives or respectively practical course coordinators and confirm their appointment, and the associated tasks, by signature. They provide the necessary working hours.

The tasks of these safety representatives is performed by the SE management.

The tasks of the safety representatives are:

- Instructing and supervising the safety officers within their area, possibly also those who are adjacent to the department or institute (e.g. teaching laboratory, high-pressure laboratory, workshop, etc.).
- Informing and advising within their responsible areas, as well as processing and forwarding of suggestions and complaints.
- Registering and reporting events to the SSHE department and the SE management.
2.4.5. Safety Officers and assistants

Each unit and practical course requires a contact person for safety and environment. The responsible supervisors appoint safety officers or assistants. The responsibility (except for grossly negligent acts) still always lies with the managing professors.

The employer and professors must ensure that their delegated safety officers have not been forced into this duty and perform their office with good motivation.

Duties for safety officers and assistants are:

- Personally introducing and training new employees/students on the topic of safety and environment. The basis for the personal safety introduction is given in the form of the document 'Guide for Safety Introduction of New Staff at HCI', which can be downloaded from the SE management's website. The goal of the personal introduction and training of new employees/students is that in case of an incident no one can say, "I did not know this, I was not informed!"

- Verifying (situational in consultation with the responsible office) that the new employees/students have taken and passed the mandatory Safety-Test or Safety Test Lecture.

- Ensuring that new employees/students have proper personal protective equipment. They check how the safety glasses fit the new employees/students especially and sensitize them to the dangers of open gaps between the rim of the glasses and the face.

- Informing and transmitting the safety guidelines and instructions in their sector.

- Advising employees and students, as well as processing and forwarding risk assessments, suggestions, and complaints to chab-safety@ethz.ch.

- Recording and reporting events to the SSHE dpt. and the SE management. Accidents must be immediately reported to the SSHE dpt. and the SE management in brief. In case of medical treatment or hospitalization, the accident form must also be submitted immediately and separately for insurance reasons.

- Safety officers (= voluntary service) also act as evacuation assistants in their area. If they are on site, safety officers automatically act as evacuation assistants on staff according to the concept for evacuation helpers. They act as quasi crew members to evacuate as many as possible from the building while keeping their own safety in mind.

- Personnel interview: The professors in D-CHAB must carry out an interview with their safety officers at least once a year. This should help emphasize the importance of and provide better support for the safety officers. For the other departments this is recommended correspondingly.

2.4.6. Obligation to supervise in the practical course

Definitions:

Practical courses in organic, biological, physical, pharmaceutical, and analytical chemistry count as beginner's practical courses. In these courses, students are taught the basics on general laboratory work and the handling of chemicals or biologically/pharmaceutically active substances.

Chemicals, glassware under vacuum or overpressure, special physical, biological, pharmaceutical, and chemical experiments pose a danger to users if they lack training and experience. The main risk in beginner's practical courses is that the students lack knowledge and experience in practical work. For this reason, special attention must be paid to support them well both in theory and practice. In the beginner's practical courses, only manageable and safe experiments should be carried out.

A basic practical course is one that is carried out before the student's bachelor's degree. If there is a provably low risk of danger, the practical course coordinator decides whether a basic practical course is better specified as a beginner's practical course or as an advanced practical course.

Advanced practical courses are those in which a certain basic knowledge of theory and practice is required to carry out experiments and activities. The students must be enabled beforehand to carry out these experiments and activities with high quality and in a safe manner. In the advanced practical course, the students can apply their acquired basic knowledge to research-related experiments and activities, which means the risk now lies in the correct execution and compliance with the safety concept.
Obligation to supervise:
The assistants ensure that the obligation to supervise is fulfilled as detailed below in their practical course. Assistants must be familiar with the current laboratory regulations and act accordingly. Before starting a practical course, the assistants must give the students a personal safety introduction and discuss with them the training program and its inherent dangers. Students are not allowed to work alone in the laboratories of the practical courses (students' laboratory). When the work is finished, the assistants check the students' laboratory a final time and ensure that all media and devices are switched off or operating safely. After the final check, the students’ laboratory is locked.

- Obligation to supervise for a beginner’s practical course: At least one assistant must be present at all times in the students’ laboratory during the entire course period. A replacement must be on-call to come immediately if needed.

- Obligation to supervise for a basic practical course: The practical course coordinators can decide whether the obligation to supervise can be reduced if there is little risk of danger. Otherwise, the same rules apply as for the beginner’s practical course.

- Obligation to supervise for an advanced practical course: The practical course coordinators can decide whether an assistant must always be present in each room used for the course for the entire duration of the course or whether this can be forgone if there is little risk of danger. In this case it is, however, required that an assistant located in the HCI building is on-call to come immediately at any time (phone/pager).

Fact is: When safety officers and assistants do excellent work and the supervisors take on their responsibilities and set good examples, the danger and probability of accidents is significantly reduced!

2.5. QR-Code for safety-relevant Information

The QR code is a two-dimensional code for quickly finding safety-relevant information. For example, they can be found at the filling station for liquid nitrogen (= link to the training video for filling tanks with liquid nitrogen), or on media columns (= link to the training video for correct operation of the media column) etc. These QR codes can be read with any mobile device using an appropriate app. After scanning the code, you will be forwarded directly to the safety-related information or the training videos on our video portal. WLAN (Wireless Local Area Network) is required to read the QR codes. Devices marked with “WiFi” can connect to WLAN.

All the information and training videos can also be found on the SE management’s website without the use of a QR-code, pay attention to the appropriate heading.
3. Deficiency management

3.1. Reporting defects and deficiencies

Defective fume hoods, media columns, chemical cabinets, waste disposal stations, laboratory furniture, equipment of the BTA (see 3.2) etc. can be directly reported to the email-hotline chab-safety@chem.ethz.ch. A short comprehensible description of the situation, circumstance, or defect of laboratory infrastructure is required. Please always add the correct number, e.g. of the media column or the fume hood. Imprecise reports will be neither accepted nor dealt with.

Defective vacuum pumps, rotary evaporators, magnetic stirrers etc. can be taken to the HCI-Shop for repair. Prior to bringing vacuum pumps for repair, the laboratory users have to fill in and hand over a safety clearance form. If a rotary vane pump has to be repaired, the laboratory user is responsible for changing the oil and for the oil drain.

Deficiencies within the domain of the technical service, the cleaning facilities and waste disposal as well as the building services (heating, ventilation, climate, air conditioning, sanitary installations, electrical installations, window blinds) have to be reported to the real estate services portal (see 3.3).

3.2. BTA (Betriebstechnische Anlagen: operational installations)

A part of the laboratory infrastructure in the HCI is subdivided in operational installations (BTA) that are managed by D-CHAB:

**Operation list 1:** Laminar flow boxes/bio-safety work benches, nitrogen-/helium-plants, filling station of liquid nitrogen, compact coolers etc.

**Operation list 2:** All fume hoods, all media columns including their modules, all cooling devices and brooders, all ice machines

3.3. The Real Estate Services Portal (Meldeportal)

Users can report building service problems, keys, and locks/modifications thereof, cleaning tasks etc. via the services portal. All necessary details must be entered in the online form, in particular the description of the circumstances must be clear and comprehensible.

Projects for new installation, remodeling, and redevelopment: The departments and institutes have expert representatives for such projects who must be part of the planning and arrangement of the projects. The real estate services are responsible for the realization of the projects and the execution on schedule.

**Procedure:**

- Open the website www.gmis.ethz.ch
- Login (ETH user name, password)
- Enter a relevant keywording in the search field, for instance “building services”.
- Use the online form to enter your request in detail.
- If necessary, upload sketches and further material
- Click “send”; done
3.4. Laboratory service and laboratory safety inspections

Maintenance and service work is carried out every two years on the laboratory media and laboratory infrastructure in all laboratories and technical rooms. This is always carried out alongside a laboratory safety inspection. Usually, the maintenance and service work is announced in advance and carried out on weekends. The concerned users of the laboratory do not have to be present during the maintenance and service work but are obliged to carry out all necessary preparations on time to ensure that the service staff is not in any danger or at risk of injury. If the group leader objects, the service staff must not enter the rooms in question.

After every maintenance step and safety inspections a report will be written (see databank of laboratory service reports). Based on the results of a two-year laboratory service period deficiency statistics are always set up.

The laboratory service reports show how the work groups realize the obligation to supervise and focus on safety.
The laboratory service can block access to the laboratory and workplaces temporarily if they are in unacceptable conditions until a solution is found with the users and the superior.
4. Emergency response in the HCI building

4.1. Alerting the ambulance in HCI

First Aid procedures – check the last pages of this manual!

In case of an emergency, the concerned persons on-site must decide if the injuries are acute or not. If in doubt, the emergency has to be classified as acute.

In case of an acute emergency (severe injuries/disease):
- Highest priority: always call 888 and mention explicitly that there is an acute emergency (reporting procedure on page 2). The emergency desk will then immediately call for an ambulance as well as the HCI emergency response officers (ERO). If the accident involves chemicals and if needed the chemical intervention team (CIT) is called as well.
- In case 888 cannot be contacted, dial 0-144 directly! (0- stand for zero output, has to be used on internal phones); then inform the emergency desk!
- In case of poisoning: Call the tox info Suisse 0-145 for further instructions!

After the call, first aid for the injured/patient has highest priority. Someone must wait for the ambulance staff at the ETH Hönggerberg bus stop. For emergencies in fingers 3-5, guide the ambulance team to the main entrance of finger 3, otherwise to the respective main entrances of finger 1 and 2 (always in the “combed area of the HCI). From the main entrance of finger 3, all accident locations in fingers 4 and 5 can be accessed via the freight elevator. After an alarm, the emergency desk will automatically call the HCI emergency response officers or - outside office hours - the security staff. They will go to the accident location to prepare access and open doors for the ambulance staff (24 h a day).

In case of a non-acute situation (simple injuries):

Highest priority: Always alert 888 (reporting procedure on page 2). The emergency desk will call the HCI emergency response officers but not the ambulance.

After alerting
Case a):
If the HCI emergency response officer does not appear within 10 minutes, call 888 again! Only call 0-144 when all previous steps have failed! (0- stand for zero output, has to be used on internal phones); then inform the emergency desk.

Case b):
The patient recovers quickly and can be treated on site but must be transported to the hospital for further treatment. Together with the emergency response officer/security service, the transport will be arranged as follows:
- The patient feels well enough to take public transportation accompanied by a colleague or a taxi to the hospital/a doctor. The taxi fare will be reimbursed by the D-CHAB-SE management (a payment receipt is required).
- If the patient cannot travel by themselves, an ambulance will be called. The HCI emergency response team will not transport the patient.

Case c):
- The patient recovers quickly and does not need further treatment. Inform the emergency desk that the emergency is over.

Mandatory for every accident: the accident report! Accidents have to be reported immediately in brief to the SSHE division (sgu_schaden@ethz.ch) and to the SE management (chab-safety@chem.ethz.ch). In case of medical attention or a hospital stay, the accident form must be filled in immediately and handed in separately for insurance reasons.
4.2. Evacuation-Concept in the HCI-building

4.2.1. HCI evacuation system

Each of the 6 building sections HC0 to HC5 has its own, autonomous evacuation system. The loudspeakers of the evacuation system are placed in the corridors and staircases, as well as in rooms with larger numbers of people such as lecture halls, students’ laboratories, cafeteria, etc. Normally, the emergency desk triggers the evacuation systems automatically via IAT (information and alarm toll). Alternatively, the fire alarm team can trigger the system manually. During an evacuation, an entire building section will be evacuated, e.g. HC3. Whenever the IAT triggers the evacuation system in a building section, a siren will first be audible, followed by a voiced announcement in German and English. This sequence is stored and will be repeated in regular intervals on the loudspeakers. During an evacuation announcement, all other permanently installed audio transmissions in the lecture halls, cafeteria, etc. will be automatically suppressed. The announcement will be repeated until the all-clear signal is given. The fire alarm team is in charge of the emergency usage of the evacuation system. The entire HCI complex is structurally and technically divided into the 6 parts HC0 – HC5. There is little chance that an incident will happen simultaneously in several parts of the building complex. Therefore, the evacuation plan is set up for the evacuation of one part only, e.g. HC4.

4.2.2. Information and alarm tool (IAT)

With the IAT the operator at the emergency desk can alert all concerned people and rooms (e.g. laboratories, lecture halls, computer rooms, etc.) in case of an evacuation incident. According to the plan of the employer, the tool is supposed to replace the user heavy concept for evacuation helpers in the HCI. In the case of an evacuation this tool automatically sends emails and SMS text messages to the personnel with the request to evacuate (if those concerned have added their phone number in their personal and communication data and their preferred language of communication is German or English). Ideally, all landline telephones should ring in the rooms to be evacuated, when the phone is answered a prerecorded message should transmit the request to evacuate.

4.2.3. Assembly Point

The assembly point for the entire Hönggerberg campus is the HXE building (Wolfgang-Pauli-Strasse), see page 3.

4.2.4. Evacuation

Every user of the building can request an evacuation via the emergency desk in case of an emergency (call 888 internally, or 044 342 11 88).

During an evacuation, follow the escape route signs in general. During an evacuation, the use of elevators is forbidden. Everybody is obliged to assist disabled or injured persons during this time. Keep yourself protected.

Internal ETH staff is present during standard ETH opening hours from 8 am to 6 pm for the support of the technical evacuation system (evacuation facility). As a general rule, no supporting internal staff will be present in case of an evacuation outside of the ETH opening hours, from 6 pm to 8 am as well as on weekends and national holidays. In the case of an incident, the ETH safety service and the emergency services are present. Additionally, users have to self-organize (see the SSHE website, heading "Evacuation").
Recommendations for building users:

- We recommend all users walk along their own escape paths at least once (if you have further questions, the safety officers are available).
- The evacuation system and emergency lights will work for another 60 minutes if the power fails. In case of an evacuation during the night accompanied by a power failure, the normal lighting is switched off. There is no emergency lighting in the laboratories; only the escape route signs will provide minimal lighting. For this reason, we recommend having a flashlight available in critical rooms.

4.2.5. Duties of concerned people

**Whoever started the evacuation via the emergency desk:**

- Inform one or more colleagues and ask them to keep all people away from immediate danger zones.
- Immediately go to the main entrance of the affected building (rotating doors).
- Wait there for the emergency response team to arrive and provide them with all the information on the incident.
- Be ready for further questions.

**Duties of building users:**

Act as follows whenever the loudspeakers transmit a siren, combined with an evacuation order (while always protecting yourself):

- Office users: leave the office and lock the door with your key, take personal items (keys, money, mobile phone, etc.) with you. Inform the neighboring laboratory area about the ongoing alarm and then go to the assembly point.
- Laboratory users: Stop and secure dangerous experiments and instruments before leaving the laboratory. Take personal items (keys, money, mobile phone, etc.) with you. Do not lock the laboratory door with your key (except for special laboratories).
- Locked rooms are considered evacuated. Those who deliberately lock themselves inside a room, or who otherwise refuse to evacuate, will be left to their fate.
- Follow the instructions of the evacuation helpers, who are wearing bright orange jackets and are mobilized automatically with the evacuation alarm during the previously mentioned opening hours.

**Duties of the evacuation helpers from institutes and special service groups:**

Note: Between 6 pm and 8 am the users have to self-organize in case of an evacuation (see the Evacuation section on the website of the SSHE department). The emergency desk of ETH is always staffed and must be informed in case of an incident (internal phone number: 888, external: 044 342 11 88).

When an evacuation alarm goes off, instructed people (= voluntary service) can start acting as evacuation helpers (e.g. the safety officers).

- They go to the corresponding emergency niche and take the sealed evacuation bag; from it they remove the orange high-visibility vests and evacuate in teams of two when possible.
- All rooms to be evacuated are indicated on the laminated plan found in each evacuation bag.
- The evacuation helpers instruct everybody to leave the room. Unlocked rooms (except for special rooms) are systematically entered and all present are informed about the evacuation with the whistle or by calling out loud. Locked rooms are considered evacuated.
- The evacuation helpers check the evacuation status of each room (including toilets and rooms), normally from south to north.
- Evacuated rooms are marked with an “Evakuiert” tape section.
- Observe self-protection, do not enter smoke-filled corridors or rooms and tell the evacuation team about any such locations.
- Evacuation helpers do not have to wait until the laboratories are cleared. Discussions with colleagues should be avoided (loss of valuable time).
After the evacuation, the helpers hand over their plan to the incident commander wearing a yellow high-visibility vest in front of the northern building entrance, and report any important particularities. The incident evacuator is thereby informed about which floors have been evacuated and which have not and decides on the further procedure.

Evacuation helpers then await further instructions.

**The evacuation bag for evacuation helpers:**

The evacuation bags are placed in the specified emergency niches of each corresponding evacuation zone (sealed box).

- 1 shoulder bag
- 2 orange high-visibility vests
- 2 pairs of safety goggles
- 1 evacuation plan
- 2 whistles
- 1 roll of sticky tape „Gesperrt“ (barred)
- 1 roll of sticky tape „Evakuert“ (evacuated)
- 1 tape cutter

**Example of an evacuation zone** (a laminated plan is found in each evacuation bag):

![Example of an evacuation plan for HCI Finger 3, G floor]
4.3. Accidents with chemicals/spills - emergency cabinets

Every finger section HC1-HC5 has such an emergency cabinet, located in one of the side corridors on certain floors. Next to each cabinet there is a small box on the wall with the key to the cabinet behind a glass window, best broken with an object. Thus, every user of the HCI always has access to first aid equipment.

The basic content of the emergency cabinet:

- 2 gas masks; note:
  - These are unsuitable for people without experience or military training
  - Filter masks are not adequate for all gases/vapors
- Protective overalls
- Acid- and heat-resistant safety gloves
- First aid box with first-aid instructions
- Anti-hydrofluoric acid set, Hexafluorine-eye shower, and hydrofluoric acid-absorbent material
- Civil protection woolen blanket
- First aid blanket (foil)
- Various absorption materials for chemicals for spillage of any kind
- Liquid barrier
- Barricade tape
- Orange box containing Diphotérine eyewash and Diphotérine spray
- As required work group-specific material

The basic content in the emergency cabinets can be extended at will by the department-/institute safety representative.

Location of the emergency equipment cabinets:

- HC1: In the middle side corridor of the open-plan laboratory D118
- HC2: In the side corridor in front of D212
- HC3: In the side corridor in front of D312
- HC4: In the side corridor in front of H412
- HC4: In the side corridor in front of E412
- HC5: In the side corridor in front of F512

Bigger incidents: Chemical intervention team (CIT)

If the event cannot be safely managed by the laboratory personnel, the emergency desk must be alerted immediately. During the day they can call the chemical intervention team (or the fire brigade at night and on weekends).
4.4. Emergency niches in the corridors of the HCI building

The emergency niches are regularly distributed on all corridors throughout the HCI building. They contain two CO₂ handheld fire extinguishers, a hose-on-reel extinguisher (water), a fire blanket, fire sand, a body shower, an eye shower, a telephone (with emergency power), a fire alarm button, and a small first aid set. An expended or missing first aid set can be requisitioned via real estate service portal.

4.5. Fire-fighting equipment and fire safety training

Usually each laboratory is equipped with at least one CO₂ handheld fire extinguisher. The following recommendations should be followed when fighting a fire:

<table>
<thead>
<tr>
<th>Burning material</th>
<th>Fighting measures (things that are normally at hand are in bold)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid, glowing materials (wood, paper, textiles, coal, etc.)</td>
<td>Water, foam, maybe fire blanket</td>
</tr>
<tr>
<td>Liquid, non-glowing materials (solvents, petrol, oil, tar, paint, fat, paraffin etc.)</td>
<td>Powder, carbon dioxide (CO₂), maybe fire blanket (small fires). Contained fires: foam</td>
</tr>
<tr>
<td>Gases (after closing the vials)</td>
<td>Powder, carbon dioxide (CO₂)</td>
</tr>
<tr>
<td>Light metals and certain chemicals such as potassium, sodium, magnesium, phosphorus etc.</td>
<td>Sand, diatomaceous earth, special powder</td>
</tr>
<tr>
<td>Electrical systems (motors, transformers, laboratory equipment etc.)</td>
<td>Carbon dioxide (CO₂), powder</td>
</tr>
</tbody>
</table>

A handheld fire extinguisher must always be used starting at the edge of the fire and moving from the bottom to the top towards the source of the fire. An appropriate leaflet can be found on the website of the SSHE department.

Fire safety training:

On the website of the SSHE dpt. there is detailed information on the fire safety training. Registration for the fire safety training can also be done through the website of the SSHE dpt. www.sgu.ethz.ch. The fire safety training is offered once a year. New employees that have never taken a fire safety training must do so within their first employed year. The administration offices and safety officers must ensure this.
4.6. Emergency shutdowns

4.6.1. Main valve for cooling water for laboratory units or students’ laboratories

If the cooling water system leaks, either in a media column or in any equipment connected to a media column, the main valve for the cooling water network must be closed immediately. The main valve (indicated with a red dot) can generally be found inside a vertical duct in the corridor in front of the laboratory unit. In some special technical rooms, it may be located on the ceiling grid instead of the vertical duct (ask the technical staff). You can open the doors marked with a red dot with your HCI building key. Close the main valve for cooling water which is also marked with a red dot. Important: make sure all equipment and experiments connected to the cooling water in the affected laboratory unit are properly secured before turning the cooling water off!

4.6.2. Electrical main switch for laboratory units and students’ laboratories

May only be used in emergencies! Pushing the red button shuts down all electricity in the laboratory, including the media columns and the fume hoods. Without properly functioning fume hoods, the air ventilation system in the laboratory will fail, and the fume hoods will lose their protective function. Furthermore, turning the electricity off may lead to power surges and could seriously damage fume hood control electronics, equipment, and computers.

4.6.3. Natural gas main switch for laboratory units and students’ laboratories

Some laboratories are equipped with a natural gas supply network. The main switch can be found next to the laboratory exit. When not in use, or in case of emergencies, the main switch must be turned off, and the key removed. The supervising assistant or the group safety officer is responsible for the key. Important: If no gas is flowing even when the supply system is on, it is possible that other main valves are closed, which cannot be accessed by everyone. Contact the staff for the building area in such cases.
4.7. Periodic inspections of the safety infrastructure

The infrastructure’s safety equipment is regularly inspected for functionality and completeness by the facility management. Missing material, defects and faults must be reported to the D-CHAB hotline chab-safety@chem.ethz.ch or via the real estate services portal.

All safety officers and practical course assistants must also be aware of the following aspects:
- General labels, brochures on “how to act in an emergency” and safety manuals must always be kept up to date. Outdated material and handouts must be removed.
- Protection equipment for internal use in specific work groups must be inspected regularly for function and quality; Protective material must always be ready to use. Check the expiry date. If any material has exceeded its expiry date it must not be used anymore.
- Eye showers must be rinsed regularly (at least once a month) to prevent contamination and rotting.
- Hydrofluoric acid (HF) kits: The responsible safety officers and assistants are contacted periodically by the SSHE dpt. to replace expired HF-gels (calcium gluconate).

4.8. Power, ventilation, and other media supply outage “What now?”

Establishing an emergency plan:

Always expect a failure of the media supply for your systems and devices in the HCI building due to malfunction or another crisis.

Create an emergency plan for your systems and devices (usually derived from an existing malfunction risk assessment). When doing so, evaluate the possible threats and risks in your case if media supplies or ventilation suddenly fail. Assess how self-sustaining you are in case of a malfunction. Assess how you can defuse dangerous situations quickly by having means at hand that you can use to intervene without danger. Check whether the emergency plan indicates all accessible persons and contact interfaces who can act quickly and properly in case of a malfunction. Always keep your emergency plan up to date.

Supply shortages:

In case of a supply shortage, we are happy to help, contact us via our email hotline chab-safety@chem.ethz.ch.

Media supply outage:

Get an overview of the extent of the incident. Does the media supply outage of t only affect your work group or the entire building? Check your work group’s supply systems.

Our email hotline chab-safety@chem.ethz.ch usually immediately informs all HCI personnel if the media supply has broken down in the HCI.
4.8.1. Power outage/voltage dip

In case of a power outage or voltage dip, not only your systems or devices but also infrastructure systems like ventilation supply and cooling units may fail. Gas supply systems are usually not affected by this. Follow the instructions below in case of a power outage:

- Where necessary, keep a flashlight or emergency lighting at hand.
- A power outage is usually not an emergency. Therefore, do not inform the emergency desk unless there is an acute emergency.
- If there is a failure of ventilation in addition to the power outage, follow the instructions given in 4.8.3. If there is an additional failure in the cooling supply, follow the instructions given in scenario 4.8.5.
- Emergency plan: immediately secure or stop all experiments and reactions that have been started and may cause an issue due to the power outage or voltage dip.
- Secure all chemicals that may be dangerous.
- Switch off all systems and devices that may be dangerous when the power returns.
- Sensitive systems and devices should also be turned off since there may be voltage peaks while restoring power, which might damage these devices under certain circumstances.
- Leave refrigerators and freezers closed if possible. Several hours of power outage is not a problem for most of these devices as long as they stay closed.
- If you have a mobile phone with internet access and the battery has sufficient power, await further information from our email hotline.

4.8.2. Failure of argon or nitrogen gas supply

The argon and nitrogen gas supply are fed from liquified gas tanks in D374. Argon and nitrogen gas is led from the tank facility with pressure of 10 – 12 bar to the laboratories into the gas modules of the media columns or directly to your systems and devices. If you notice that the argon or nitrogen gas pressure collapses, get an overview of the extent of the gas supply failure. Has the gas supply only broken down in your work group or the entire building? Check your gas bottle station and your pressure regulators/gas modules. Follow the instructions below in case of a gas supply failure due to an incident:

- Shut down all systems and devices! Finish all measurements as long as this does not impose any risks. Close all gas-supply valves since restoring the argon or nitrogen supply may lead to unexpected overpressure (up to 20 bar).
- Reactions and experiments: finish and secure all reactions and experiments that rely on argon or nitrogen supply.
- Emergency plan: always be prepared to quench dangerous reactions or chemicals in case of an incident without any risks.
- Secure storage: if there is a safety risk from an argon or nitrogen supply failure for storage of pyrophoric or decomposition-sensitive chemicals, samples, and research specimens, place them in gas-tight compartments with inert gas (e.g. desiccator) or available gloveboxes.
- Emergency situation: in case of an acute emergency situation, alert 888 or 044 342 11 88, respectively.
Particular considerations for operators of gloveboxes:

- Check regularly that the gloveboxes are as airtight as possible (gloves, O-rings, valves), conduct standard leakage tests regularly (c.f. user manual of the glovebox). In addition, always check the airtightness of the front chamber/air lock.
- Identify the most dangerous chemicals stored in the gloveboxes and regularly check their containers for airtightness. Increase safety by always adding an additional seal to the containers; if possible, place them in gas-tight packaging. Dispose of chemicals no longer needed. Minimize the quantity of stored dangerous chemicals; combine them in a gas-tight box but only if safely possible.
- Please always clearly define a responsible for the gloveboxes and chemicals (define multiple substitutes!). Ensure that they can act quickly if the argon or nitrogen supply fails due to an incident. In case of an emergency the responsible person (including a knowledgeable second person) should immediately deactivate/neutralize the dangerous chemicals or temporarily store them in gas-tight containers (airlock), which can be closed from inside of the glovebox. Please consider that the airlocks of a glovebox are not necessarily completely gas-tight compartments! In general, the oxygen and moisture penetrate into these compartments less than into the glovebox, so that chemicals can be stored there temporarily. Even in the case of failing ventilation in the building, only small amounts of volatile toxic by-products would reach the outside. Gastight airlocks would also minimize the danger of spontaneous combustion of known chemicals.
- Emergency plan: when operating gloveboxes, always be prepared for an incident so that you can act in an emergency. Also always be prepared to quench dangerous chemicals without any risks.

4.8.3. Failure of building ventilation

The system for fresh air supply depends on the exhaust air system and vice versa. If the exhaust air system fails, the system for fresh air supply has to shut down automatically. If the exhaust air system operates at reduced capacity for some reason, the system for fresh air supply adapts accordingly. If the system for fresh air supply fails, the exhaust air system will operate with reduced capacity.

System for fresh air supply fails, exhaust air system still operational (reduced):

In case the fresh air supply system fails, the exhaust air system normally operates with reduced capacity (which leads to an increased but not dangerous negative pressure in the laboratories). This means that all installation for exhaust air will continue to operate at reduced capacity.

Follow the instruction below in case the fresh air supply system fails:

- Lower the sash window on all fume hoods. Reactions that pose no special risks or hazards can continue.
- Due to the reduced exhaust air, avoid working in the fume hood with open sash window.
- Never open the balcony doors (except in case of an emergency as escape route)!

Entire air supply or exhaust air system fails:

- In case ventilation system or exhaust air system fails, there is no exhaust air at all. The fume hoods can no longer fulfill their protective function. Follow the instruction below in this situation:
- The failure of the air system does not necessitate an evacuation of the building.
- Finish and secure all reactions and experiments, lower the sash window of all fume hoods.
- Emergency plan: always be prepared to quench dangerous reactions and chemicals without any risks.
- It is not possible to avoid odor emissions during an air supply failure from the pharmaceutical, chemical and safety cabinet as well as fridges, fume hoods, and disposal tanks. Close all containers for chemicals and waste as long as there is no overpressure hazard.
- Note that there is no more exhaust air and air circulation for gas supply or for storing and processing liquid gases and dry ice in the rooms. On the one hand, carbon dioxide can be harmful to health already starting at 1% and on the other hand the oxygen content of the room atmosphere can be lowered due to the increased gas consumption. Please take the necessary safety measures immediately!
- Leave the laboratories if you notice odor emissions. Never open the balcony doors (except as an emergency escape route).
- After rectifying the disruption, the exhaust air supply is put back into operation (= consequently causing an increased negative pressure in the room) and, subsequently, the fresh air supply. You must expect sudden ventilation problems even after the ventilation systems have started up again.

4.8.4. Failure of the laboratory cooling water supply

The laboratory cooling water runs in pipes with the identification marking SAN61/62 on the ceiling grid.

- Shut down all laboratory cooling water-dependent systems and devices, provided that there are no special risks.
- Chemical reactions and experiments: stop and secure all reactions and experiments that rely on cooling water supply.
- Emergency plan: always be prepared to quench dangerous reactions or chemicals in the event of an accident at any time without any risk.
- Air-cooled chillers: if the cooling water operation absolutely must be maintained, bypass the cooling water supply with a chiller locally. Clarify where an air-cooled chiller would be available in an emergency.

4.8.5. Failure of the technical cooling supply

The technical cooling runs in pipes identified with the identification markings KAE 61, 62, 63 or 64 on the ceiling grid.

This cooling supply (= cold water supply) is not related to the laboratory cooling water supply. If the cooling supply fails, the laboratory cooling water supply is therefore not affected. An outage of the technical cooling supply hits the working and incubation rooms, the compact cooling units, the air-cooling units, the ice machines, and many other larger systems/machines with high waste heat which are all directly connected to the cooling supply. If it fails, the waste heat can no longer be dissipated in the listed systems and machines mentioned. This usually results in an overheating of the room, or the above-mentioned systems and machines malfunction and fail. What should be done if this scenario occurs?

- Rooms D486 and D305 (= central rooms of -80 °C freezers) are equipped with emergency cooling systems. No measures are necessary there in the event of an incident.
- Emergency plan: always be prepared to shut down systems and machines that are dependent on technical cooling supply in case of an incident without any risks.
- If the technical cooling supply must be maintained for imperative reasons, bypass the cooling supply locally with running drinking water. To do this, contact the building staff.
- Emergency: in case of an acute emergency situation, alert 888 or 044 342 11 88, respectively.
5. Laboratory and building operation regulations for the HCI

5.1. Personal protective equipment

Your personal protection and the protection of the environment depends largely on the proper handling of hazardous materials, proper implementation of work processes, as well as on order, cleanliness at the workplace, personal hygiene and use of the HCI internal recycling system.

Never carry out potentially hazardous work when you are alone in the laboratory. Make sure there is a second competent person present that can help in case of an accident.

Use of appropriate work clothing, single use gloves, plastic foils and suitable skin care lotions increases the skin’s protection against irritations and eczema.

5.1.1. Safety goggles

Safety goggles can be obtained from the HCI-Shop where the staff can help you find the best safety goggles for your specific needs. When working in a chemistry laboratory, glasses with side protection must always be worn. When working on something that is particularly dangerous for the eyes, goggles which are closed all around or a full-face shield must be worn. People who wear glasses and are employed by ETH can ask the SSHE dpt. for corrected safety glasses.

5.1.2. Contact Lenses

Contact lenses are forbidden while working with chemicals and biological material even when safety goggles are worn. Experience shows that eye injuries from splashes of dangerous liquids are particularly serious when contact lenses are used.

**Chemical labs: Attention!**

**Not appropriate!**

- Without safety goggles!
- With ill-fitting goggles and open gaps!

**Reminder:** contact lenses are forbidden in chemical laboratories, reading glasses are not safety goggles.

**Sufficient protection!**

We are happy to help! Contact: Safety officers, assistants, HCI-Shop

SU Management D-CAM/PM Jan. 2015
5.1.3. Laboratory coats

Proper protective clothing must always be worn inside a laboratory. For normal laboratory work, this means a sufficiently long laboratory coat with long sleeves made of non-melting material such as cotton, or better yet, a mixture of polyester and cotton. This holds for private clothing underneath the coat as well. Footwear must be firm and closed. Modules on the media columns, or dosage valves and gas governors must not be misused as coat hooks!

The laboratory coat must not be worn in seminar rooms, libraries, lecture halls, cafeterias, etc. In general: Public access area (e.g. HCI-Shop, cafeteria, toilets etc.) must not be entered while wearing work clothes or carrying laboratory items – no matter whether they are clean or contaminated. In principal, disposable gloves have to be discarded before leaving a workplace, even if they are not contaminated.

Laboratory coats are to be washed regularly. A laundry service is on offer at the ETH for this. However, work groups must register for this laundry service.

5.1.4. Classification of gloves

The producers of personal protective equipment (PPE) divide their products into three categories. They show what the protective equipment can handle, in our case gloves. The greater the hazard, the higher the demand on the glove. Safety gloves must also carry the CE badge. With this the producer confirms that their goods comply with the basic safety and health regulations of the EU. A first clue as to which glove is adequate for which chemicals and microorganisms can be found in the respective safety data sheet.

<table>
<thead>
<tr>
<th>Safety category</th>
<th>Protective effect</th>
<th>Possible applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category I</td>
<td>Minimal risk protection</td>
<td>Cleaning with mild detergents and short contact with water, repair works, garden work, handling objects up to 50 °C</td>
</tr>
<tr>
<td>Category II</td>
<td>Medium risk protection</td>
<td>All activities not within categories I or III</td>
</tr>
<tr>
<td>Category III</td>
<td>High risk protection (irreversible damage and lethal dangers)</td>
<td>Dealing with chemicals, electricity, or elevated temperatures above 100 °C</td>
</tr>
</tbody>
</table>
The **pictograms** on the gloves’ packaging indicate the risks the gloves protect against and that they fulfil the minimum requirements of the respective norms. If a glove fulfills several norms, all pictograms must be shown.

**European norms:**
- EN ISO 374-1 = norm for chemical safety gloves
- EN ISO 374-5 = norm for safety gloves to protect against dangerous microorganisms

### Table: Pictograms and their meanings

<table>
<thead>
<tr>
<th>Piktogramm</th>
<th>Leistungseinstufung</th>
<th>Beschreibung</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN ISO 374-1:2016/Type B</td>
<td>Typ B</td>
<td>Minimale Durchbruchzeit von mindestens 3 Referenz-Chemikalien &gt;30 min.</td>
</tr>
<tr>
<td>EN ISO 374-1:2016/Type C</td>
<td>Typ C</td>
<td>Minimale Durchbruchzeit von 1 Referenz-Chemikalie &gt;10 min.</td>
</tr>
</tbody>
</table>

| Kein offizielles Piktogramm | Level 1 | AOL of 4,0 |
|                            | Level 2 | AOL of 1,5 |
|                            | Level 3 | AOL of 0,65 |

| Kein offizielles Piktogramm | Level 1 | >10 min |
|                            | Level 2 | >30 min |
|                            | Level 3 | >60 min |
|                            | Level 4 | >120 min |
|                            | Level 5 | >240 min |
|                            | Level 6 | >480 min |

| Kein offizielles Piktogramm | Keine Leistungseinstufung |

<table>
<thead>
<tr>
<th>EN ISO 374-3:2016</th>
<th>Minimum AOL of 1,5</th>
</tr>
</thead>
</table>

| EN ISO 374-5:2016 | Schutz vor Bakterien und Pilzen |


*Plaque-Forming Unit*
So-called Glove Chemical Resistance Charts on websites of manufacturers/specialist retailers can help you find the appropriate glove type. For example, according to this table, butyl gloves are best suited for working or cleaning with acetone, while nitrile gloves are to be avoided.
Single-use gloves (vinyl, nitrile, butyl etc.) only offer short-term splash protection when contaminated. They should basically be taken off and disposed of immediately at the end of a work cycle, when external wetting with a hazardous substance is detected or the glove is damaged. The permeation effects of the chemical start at first contact, wiping or rinsing the gloves does not fully stop the danger.

Because of potential allergies, latex gloves should basically not be used anymore.

Never leave the laboratory to walk around in the building with gloves (even if they are not contaminated or you are only wearing one of them)!

Anyone wearing gloves will not receive service by the service sectors!

5.2. Hazard, risk analysis and environmental compatibility

5.2.1. Risk assessment: mandatory before each new experiment!

The safety lecture describes the method for setting up the risk analysis in detail (see section safety lecture on the SE management’s website). The goal of the risk assessment is to correctly estimate the hazards and risks of not only chemicals but of the entire experimental procedure, the used material, and devices. Further goals are understanding reaction mechanisms, material compatibilities, choosing the correct methods and tools (after testing possibly less risky alternatives) as well as preparation for possible incidences. The risk analysis is the best reason for investing in additionally necessary safety measures or for acquiring alternative safer technologies. Pay attention to legal requirements and check whether experiments may need to be authorized. Also pay attention to environmental compatibility as well as a reasonable energy consumption when performing an experiment or running machines.

Note: The smaller the batch size in an experiment, the smaller the risk and energy consumption and the smaller the impact of an incident on the environment!

In the following diagram the risk potentials are shown first without risk assessment or safety recommendations and then after implementation of all safety measures. A risk assessment’s objective is to minimize the major risks in area 1 (red) by implementing safety recommendations. Completely going from area 2 (yellow) to area 3 (blue) would possibly afford disproportionate and unjustifiable financial investment. Any potential residual risk has to be documented.
Machines, systems, and all other technical equipment can be dangerous for human beings as well. They often pose a direct or indirect danger not only for the operators but also for the maintenance staff or uninvolved people. The level of risk depends on the type and function of the machine or system as well as the behavior of the person. Machines or systems are usually controlled with the help of electrical or electronic systems. These systems are ultimately responsible for ensuring that people are not endangered. Therefore, there are certain requirements for such systems, which result from the risk they pose to anyone involved. With the help of a hazard analysis, the level of danger a machine or system may cause can be classified, risk graphs help to assess the risk. From the risk graph the performance level can be derived. The classification of the PL-value ranges from a (minor contribution to risk reduction) to e (major contribution to risk reduction). Additional information on the topic can be found on SUVA’s website; link: www.suva.ch.

**Safety begins with you!**

**The SLAM-Risk Assessment = Stop – Look – Analyze – Measures**

**Stop**

**Look**

**Analyze**

**Measures**

**Checklist for preparation of risk assessment**

**Chemicals/substances:**

- Study the material safety data sheets (MSDS) of substances and chemicals. The safety data sheets of chemicals can be found online.
  
  Link: www.msds.com (requires registration)

  The safety data sheets contain all information concerning the characteristics of the substance, dangers and risks, environmental impact, recommended safety equipment, and advice for disposal and storage.

- Always pay attention to instructions and pictograms on the labels of chemicals, as well as the GHS H/P codes (danger and safety notes).

- Determining dangers of reactions, decomposition and biologically active compounds requires a specific literature search, e.g. in the faculty libraries of the ETH; Link: www.infozentrum.ethz.ch

- Reference books on all safety and environmental topics can be bought for example from the website www.reaxys.com or from ELSEVIER science & technology books. In general, a thorough literature search is also possible via various websites, e.g.:

  - Reaxys: www.reaxys.com
  - Wiley Online Library: www.onlinelibrary.wiley.com
Ensure that you are using the appropriate infrastructure for performing the experiment (appropriate/prescribed premises, ventilating systems, fume hoods etc.). Certain experiments may only be conducted in specific, approved laboratories (e.g. the high-pressure laboratory when using synthesis/reaction equipment at pressures >10 bar, the toxlab when working with highly toxic or foul-smelling chemicals, the isotope laboratory when radioactive substances exceeding the exemption limit are used, the biosafety laboratory when working with microorganisms and genetically modified materials, etc.).

Systems and equipment:

- Check whether proper equipment for the experiment is available. Only laboratory tested and certified equipment may be used. It is forbidden to use modified leisure or household equipment for laboratory experiments.
- The instruction manuals and safety instructions of the manufacturers/suppliers must be taken note of and strictly followed.
- When using home-made or converted facilities and equipment legal requirements must also be respected and risks appropriately labelled.
- Facilities and equipment that pose a particularly high risk may only be installed and used in suitable rooms. Such laboratories or areas must be equipped with warning signs and emergency instructions. Access must be refused to unauthorized and untrained cleaning and service staff.
- Outdated systems or equipment with excessive energy consumption should be replaced within a reasonable timeframe with more modern and secure systems or be completely discarded.

Legal requirements/responsible authorities:

- Check whether official authorization is needed or whether legal requirements must be met for conducting the experiments or operating a system or device. See chapter 11 for responsible authorities. Requesting authorization must be done via the SSHE division.
- Workplace threshold limit values must always be respected! On the SUVA website www.suva.ch you can find data for the current threshold limit values at the workplace.

Providing protective equipment and intervention material/measures in the event of an incident:

- Ensure that provisions have been made for the case of an incident (available protective equipment, extinguishing agents and/or other incident-fighting measures, first aid kits, disinfecting/decontamination media, emergency shutdown, an informed second person, etc.).

Flow of information:

- Secure the flow of information: declare (to all those responsible for safety) who is working when and where with which hazardous materials.

Right of access/regulations:

- Define and respect the regulations and right of access for the laboratories with special experiments or with special facilities and equipment in operation. Laboratories marked with special warning signs may only be entered by a knowledgeable person.

5.2.2. The accident risk assessment

Establish an accident risk assessment of your systems and devices. Evaluate which dangers and risks might be involved when the media supply fails. Evaluate which measures and technical investments could minimize the accident risk. The easiest way to protect equipment/systems from power outages or voltage sags (can contain undervoltage, overvoltage, frequency changes) is to use an uninterruptible power supply (UPS). UPS systems work like a filter and can protect equipment/systems from voltage variations and short-term power outages of any kind but not usually from any longer power outage (autonomy time). UPS systems must be serviced and maintained. Another option is installing an appropriate overvoltage protection to protect equipment from increased voltage. With the incident risk assessment, you can apply for emergency power supply and alarm systems which would then become active in the event of an incident via the ETH real estate services.
5.3. Preventing fire incidents

5.3.1. Properties of alkali metals

Reaction properties of alkali metals:

Please note: Lithium (depending on the surface properties) can even react under nitrogen at room temperature. The reaction proceeds very slowly but can accelerate itself. The reaction produces lithium nitride. Because of this, lithium may only be handled under argon atmosphere.

Please note: Alkali metals and their hydrides might ignite spontaneously upon contact with air or water!!!

5.3.2. Disposal/destruction of self-igniting chemicals

If you want to destroy residual chemicals or have to because they cannot be stored or transported, please verify in advance how dangerous they are. Otherwise, put them in an appropriate container (if needed, under inert gas) and bring them to the central waste management HCI D276, label the contents and include a sender’s address. You must register and arrange an appointment by phone or email beforehand.

5.3.3. Cleaning glassware contaminated with residual self-igniting chemicals

Glass/instrument parts contaminated with spontaneously igniting chemicals require immediate special treatment with great caution. Most small fires are caused by cleaning glass and instrument parts that were contaminated with self-igniting chemicals. Such chemicals often spontaneously and surprisingly ignite in the sink or in waste disposal containers. Keep in mind that great quantities of highly flammable solvents are always in close proximity, especially in synthesis laboratories!
5.3.4. **Hydrogenation with balloons filled with hydrogen gas**

Safety rules must be followed strictly not only when handling hydrogen gas, but also when using certain catalysts. For example, after hydrogenation with 20% palladium as a catalyst on carbon, further processing the product poses a very high risk of fire! Always work under inert gas atmosphere and plan each processing step in advance!

![Diagram of balloon filled with H₂ attached to a syringe, placed on the flask by piercing through the rubber septum.](image)

In the situation depicted in the figure on the left there is a high risk of ignition, for example upon removal of the septum together with the hydrogen-filled balloon. At this point air enters the flask where the palladium-catalyzed hydrogenation was carried out. To minimize the risk of ignition, at least for this kind of hydrogenation, three-way valves have to be used (see figure below) so that any residual hydrogen in the flask contents can be removed completely and without air entering by alternately applying vacuum and inert gas.

![Diagram of removing hydrogen gas from flask contents, alternating vacuum and inert gas.](image)

Removing the hydrogen gas from the flask contents, alternating vacuum and inert gas:

![Diagram of filtration under inert gas with a column.](image)

There is also a high risk of ignition if the content of the flask is filtered when air is suddenly admitted after hydrogenation with a palladium catalyst. The filtration has to be carried out under inert gas atmosphere here as well after thoroughly rinsing out the hydrogen gas.

<table>
<thead>
<tr>
<th>Filtration with admission of air</th>
<th>Filtration under inert gas with a column</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram of filtration with admission of air." /></td>
<td><img src="image" alt="Diagram of filtration under inert gas with a column." /></td>
</tr>
</tbody>
</table>

- Hypodermic needle
- Argon or nitrogen
- Column
5.3.5. Distillation apparatus containing alkali metals or alkali metal hydrides

Many solvent distillation apparatuses contain alkali metals or alkali metal hydrides as drying agents in the solvent to be distilled. The main hazard in these distillation systems is the complete evaporation of the solvent due to unexpected failure of the cooling water flow, or spontaneous breaking of a glass cooler. Therefore, a metal cooler must be used for such distillation systems and a cooling water flow switch that turns off the system when the cooling water flow is interrupted. Furthermore, these solvent distilleries must be under constant supervision.

Please note: dry solvents of a similar quality to what is obtained from alkali metal distilleries, can be obtained without danger in the toxlab D312, see chapter 10.1.3. You should not run additional distillation apparatuses in the laboratory for solvents that can be obtained from the central drying facility.

5.3.6. Bunsen burner with or without gas cartridges

Another potential danger in the laboratory that should never be underestimated is the use of mobile Bunsen burners with gas cartridges. Bunsen burners generally should not be used near flammable materials and solvents.

Bunsen burners with gas cartridges may only be stored in ventilated cabinets, well separated from flammable and corrosive chemicals. The empty gas cartridges may only be stored in ventilated safe containers until they are disposed of.

5.3.7. Use of hot air blowers/heat guns

Just like Bunsen burners, hot air blowers are another potential source of ignition. When using hot air blowers, increased risks occur when

- Attempting to loosen stuck glass fittings
- Drying glassware after rinsing with solvent (usually acetone)
- Drying substances with unknown thermal properties
- Using them in close proximity to flammable materials and solvents.
5.3.8. Danger of electrostatic discharges

Electrostatic discharges (ESD) are sparks caused by a very large potential difference over an electrically insulating material, which causes a short, very strong, electrical current pulse. The main cause of the potential difference is usually an accumulation of static electricity through friction.

In a laboratory, the following can cause electrostatic discharges:

- Transferring powders
- Stirring or decanting liquids
- Discharging compressed gases
- Whirling powdered chemicals
- Movement of people wearing insulating clothing (synthetic fiber, plastic or rubber shoe soles)
- Walking on non-conductive plastic floors or working on plastic table coverings
- Handling chemical containers and equipment made of plastic or glass, though glass is somewhat less prone to charging.

Although electrostatic discharges through the body usually only cause a startled reaction, they may cause a fire in fire-risk areas. This applies to handling flammable liquids or gases.

The following objects may discharge and cause sparks:

- Metal bottles discharging on plastic or glass pipes over an approaching person
- Electrically insulated people (rubber soles!) discharging on grounded objects (door latch, water tap, heater, containers, equipment)

Electrostatic discharges are to be handled by consistent grounding and using appropriate materials, such as conductive plastics that do not allow high charge accumulation but instead lead it away before it builds up to a dangerous amount.

The following precautions must be followed during laboratory work to prevent the generation of static electricity:

- In general: use conductive parts and ground them.
- Transfer larger quantities of powder or highly flammable chemicals only into grounded containers (but do not attach the ground contact right at the filling nozzle)
- Use closed installations and piping systems
- Use inert gas (usually nitrogen) to pneumatically pump highly flammable liquids and render the apparatuses inert.
- Avoid splashing of solvents and the formation of dust clouds. Use funnels with long nozzles.
- Metal funnels must be grounded. Ungrounded metal funnels should not be used with glass or plastic containers, and glass or plastic funnels should not be used with ungrounded metal containers (risk of spark formation).
- Ground metal parts on insulating equipment.

Fig.: unsuitable clothes, shoes and plastic gloves promote electrostatic discharges; symbol for an ESD protection component and hazard symbol
5.4. Preventing odor emissions

5.4.1. Preventing odor emissions from chemical reactions

In principal, dangerous emissions of all kinds must be eliminated or reduced as much as possible (or at least their consequences) with special jigs. Especially when injecting gases into liquids, jigs must be installed to prevent the liquid from flowing back into the gas line or the supply vessel, in case the pressure drops (see figure below). All gas injection equipment must have a pressure-less outlet opening directly into the laboratory exhaust system with an exhaust gas line. An intermediary bubble counter additionally allows the control of gas absorption in the reaction.

The escape of large quantities of not fully reacted, toxic, smelly, corrosive gases and vapors into the exhaust system is forbidden. These gases can be absorbed by an appropriate reaction media (e.g. phosgene is absorbed in dilute sodium hydroxide).

Further safety measures:

- Before working with smelly and/or toxic chemicals, please acquaint yourself well with their risks.

- Experiments with foul-smelling or toxic chemicals must be carried out in special laboratories, such as the toxlab D312. Consult your safety representative beforehand. You must register on the website www.toxlab.ethz.ch.
5.4.2. Preventing odor emissions from dried out siphons

Depending on the biological condition of the wastewater, smelly (and possibly poisonous) gases and vapor might evolve in the wastewater tank. Due to the prevailing negative pressure in the building, such gas and vapor in the chemical wastewater tank might be sucked into the laboratories via dried out siphons and cause odor emissions. Most laboratories have three of these siphons whose wastewater is led to the chemical wastewater tanks. The first one is the sink, the second one the drain on the floor, and the third one the siphon about 2 m height in the entrance area of the laboratory (see image on the right). More siphons may be hidden from view in the vertical service ducts, in small corner spaces or located under or behind machines and cabinets. If something is unclear, contact your in-house technician. In biolabs no open floor drains are allowed. Please contact the in-house technician to seal your drains.

Please note: The siphon which is at a height of about 2 m in the laboratory entrance has been closed off of and disconnected from the waste water drainage in the vertical ducts in all laboratories of the HCI, but they have not been removed (except where air conditioning units, flow hoods, dehumidifiers, etc. are installed that drain condensation water). NEVER rinse disconnected siphons such as these with water or other preservative fluids. For further information, contact an in-house technician.

Countermeasures for dried out siphons which produce bad smells:

- Siphon underneath floor drain: Preserve these drains with technical glycerol (use approximately 1.5 liters/siphon) once a year but check whether there is some glycerol left every 3-4 months. Glycerol does not dry out over a long time and mostly keeps back vapor and gases from the chemical wastewater tanks. The glycerol for siphon preservation can be obtained at the HCI-Shop. Each working group is responsible for preserving unneeded siphons.
- Siphons in use: These cannot be preserved with glycerol. We recommend that they are regularly rinsed with water.

5.4.3. Behavior in case of odor emissions

In case of an odor emission which does not originate from a dried-out siphon, alert your safety officer, or call the emergency desk (888) in an emergency. After alerting, try to find the source of the smell (make sure to protect yourself) and record your findings. In severe cases of odor emissions, the affected laboratory or part of the building will be evacuated. Never ventilate the laboratory by opening balcony and laboratory doors. This would transfer the smell into the interior of the building, thus endangering other building users. Note: Odor emissions can also be caused from outside the building (agriculture, barbecue, construction).
5.5. Handling pressurized gas cylinders

5.5.1. General information

Before purchasing compressed gas cylinders, clarify to what extent and in what quantities combustible or toxic gases must be processed and whether a better alternative is available. It is important to prevent work groups from accumulating unnecessary amounts of gas cylinders or using unnecessarily large, steel compressed gas cylinders. The gas cylinder supply office generally does not supply 50 L-pressurized gas cylinders with hazardous gas content. The SSHE dpt. may grant an exception, after an application with sufficiently good reasoning has been submitted. Also observe the gas guidelines for the use of gas cylinders and networks found on the SSHE website.

5.5.2. Storage and operation of compressed gas cylinders

Pressurized gas cylinders with non-hazardous contents can be used in the laboratory, but they must be secured with a chain to a gas cylinder holder to prevent them from falling. If the total volume of all gas cylinders in one room amounts to 200 liters or more, they have to be stored in safety cabinets, irrespective of which kind of gas is stored (VKF fire protection regulations; VFK = Vereinigung kantonaler Feuerversicherungen = union of cantonal fire insurance). In the case of gas cylinders with ≥ 20 L of flammable contents or pressurized gas cylinders containing at least 2 liters of dangerous substances, a risk assessment (the kind of gas, ventilation and size/volume of the room) must be made to evaluate whether the cylinders have to be stored in a safety cabinet (permit from the SSHE dpt. must be present). Gas cylinders no longer in use must be returned to the producer. Collecting or storing old obsolete gas cylinders is not permitted. Oxidizing and flammable gases must be stored separately, if needed in 2 safety cabinets. Empty bottles are to be treated as full and stored in the same manner.
5.5.3. Labels on compressed gas cylinders

(1) Risk and safety phrases
(2) Warning labels
(3) Composition of the gas/gas mixture
(4) Suppliers product description
(5) EEC-number for unique materials or the words „gas mixture“
(6) Complete designation of the gas according to GGVS
(7) Supplier comments
(8) Name, address and telephone number of the supplier

Color coding of compressed gas cylinders old – new (note: if there is still a gas cylinder with the older color coding please contact SSHE).

<table>
<thead>
<tr>
<th>Old</th>
<th>New</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylene</td>
<td>Acetylene</td>
<td>Properties</td>
</tr>
<tr>
<td>yellow</td>
<td>orange</td>
<td>Acetylene is a colorless combustible gas with a slightly ethereal, sweet odor.</td>
</tr>
<tr>
<td>Oxygen, techn.</td>
<td>Oxygen, techn.</td>
<td>Properties</td>
</tr>
<tr>
<td>blue</td>
<td>white</td>
<td>Oxygen is a colorless, odorless gas. Air contains 20.95 vol.% of oxygen. Even at a slightly higher percentage of oxygen, combustion reactions proceed faster than in air. All parts in contact with oxygen must therefore be free from oil, grease or lubricants.</td>
</tr>
<tr>
<td>Argon</td>
<td>Argon</td>
<td>Properties</td>
</tr>
<tr>
<td>brown and green</td>
<td>emerald green</td>
<td>Argon is a colorless and odorless inert gas that is contained in the air at 0.93 vol.%. Argon is non-flammable and nontoxic.</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Nitrogen</td>
<td>Properties</td>
</tr>
<tr>
<td>green</td>
<td>black</td>
<td>Nitrogen is a colorless and odorless gas that is contained in air at 78.09 vol.%. Nitrogen is non-flammable and nontoxic and behaves as an inert gas towards most substances.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Properties</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Helium</td>
<td>Helium</td>
<td>Helium is a colorless and odorless gas that is contained in the air at 0.00052 vol.-%. Helium is non-flammable and nontoxic.</td>
</tr>
<tr>
<td>yellow and green</td>
<td>olive brown</td>
<td></td>
</tr>
<tr>
<td>Hydrogen</td>
<td>Hydrogen</td>
<td>Hydrogen is a colorless, odorless gas that is much lighter than air. Hydrogen is not toxic, but it is flammable.</td>
</tr>
<tr>
<td>red</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Carbon dioxide</td>
<td>Carbon dioxide is a colorless, non-flammable, odorless and tasteless gas. Carbon dioxide is about a 0.03 vol. % natural constituent of our atmosphere.</td>
</tr>
<tr>
<td>black</td>
<td>grey</td>
<td></td>
</tr>
</tbody>
</table>

Color coding of compressed gas cylinders, general rules:
- **Yellow (toxic or corrosive)** - ammonia, chlorine, arsenic, fluoride, carbon monoxide, nitrogen oxide, sulfur dioxide
- **Red (flammable)** - hydrogen, methane, ethylene, forming gas, nitrogen/hydrogen mixture
- **Light blue (oxidizing)** - Oxygen, nitrous oxide mixtures (except medical inhalation mixtures)
- **Bright green (inert)** - krypton, xenon, neon, technical grade of compressed air

5.5.4. Transporting compressed gas cylinders

For transportation to the operation site, set the cap on the cylinder and chain it to a gas cylinder transport trolley! If the bottle valve is already flange-mounted, large lever forces can be exerted if it tips over or hits something, with the risk of serious dangers. Transportation with an attached valve is therefore forbidden! Compressed gas cylinders must only be transported with the freight elevator, never the normal one.

5.5.5. Reducing valves

**Connecting a reducing valve**: Pressure reducing valves must always be kept in perfect condition. Take a good look at the valve. Pay careful attention to the following things: Unlike other gases, flammable gases have a left-handed thread. Does the valve match the type of gas? Does the valve have an intact seal at the connection flange? The seal must be smooth and even. You must also ensure that the valve is closed! Whoever flanges the valve is also responsible for verifying the leak tightness! If the connection cannot be sealed properly, or if the valve turns out to be defective, it must not remain flanged to the bottle!

**Reducing valves - maintenance and upkeep/passivation regulations**: Special regulations exist for the maintenance of reducing valves for each specific gas. In the case of reducing valves for hazardous gases, the manufacturer's instructions must be strictly observed before use (e.g. passivation regulations). Passivation means the production of inert surfaces on typically reactive metals. The state of inertness achieved by passivation is called passivity. It occurs in many of the base metals, i.e. normally mildly reactive metals. Passivation is caused by the fact that an impervious layer for potential reactants develops on the surface of the metal.

**Unscrewing a reducing valve**: Before removal, make sure that the cylinder valve is closed. Under certain circumstances, cylinder valves with corrosive gases must be rinsed with nitrogen gas, as required by the manufacturer. Then unscrew the cylinder valve. Do not forget to screw the cap back onto the threaded coupling and the large steel cap on the pressure cylinder.
5.6. Protection against over-pressure in apparatuses

Several accidents in HCl, which nearly ended in worst-case scenarios, were caused by over-pressure in gas pipes or as a result of pressure accumulation in various apparatuses. Therefore, we strongly recommend the use of safety valves for all hazardous and pressure-delicate apparatuses. In particular, we recommend the safety valves from “Lorch” that are available in different variations; link: www.lorch.de/ under the section “Safety Valves”.

Among other things, the safety valve can be installed easily on Lüdi-fittings. On example is the safety valve type 2108 for neutral gases and vapors which starts operating at 0.3 bar over-pressure. Applications: Over-pressure protection of gas pipes in flash-chromatography-columns, over-pressure protection of gas pipes in distillation using alkali metals, over-pressure protection in case the gas modules or the gas amount regulator in the media column fails etc. The safety valve should not be used where vacuum is applied, as is done e.g. with a Schlenk line.

Fig.: The Lorch safety valve and the matching Lüdi-fittings can be obtained from the HCI-Shop.

Another option are over-pressure valves from “Stutz” (see Fig. below) which are also available in different variations from laboratory specialist shops. However, we do not recommend the use of the valve-type in which the critical pressure threshold has to be set manually at one’s own discretion. Sadly, the appropriate setting of the critical pressure threshold has been misjudged and thereby led to actual accidents. Hence, we suggest only buying and using product versions from the manufacturer with a pre-set and calibrated over-pressure protection point.

Rupture disk ( predetermined breaking point as over-pressure protection): Chemical reactions under pressure require apparatuses with a high safety level. Rupture disks are often used when pressure reactors are connected to a blow-off tank.

See chapter 10.3. regarding the use of services of the high-pressure laboratory.
5.7. At the end of the workday

Reactions and equipment with a low safety risk that need to stay in operation overnight (if possible, with safety drip pan; heating only with a contact thermometer or regulators), must be labelled with a sign for overnight experiments (see chapter 10.8.). The night work sign must be attached clearly visible on the fume hood window or placed close to the experiment or equipment. Equipment in continuous operation must be labelled with the phone number of the person responsible and with information on correct behavior in case of an emergency.

The staff must ensure a final inspection in the laboratory after work, and make sure that all equipment without an overnight experiments sign is turned off, all chemicals are stored safely, all valves for gases and liquids on the media columns and on gas cylinders are closed, and that all equipment or reaction apparatuses running with an overnight experiments sign are working properly. During the check, pay special attention to whether both stills with alkali metals in the distillation residue and the main natural gas switch are turned off.

5.8. Work during the night or an weekends and holidays

A permit from the head of the work group is required for interns and apprentices to work before 8 am or after 7 pm. For master’s theses working before 8 am or after 7 pm is allowed, though the supervisor is responsible for safety.

All other employees are required to have a second qualified person present whenever they work with chemicals or glass equipment on holidays or between 7 pm and 8 am. These two people are responsible for each other and their safe working procedure. Planned night, weekend and holiday-work with chemicals or glass equipment must be announced early to the group safety officer.
6. The HCI building and technical infrastructure

6.1. The HCI building

Users of the HCI (brief overview):
- Sector HC1 – HC3: Practical courses
- Sector HC4 – HC5: Practical courses and research
- The Fingers: Research

The sectors of the HCI include:
- Chemistry
- Physics
- Biology
- Materials science/process engineering
- Pharmacy
- Radiochemistry/radio pharmacy

The highest risk potential in the HCI building is due to…

Chemistry!
6.2. Opening hours and access system

Info + Service Center (ISC) – Location and opening hours

Location:
ISC Hönggerberg
Building HIL, room D 25.1
Tel.: +41 44 633 33 00
E-mail: gmh_isc@ba.ethz.ch

Opening hours:
Monday - Friday 7:30 am – 5 pm

Electronic access system for the HCI building:
Outside regular opening hours, the HCI building can only be accessed with the personal ETH card and a 6-digit PIN code. More information can be found at www.eth-karte.ethz.ch

Basically, all doors are automatically locked without electricity. This means that in case of a power outage, from the outside the doors can only be opened with a mechanical key. However, for escape routes this means that doors must be opened mechanically via a door handle or a terminal.

If the card reader does not work properly outside regular opening hours, the emergency desk must be contacted. The emergency desk can call security personnel, who will make their way over to you. The security staff has the corresponding keys to grant building access. The phone number of the emergency desk is visible at all electronic access points.

Changing PIN-codes: log in to www.bi.id.ethz.ch/eAdressen with your personal NETHZ name and password. The PIN-code can be changed on the page Personal and Communication Data in section ETH-Card.
6.3. **Overview of the HCI building sections**

- **HC-0** (= auditorium building): Entire building is one section

- **HC-1**: Finger 1 incl. high-pressure laboratory, laboratory C + D 151, north courtyard HC1 (all workshop rooms, rooms C + D 182, toxlab 2 C174, D174, C + D 176), all practical courses on floors G – J 190-196, as well as J198 and all C191-rooms in the northern corridor. The high-pressure laboratory and the FIRST are separate sections.

- **HC-2**: Finger 2 incl. northern courtyard HC2 (HCI-Shop, storage rooms & safety parcour C280 - 286) and all practical courses G – J 198, 290 - 294 in the northern corridor. The hazardous waste disposal of the SSHE, the NMR hall B225 (without corridor) and the tank depot are separate sections.

- **HC-3**: Finger 3 incl. Ex-radiochemistry, delivery area and all practical courses G – J 296–298 in the northern corridor. The tank depot is a separate area.

- **HC-4**: Finger 4 incl. the animal laboratories E438, D394.5-394.8, courtyard 3 as well as all rooms on floors G – J 390 – 398 in the northern corridor. The rooms G – J 490 – 498 in the northern corridor belong to the HC-5-section. PET, cyclotron and the central animal laboratories are separate areas.

- **HC-5**: Finger 5 incl. courtyard 4, all rooms on floors G – J 490 - 498 in the northern corridor as well as animal laboratories D484.1 – 3.
6.4. The laboratory unit

Each laboratory unit (highlighted in yellow), and each students’ laboratory (marked blue) is an independent fire section. Each laboratory unit has its own autonomous pneumatic control, which regulates the exhaust air and fresh air supply flow rate to a defined constant value. For the safety of the users and to prevent any contamination of the rest of the building, the laboratories are generally kept at negative pressure (unless otherwise programmed). The pneumatic room pressure regulation maintains a constant duct pressure of -135 Pa (1.35 mbar) in the exhaust air duct system of the laboratory. The pneumatic room pressure regulation allows the independent installation of one or more fume hoods, chemicals storage cabinets, TLC spray cabinets, etc., to the existing exhaust air system. At the same time, fume hoods and other exhaust air dependent devices also function as an exhaust air system for the laboratory room. The limit of exhaust air in the laboratory unit should not be exceeded. For this reason, the number of installed fume hoods is limited depending on their size as well as on the rest of the laboratory’s infrastructure. Opening the balcony and laboratory doors disturbs the delicate balance between ventilation and exhaust air in the laboratory unit and creates an increased risk potential (incident spreading), combined with an unnecessary increase in energy consumption levels.

Note: Never open balcony and laboratory doors in case of an incident (fire, smoke, the release of toxic vapors and gases, odor emission etc.)! Instead, evacuate the laboratory unit, secure it and call 888!
6.5. Escape routes/fire doors

In case of an emergency it must be possible to leave workplaces, rooms, buildings, and the surrounding area in a safe and quick way. Paths which serve as escape routes are marked and are to be kept clear at all times. Non-flammable and lockable cupboards for storing harmless materials (not chemicals) may only be installed in escape routes with special permission from the SSHE staff. The minimal remaining width of 1.20 m must be guaranteed in any case. Two photocopiers or multi-function printer are allowed in each fire sector, but the stock materials must be stored in fireproof cupboards.

The fire doors are installed in sliding walls that are pulled into the corridors and thus divide them in case of an evacuation or fire alert. Thus, the view of the corridors, especially in the finger building sections, change and a continuous view is no longer given. Open the fire doors carefully, anticipate that you may be moving towards the incident when passing through. When leaving the building you can only move in one direction, but the escape doors on the face of the building do not allow a return in the opposite direction.

According to an ETH-internal principal, all locked-in people without their own keys must be able to leave the building on the escape routes with turn or panic locks. The working groups must communicate which rooms cannot be left with turn or panic locks. Necessary retrofits can be requested at any time via the real estate services portal (services portal, fill out the correct form in the section “Key management” and hand it in).
6.6. Escape balcony, balcony and laboratory doors

6.6.1. Escape balcony/balcony doors – terms of use

Note: Balcony and laboratory doors must never be left open. Opening the doors of the escape balconies of students' laboratories is forbidden (except for emergencies).

Standing on the escape balcony is permitted (except for students' laboratories) as long as the door is shut. The escape balcony doors must not be left open or wedged open with any objects. Closed balcony and laboratory doors ensure the ventilation system balance and a slight under-pressure in the laboratory area, so that incidents can be more easily constrained and dealt with.

In an emergency, the laboratory must be evacuated and work has to be interrupted, until the incident causing the emergency situation has been cleared! Additionally, balcony doors on the ground floors must be kept closed, to prevent pests such as mice, insects, etc. from entering the building.

The escape balcony serves as an escape path in emergency situations. Therefore, it is important that the balconies are kept clear of objects that might block the escape path.

Balcony railing ropes:

Please do not rest your feet on the railing ropes. They bear only little weight and consequently break at the fixations. Please inform your house warden or the house service box in case of broken rail rope fixations.

Partying or apéros on the escape balconies:

The roof terrace on finger 2 is available for celebrations of all kinds. Staying outside on the escape balconies is permitted, but it is forbidden to organize parties, receptions, etc.
6.6.2. Laboratory doors – terms of use

Laboratory doors must not be left open or wedged with any objects. As mentioned previously, the closed balcony and laboratory doors secure the building ventilation balance and the negative pressure in the laboratory areas, so that incidents can be better contained and fought off. In an emergency, leave the laboratory and interrupt any work in process, until the incident causing the emergency has been dealt with!

The window in the laboratory doors must not have stickers on it or be otherwise obscured, except where a permit has been obtained (e.g. in laser laboratories).

The automatic door closer in the laboratory doors must not be dismantled.

Abb.: Inserted lever arm of the door closer:

Consequences of unhinged door closers:

Often, the door handle crashes into the adjacent gypsum wall and leaves a hole due to the missing resistance. The building areas charge the institutes for the repairs of the wall damage caused by the dismantled door closer.
6.7. Standard door labels

The safety officer, the assistants or the administrative office of each work group has to create their own standardized door labels. A simple Excel template is available, you can request one via chab-safety@chem.ethz.ch.

How to make a standard door label:

- PDF example files come with the Excel template as illustrative samples
- The Excel template represents the creation mask (version with and without a laboratory head, microbiology, practical course etc.).
- A table with all possible symbols for the door labels is added to the template. These necessary symbols can be copied at will and inserted while making the label.
- The template can be printed on normal A4 paper with a color printer, and then cut or folded, and placed underneath the acrylic glass plate next to the door.

![Sample Door Label](image1)

Depending on the situation you may have to correct the page breaks and column widths for an appropriate A4-print of the door label. When compiling a standardized door label, note that the laboratory number is already attached to some of the plastic plates for the door labels.

![Sample Door Label](image2)

Additional labeling material, e.g. laser warning signs, can be obtained at stickers@ethz.ch!
6.8. **Office rooms**

6.8.1. **Windows**

According to ETH house rules, the office windows must be closed over night without exception. Unfortunately, wild animals or even birds often get stuck in tilted windows and die miserably. Additionally, in extreme weather, wind and water can damage a room through open windows. Wet parquet floors usually have to be serviced after water leaks in.

6.8.2. **Manual for the office convector “cooling/heating”**

The building automation centrally switches between cooling in the summer/heating in the winter. The filter in the convector is exchanged periodically.
6.9. Laboratory fume hoods

6.9.1. Exhaust air capacity

Each standard research laboratory in the HCI has an exhaust air capacity of ca. 3200 m$^3$/h. A professorship (especially in the LOC, LAC, ICB) should have the possibility of installing 6 workstations in their laboratories. A workstation usually contains a writing desk in the laboratory “writing zone”, a bench in the laboratory area and a 150 cm standard laboratory fume hoods (the students’ laboratories have 120 cm standard laboratory fume hoods). Therefore, a standard research laboratory for 6 workstations requires 6 fume hoods with 500 m$^3$/h each (= 3000 m$^3$/h). Additionally, pharmacy and hazard cabinets are needed as well as various other source extraction units which use another ca. 500 m$^3$/h of exhaust air. This adds up to a required exhaust air demand of 3500 m$^3$/h, which would clearly exceed the 3200 m$^3$/h.

Sketch: typical standard research laboratory with 6 workstations

Because the exhaust air capacity was insufficient, each of the 6th workstation was equipped with a recirculation filter fume hood, which can work at a reduced capacity of 250 m$^3$/h. About 90 of these recirculation filter fume hoods are still being used in the HCI. However, they are unpopular with most users because they can only be used to a limited extent (as intended) unlike standard fume hoods. In addition, substructures do not fit underneath the recirculation filter fume hoods because the available space already houses the recirculating air filter packs. These must be exchanged every two years. Service and maintenance costs, as well as repairs of the recirculation air filter fume hoods are very expensive.

Since the beginning of 2020, there is an alternative for the recirculation air fume hoods, namely standard laboratory fume hoods with supportive flow technology, which also manages with a reduced exhaust air capacity of 300 m$^3$/h. These fully comply with the certification guidelines EN 14175. The costs for service and maintenance are much lower than for the recirculation air fume hoods, since they do not have circulation filters that need to be replaced regularly. Standard substructures fit under these fume hoods.

6.9.2. Standard laboratory fume hoods (DIN 12924), 1st generation

The standard fume hoods of the 1st generation have a three-point exhaust air control and function autonomously and independently of the pneumatic room pressure control. They measure their own air volume to control and monitor the desired operating value, depending on the operating mode of the hood and the position of its sash window. As a general rule, the higher the sash window is, the closer to its maximum limit the extraction capacity of the exhaust air controller in the hood comes.
The 1st generation fume hoods can have different control devices. Originally, fume hood controllers from Schneider-Elektronik, type LR301 (with timer), were installed which are successively being replaced by the successor model FC500 (without timer, with m³/h display).

**Operation of control device with timer function Tag Std**

- Function keys "Tag" (day), "Std" (hours): When pressed, the timer for the operation of the fume hood is activated, and the indicator "Betrieb" (operation) lights up. After the specified time has expired, the exhaust ventilation will automatically reduce to the prescribed minimum value, and the indicator "Abluft aus" (no exhaust) lights up.
- Function key "Not" (emergency): When activated, the fume hood exhaust ventilation is increased to the maximum power usually for 15 minutes.
- Indicator "Zu niedrig" (too low) combined with an acoustic warning: there is not enough exhaust ventilation power available. If this situation cannot be solved, dangerous experiments have to be stopped immediately. Problems must be reported to the safety officer or assistant.
- Indicator "Schieber zu": Sash window position is too high!

**Operation of control device with m³/h-indicator**

- Function key “Abluf aus” (no exhaust): When pressed the fume hood is either turned on or off. The indicator "Betrieb" (operation) lights up.
- Function key “Tag/Nacht” (day/night): Usually inactive since the fume hood automatically switches to a reduced exhaust air capacity when the sash is lowered.
- Function key "Not" (emergency): When activated, the fume hood exhaust ventilation is increased to the maximum power usually for 15 minutes.
- Indicator "Zu niedrig" (too low) combined with an acoustic warning: there is not enough exhaust ventilation power available. If this situation cannot be solved, dangerous experiments have to be stopped immediately. Problems must be reported to the safety officer or assistant.
- Indicator "Schieber zu": Sash window position is too high!
- Function key "Quit": silences the acoustic alarm.
6.9.3. Standard laboratory fume hoods (EN 14175), 2nd generation

The standard laboratory fume hoods of the 2nd generation also function autonomously and independently of the pneumatic room pressure control. To raise the sash all the way, the red lever on the lower sash rail must be used to release the latch. If installed: The sash is lowered automatically after a certain amount of time if the user moves away from the hood. Originally fume hood controllers from Schneider-Elektronik, type FC500 were installed.

![Fume hood without motion sensor](image1.png) ![Fume hood with motion sensor](image2.png)

**Automatic lowering of the sash window/motion sensors:**

Some of the laboratory hoods of the 2nd generation lower their sashes automatically and electronically. The motion sensor that should notice whether a person is working in the hood or not, is installed on the top panel of the fume hood. When the sensor no longer detects motion, the sash is automatically lowered. Since the detection area of the motion sensor is not always optimal, the sash may be lowered suddenly and unexpectedly. Despite these unsatisfying circumstances, users must not block or electronically deactivate the motion sensor incl. the automatic lowering of the sash.
Sash window latch at mid-working height:

If users work in a fume hood, the sash window is raised and lowered again and again daily. Whenever the sash is moved, it always latches at mid working height, which often annoys users. The sash can only be further raised by operating the lever mechanism (see following figure). It is not allowed to manipulate the slider lock which allows the sash to be moved up or down without hindrance. If the sash lock has been manipulated, it must be repaired and reactivated.

Operating the 2\textsuperscript{nd} generation fume hoods:

- Symbol \(\bigcirc\): Turn fume hood ON or OFF. Even when OFF; a reduced exhaust ventilation is present.
- Upper LED, green: fume hood in operation
- Upper LED, red: fume hood error. If this error sign does not disappear, all dangerous experiments must be stopped immediately. Problems must be reported to the safety officer.
- Lower LED, yellow: window is open
- Vmax: fume hood operating at maximum exhaust air capacity. This function should only be used in extreme situations, or in case of emergency.
- Vmin: fume hood operating with eco-friendly reduced exhaust air capacity.

6.9.4. Standard laboratory fume hood, 3\textsuperscript{rd} generation

These standard laboratory fume hoods (150 cm wide) was developed by Lüdi/Walter and consists of:

- Housing Waldner AG Schweiz
- Integrated media supply from H. Lüdi + Co. AG Schweiz
- Control device FC700 from Schneider-Elektronik GmbH

These laboratory hoods are built according to DIN EN 14175 and according to the norm’s definition are fume hoods of general use. They keep vapors, aerosols and dust from reaching the laboratory room in dangerous amounts or concentrations. The user is protected against dangerous splashing substances or flying parts when the sash window is closed. When the operating conditions (DIN EN 14175, part 2) are complied with, the primary explosion protection is taken into sufficient account within the explosion protection guidelines (EX-RL).

Various other fume hood types may be installed sporadically in the HCI (e.g. Greenfumehood, Wesemann, Weisstechnik, etc). However, there are only a few of these. Please consult the user manuals on how to operate these laboratory fume hoods.
Fig.: Lüdi/Waldner standard laboratory fume hood in the toxlab HCI D312 with electronic sash guides

6.9.5. Recirculation filter fume hood

**Workstations from Skan AG:** The workstation is an autonomous laboratory fume hood unit without additional wall or floor mounting. The circulation filters are in the substructure section. Sensors monitor the air flow and the cleanliness of the exhaust. An acoustic-optical alarm (integrated within the workstation) indicates when the circulation filters have to be changed.

Note: The stock of Workstations at HCI will be successively reduced. Apart from a few exceptions, they will no longer be replaced by recirculation filter successor models.

Technical data of the WS-150: circulation: 250 m³/h, i.e. 120 m³/h (reduced); Exhaust air: 220 – 240 m³/h.
Workstations from Skan AG; meaning of the indicators:

<table>
<thead>
<tr>
<th>Light</th>
<th>Optional enabling or disabling of an electronic device.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTION</td>
<td>Enabling or disabling of sockets</td>
</tr>
<tr>
<td>HI</td>
<td>Note: HI and LO do not mean high- and low-operation: HI means working (operation) and LO means standby.</td>
</tr>
</tbody>
</table>

Handling of the fume hood control of Skan Workstations:

- **dP Filter (red)**: Resistance of the HEPA exhaust filter is too high (not installed).
- **FLOW (red/green)**: Exhaust power too low (sometimes they are permanently red due a programming error; see note)
- **POWER (green)**: Control is properly fed by the power supply.
- **WINDOW Position (red)**: Sash is too high
- **Filter Retention**
  - **Green**: The exhaust filters are working properly.
  - **Red**: The exhaust filters have lost their functionality. Immediately inform the safety hotline chab-safety@chem.ethz.ch

Note: For one series of Workstations, the red LED (indicating “Flow” and “Flow alarm”) glows permanently due to a programming error. This situation cannot be rectified due to a permanently installed, non-reprogrammable microchip for the electronics regulation. If the Workstation works properly, the red LED indicator may be ignored. If, however, the red LED for “filter retention” is glowing, inform your safety officer or assistant immediately.

6.9.6. Laboratory fume hood safety/ecological aspects

All fume hoods in the HCI are under a servicing contract. Every 2 years they are serviced and maintained, and the exhaust air capacity is measured (see databank of the laboratory service rapports).
If the desired amount of exhaust air cannot be maintained in the fume hood, the user is alerted with optical signaling and an audible sound for their own safety.

In case of a problem or emergency, the fume hood may no longer be used for experiments or for storing chemicals. Toxic, smelly chemicals etc. must be stored elsewhere when sufficient exhaust air available is unavailable.

**Ecological aspects:**
To protect yourself and the environment, the window sashes of the fume hoods must always be kept as low as possible. With a fully opened sash, the load on the exhaust air system, as well as the energy consumption is much higher. Additionally, this leads to loss of heat (winter) or cool air (summer).

The energy cost for 1 m³/h of exhaust air amounts to around between 1.50 CHF and 2.00 CHF per year, with an increasing tendency! This means around 190 000 CHF costs for energy/year and per building section!

6.10. **Vacuum network and network membrane vacuum pump units**

6.10.1. Introduction

Every year in students’ and research laboratories, vacuum modules and vacuum network parts are severely damaged. The damage is usually caused by wrong usage of the vacuum modules in the media columns. The most common misuse is direct pumping of liquids (solvents, acids, bases, slag) into the vacuum network. When the liquid remains inside the vacuum network, it will seep slowly through the Teflon seal of the vacuum-regulating valve, which is screwed onto the vacuum module. As a further consequence, it will slowly dissolve the plastic nut of vacuum regulating valve which may then break apart. The remaining fluid will flow out of the vacuum module and continue to damage the underlying electrical and cooling modules (see pictures below). In future media columns, the vacuum module will therefore be installed at the bottom of the media column.
6.10.2. Network chemistry vacuum pump units for multiple points of use

The chemistry vacuum pump units described below are most often used for local vacuum networks connected to several rotary evaporator systems. The vacuum network is built up with flexible PTFE-tubes, going from the pump to the individual vacuum modules in the media columns. The pump unit itself usually sits in an open substructure of a laboratory bench console.

Overview of the network chemistry vacuum pump units:

<table>
<thead>
<tr>
<th>1st generation: Network chemistry vacuum pump units, Vacuubrand PC 600 LAN/MD 4C</th>
<th>2nd and 3rd generation: Network chemistry vacuum pump units, Vacuubrand PC 3004 VARIO (3rd generation with Peltier coolers, abbreviation. EKP)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical data:</strong></td>
<td><strong>Technical data:</strong></td>
</tr>
<tr>
<td>Max. suction capacity: 3 m³/h</td>
<td>Max. suction capacity n: 4.6 m³/h</td>
</tr>
<tr>
<td>Ultimate vacuum: 2 mbar</td>
<td>Ultimate vacuum: 1.5 mbar</td>
</tr>
<tr>
<td>Standby-regulation, not RPM controlled</td>
<td>Standby-regulation, RPM controlled</td>
</tr>
<tr>
<td>In use since 2001</td>
<td>With water-cooling: In use since 2007</td>
</tr>
<tr>
<td></td>
<td>With EKP: In use since 2012</td>
</tr>
</tbody>
</table>

**Operating the pump control CVC 2:**
A short user manual can be obtained from the HCI-Shop.

**Operating the pump control VACUU SELECT:**
It is programmed by the laboratory service or the HCI-Shop so that it automatically runs with the correct settings when turned on.
In use since 2020
Use and installation of network chemistry pump units in the laboratory:

The chemistry vacuum pump unit is made up of a chemically proof membrane pump with a gas ballast valve (round black cap). This valve should be opened: Position the cap over the hole in the cylinder below or remove the gas ballast cap.

The right round-bottom flask made of glass is placed at the inlet of the pump and protects the pump from liquids and particles that could be sucked in. This should be avoided whenever possible. The glass flask should normally be empty.

On the left side you will find an emission condenser made of glass or with a Peltier element (EK) also with a round-bottom flask made of glass. This is connected to the outlet of the pump and serves to recover the pumped-off solvent vapors by condensing and collecting them. It is normal for solvents to accumulate there. Please empty if regularly in the disposal station. Small tip: you don't have to wait until is full, you may already empty it before that. The EKP starts when the vacuum controller CVC 3000 or the VACUU-SELECT is switched on. The LED flashes orange first but glows green when the set temperature (ca. 10 °C) is reached. If it is overloaded, the LED starts flashing orange again. If the LED lights up red, contact the workshop of the HCI-Shop. At the outlet of the glass cooler or the EKP, an exhaust air hose is mounted which leads directly to the building exhaust air or into a fume hood. This prevents odor emissions from solvent vapors. For this reason, this hose must not lead into the room air.

The vacuum controller CVC 2/II, VNC 1 or VNC 2, CVC 3000 or VACUU-SELECT on the pump units does not serve to regulate the vacuum at the individual vacuum connections (e.g. rotary evaporator), but automatically turns off the pump unit if no vacuum is used for a certain amount of time. If the vacuum application is opened again, the vacuum pump automatically starts again. The required cooling water supply to the glass cooler is also opened or closed via a cooling water valve when the pump unit is switched on or off. With VARIO pumping units, the speed is also reduced close to the ultimate vacuum in order to save resources and reduce the noise level.

So, please always run the pumps using the function “VACUU-LAN” (VNC 1 or 2, CVC 3000) or “local vacuum network pump” (VACUU-SELECT) and do not change the set parameters! Just turn the pump on and off as needed. Before turning the pump off, allow the pump to run for a sufficient period of time until it reaches a vacuum of < 10 mbar again and stops the vacuum pump by itself. Short user manuals for the individual vacuum controllers can be obtained from the HCI-Shop.

Network vacuum pump units must be regularly cleaned and tested for their functionality. Please prevent situations like the ones shown below.

![Image of a vacuum pump with a gas ballast valve](image_url)
6.10.3. Using the vacuum network and vacuum modules (with QR code for teaching video)

Only rotation evaporation equipment may be permanently connected to the vacuum network. For a short time, it is permitted to use such vacuum networks for filtration with suction or other purposes, as long as others, who require a good vacuum are informed and agree. For all other purposes, you must check beforehand if nearby vacuum networks would suffer from a long-term vacuum loss.

It is absolutely forbidden to suck up liquids (even in small amounts) into the vacuum network! A liquid trap must always be used between the vacuum-using system and the vacuum module.

In cases where liquids are accidentally pumped into the vacuum network, notify the safety officer or the assistant immediately.

6.10.4. Checklist for finding leaks in the vacuum network

- Electromagnetic and control valves on the vacuum modules: verify if all valves on the vacuum modules are closed, or if a control valve is broken. Even if only one valve is open or damaged, the vacuum performance in the local vacuum network can be significantly reduced. Verify whether a low-boiling solvent of a vacuum consumer is reducing the pump performance, or if too many or unsuitable vacuum consumers are present.

- Network chemistry vacuum pump units: Verify the pump performance of the pumps by isolating them from the network. If the ultimate pressure is < 10 mbar, the pump is fine. If the pump only shows a reduced performance or no vacuum at all, the membranes may need to be replaced.

- Vacuum module
  Check the vacuum module for cracks in the plastic block (these typically produce a hissing noise). Pull the vacuum module out of the media column. If there is a crack in the plastic housing of the vacuum modules (see image to the right), report it to your safety officer immediately. The damaged vacuum module will be replaced as quickly as possible.

- Liquids inside the vacuum network: Verify if there are any residual liquids inside the vacuum network. Depending on their vapor pressure, these can drastically reduce the vacuum performance.

- Screw connections/folded vacuum network hoses: Check if the vacuum network is damaged or kinked anywhere. In such cases, the damaged tube must be replaced. Check if a screw connection has come loose. Repair or replace the connection if this is the case. Replacement material can be obtained from the HCI-Shop.
6.11. Cooling water modules in the media columns (with QR code for teaching video)

6.11.1. 2nd generation cooling water modules with nickel-plated shift drum in the plastic body

The 2nd generation of cooling water modules in the HCI has completely replaced the 1st generation. The plastic body of a cooling water module of the 2nd generation contains two cooling water circuits that open or stop the cooling water flow by turning the shift drum (0- or 1- position).

---

Model of the cooling water module with shift drum:

Drip-stops inside the connectors:

---

Drip-stops are mounted inside the supply and return connectors of the module, which prevent water from leaking in case no connectors are mounted.

Technical data

The cooling water modules may only be used with water. The maximum pressure is 2 bar, the flow rate between 0.2 and 10 L/min, the temperature is approximately 9 °C. Single-sided use, using only the supply or the return line is not allowed. The main cooling water valve can usually be found inside the vertical shaft (see also 4.6.1, emergency cut-out) in the corridor in front of the laboratory unit.

Operating the cooling water module

When the cooling water valve (3 in the drawing on the right) is in the 0-position, the flow is basically blocked. If overpressure occurs inside a closed cooling water circuit, it will relieve itself automatically via the return line over a membrane in the valve. Before turning the cooling water on or off, the control valve (4 in the drawing) should be closed to prevent pressure shocks.

To open the cooling water flow: turn the valve slowly to the 1-position and open the control valve slowly. Note: if no connectors have been mounted, water may suddenly spray out of the supply and return lines due to jammed drip-stops in the connectors (1 and 2 in the drawing)! This is especially the case when the drip-stops are being pushed in or when they are jammed because of depositions, or corroded.

Media connections may only be mounted or dismounted if the valve has been switched to the 0-position and the control valve has been closed. If the cooling water modules are no longer needed, all media connectors must be removed, or a closed cooling water loop must be present.
Technical problems with cooling water modules

Nearly all cooling-water modules show corrosion deposits which are growing over time on the cooling water valve and on the drip-stops. Due to the corrosion and the deposits, the drip-stops may jam and lose their retention function against running out water.

<table>
<thead>
<tr>
<th>Jammed drip-stops with deposits</th>
<th>Cooling water shift drum with deposits. Control valve spindle can be seen inside.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image of jammed drip-stops" /></td>
<td><img src="image2.png" alt="Image of cooling water shift drum" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Typical deposits inside the cooling water module</th>
<th>Typical deposits on one of the drip-stops</th>
<th>Deposits floating around inside the cooling water network</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Image of typical deposits inside" /></td>
<td><img src="image4.png" alt="Image of typical deposits on one of the drip-stops" /></td>
<td><img src="image5.png" alt="Image of deposits floating around" /></td>
</tr>
</tbody>
</table>

Furthermore, there is the risk of moving deposited particles between the O-ring seals and mechanically scratching the sealing plastic body when rotating the shift drum. This leads to the risk of water leaking (despite the closed valve) from these modules, which has already led to several flooded laboratories with ensuing material damages.

Correct behavior if water leaks from inside the module:

If water drips or flows from the inner body of a cooling water module, immediately inform the safety officer. Then close the main cooling water valve in the vertical services duct in the corridor (see also 4.6.1, emergency cut-out) to prevent a sudden burst of water. All other equipment and experiments that depend on cooling water must be secured first!
In the case of dripping, leaking drip-stops in the cooling water connectors:

Should the drip-stops in the connectors of a cooling water module leak, even though the valve is turned to the 0-position, install a bridge connection between the supply and the return line.

6.11.2. 3rd generation cooling water modules made of chromium steel

The 3rd generation of cooling water modules was introduced in 2019 and is being installed in new laboratory equipment and renovations. These cooling water modules are made completely of chromium steel and contain neither non-ferrous metal nor plastic bodies, thanks to this all the technical issues explained in 6.10.1 are no longer present. Within the coming years all 2nd generation cooling water modules in the HCI should be replaced by 3rd generation cooling water modules. The 3rd generation cooling water modules are only operated via a single existing rotary tap. The more you open it, the higher the flowing rate of the cooling water.

Diagram of the cooling water flow rate:

6.11.3. Condensation water issues

Uninsulated metal surfaces but also the cooling water tubes themselves can form large quantities of condensation water in high humidity. The condensation water must not reach electric appliances and installations as this could cause short circuits or other damage.
6.11.4. Correct tubing for cooling water modules

<table>
<thead>
<tr>
<th>Allowed</th>
<th>Allowed</th>
<th>Allowed</th>
<th>Forbidden</th>
<th>Forbidden</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC-tubes</td>
<td>PVC-tubes with mesh</td>
<td>Polyurethane tubes</td>
<td>Silicone tubes</td>
<td>Vacuum or natural rubber tubes</td>
</tr>
</tbody>
</table>

**Issues of silicone tubes in the cooling water system:** The controversial soft silicone tubes are often used for cooling water systems. They are more prone to material fatigue and damage compared to PVC tubes. Also, the sharp edges of the metal hose clips can damage/cut the soft silicone tubes which might cause the tube to suddenly rupture at that point.

6.11.5. Media connectors for cooling water modules

**Metal adapters:**

On these, check the O-ring seals on the metal piece regularly and replace them if necessary. The entire sealing depends on these O-rings (see right-hand figure). Adapters with broken O-rings can be brought to the HCI-Shop for repair.

Note: The tension ring keeps the union nut on the metal adapters from falling off. Because of this, you cannot remove it or, as shown on the right, push it back to check the O-ring. The easiest way of checking the O-ring is to shine a torch on the end of the stamp where the O-ring is placed.

**Plastic adapter:**

**Embrittlement of plastic components:**

All plastic parts on the media columns must be regularly checked for embrittlement, cracks and leaks, and replaced if necessary. The plastic adapters also have an inner O-ring which must not be broken similar to the metal adapters.
### Forbidden cooling water connections:

1. **Forbidden: securing the cooling water tubes with zip ties!**
2. **Forbidden: unsecured cooling water tubes!**
3. **Forbidden: quick release coupling connections!**
4. **Forbidden: open cooling water circuits (open tube ends)!**
5. **Forbidden: connection nipples screwed onto the cooling water module and left open or plastic adapters without a tube bridge!**
6. **Forbidden: using the wrong tube type!**

### Correct cooling water connections:

1. **Correct: cooling water tubes secured with metal clamps!**
2. **Correct: using the correct tube type for the plastic adapter.**
3. **Correct: one-piece connection adapters.**
4. **Correct: tube bridge in case the drip-stops leak!**
5. **Correct: No connection nipples, as long as the drip-stops don’t leak!**
6. **Correct: With screw plugs, if the outlet stops drip!**
6.12. Electro-installations and electro-modules

6.12.1. Short introduction

The electricity supply in the laboratories and technical rooms at HCI may pose risks, which necessitate an adaption of our safety concept and concrete measures.

Instructions for the HCI, briefly summarized:

- Risk minimization of busbars: Only trained persons are allowed to work on the busbars.
- Risk minimization of current supply module for busbars: Any intervention with the busbars is prohibited for users. Only trained persons with the respective permission are allowed to mount and dismantle current supply unities. Changes must be registered via the ETH services portal.
- Risk minimization of missing residual current circuit breaker: A direct consumption of electricity from the current supply unities without current breaker (RCD) is not allowed.
- Risk minimization of defect sockets: Damages on those modules due to material fault, material fatigue or spillage of solvent have to be reported immediately to the ETH services portal.
- Risk minimization of the current load: carefully check the different current loads of the sockets and plugs before using powerful devices.
- Risk minimization of electrical connections: If an additional power connection is needed, an application form must be filled in on the services portal.
- Risk minimization of main power switch: The main power switch must be used only in case of emergencies
- Risk minimization of plugs: it is not allowed to independently repair 230V/400V-plugs. For mounting or replacement of such sockets, an application form must be filed in on the ETH services portal.

6.12.2. Risks emanating from the power rails on ceiling grids

Short description: a busbar is mounted to the ceiling grid with outlet units with circuit breakers (fuses) and sockets. From there all the sockets for the media columns and the outlet boxes for the laboratory and office equipment are connected.

Involved risks: the local laboratory power supply outlet units are placed on this busbar. This is a potential hazard of material fatigue due to the assembly/disassembly of the units and lever actions combined with increased aging when plugging big plugs into the sockets (and unplugging them).

Note: only qualified electricians with clearance and approval are permitted to work on busbars.
6.12.3. Structure of the local laboratory power supply 1x 230 V/3x 400 V three-phase

A 400 V power supply typically consists of 5 conductors, three outer conductors (L1, L2 und L3, neutral (N)) and one protective conductor (PE). The three outer conductors L1, L2 und L3 are basically power sources, while the neutral conductor ensures the return line. The protective conductor is used for personal and property protection.

Power is fed to the laboratory via 3x 400 V und 100 A (3L, N, PE). The three phrase conductors L1, L2, L3 arrive at the consumers in the respective rooms via a miniature circuit breaker (fuse). The 230 V – consumers only need an outer conductor and are therefore distributed symmetrically to the power rail. The current flows via the consumer and back through the neutral conductor. The circuit breaker protects the electrical installation from damage due to overload. The protective conductor protects against dangerous contact voltages in case of an error.

The maximum nominal current of the conductor rail is set to 100 A. The sockets in the outlet units are protected with 16 A. Large, sudden load changes or an interruption of the neutral conductor in the supply line may cause voltage rises for the respective consumers, resulting in the destruction of the connected devices. In one documented incident, the broken neutral conductor generated a voltage increase from 230 (normal) to 390 V. This resulted in substantial property damage. Material fatigue or poor fitting outlet units on the power rails are difficult to find and an incident of this kind can therefore happen again at any time. To minimize the risk, the power outlet unit’s operation must be carried only by the service staff.

6.12.4. Residual current circuit breaker

The residual current circuit breaker is used for the automatic shutdown of the power supply and thus serves to ensure personal safety. One can imagine a fault current circuit breaker as a simple element consisting of a summation current transformer and shut-off device: The total amount of current flowing to the consumer must be equal to the total amount of current flowing back. If someone accidentally touching live parts, a fault current flows and the fault current circuit breaker switches off. In case of accidental contact with live parts, one will still feel a shock as current flows until the circuit breaker cuts off the electrical circuit (max. 300 ms). In the laboratory the earth leakage circuit breaker is built into in the media columns and the current module. No earth leakage circuit breaker is located in the power rail outlet units. For this reason, a direct power consumption from the busbar is not allowed.
6.12.5. Risks associated with busbars without a residual current circuit breaker
Past events have shown that it is very difficult for non-qualified people to put the busbar modules on correctly. There is a major risk that busbar modules are put in operation despite having been installed incorrectly.

On those busbar modules you can plug in an extension cable or power point distributor without an earth leakage circuit breaker. Because of this, the user is exposed to a higher risk of electric shock.

Note:
Single-handed mounting or dismounting of busbar modules is not allowed. You are obliged to file a request on the services portal (Meldeportal).

The direct electricity consumption from the busbar modules without an earth leakage circuit breaker is not permitted (apart from the installations carried out by qualified electricians).

6.12.6. Risks associated with Lüdi electricity power module boxes with residual current circuit breakers
The electricity power modules built into the media columns or the standard Lüdi electricity power module boxes include a fault current circuit breaker. The fuse (line protection) is designed for 16 A.

<table>
<thead>
<tr>
<th>1st generation electric modules, containing sockets type 13 (lower sockets)</th>
<th>2nd generation electric modules, containing sockets type 23 (lower sockets)</th>
</tr>
</thead>
</table>

Problems with the electric modules, 1st generation: due to defective materials, both the upper and lower plug sockets break.

Note: Damage to electricity power modules due to material defects, fatigue, or solvent spillage must be reported immediately to the e-mail hotline chab-safety@chem.ethz.ch.
6.12.7. Risk of 10 A sockets with a 16 A fuse

A formerly common and allowed practice was the over-secure of multiple sockets. This is the reason why electric modules and media columns are equipped with 10 A sockets but have a 16 A fuse. As a result, a higher current can be obtained on a 10 A socket. This happens frequently when other multi plugs and large loads are plugged in.

In the following figure, the socket on the right is only designed to reach a maximum current of 10 A. A higher load may result in excessive heating and melt the socket. For this reason, pay special attention to the different types of sockets before putting powerful devices in operation. Make sure to only use appropriate plugs for the socket on the left in the following figure as well (only plugs with square metal pins are designed for 16 A). Plugs with round metal pins should not be put into the socket shown on the left.

<table>
<thead>
<tr>
<th>These sockets (type 23 = square holes) tolerate a max. of 16 A.</th>
<th>These sockets (type 13 = circular holes) tolerate a max. of 10 A. At &gt; 10 A the socket could melt.</th>
</tr>
</thead>
</table>

Note: Pay attention to the different current loads of the sockets and plugs, especially before powerful devices are put into operation.

6.12.8. 16 A/230 V sockets, type 23

The metal pins of plugs type 23 are square (always with a protective collar) and do not fit into 10 A/230 V sockets, type 12 or 13. Only the newest generation of the electric modules has 16 A/230 V sockets type 23.

Note: You may, but should not, plug a type 12 or 13 plug 10 A (metal pins are round), into a type 23 socket. The contact area is very small. A device delivered with a type 23 plug may not be converted to a type 12 or 13 plug since they usually draw 16 A.

Type 12 or 13

Type 23

6.12.9. Risks posed by high-volume electricity consumers

Another issue is that high volume and/or fluctuating electricity consumers connected to the busbars can lead to unforeseen peak loads. These can cause peak voltages that could damage devices.

Note: For power connections that cannot be set up via the existing sockets, an application must be made through the services portal.
6.12.10. Mounting and repairing plugs

Electrical plugs often break, wires become visible or they no longer connect. In this case a plug must be repaired immediately. Otherwise personal and property protection is no longer provided.

Note: Plugs may only be installed or repaired by a professional electrician. Place a corresponding order in the ETH services portal for mounting or replacing electrical plugs.

6.12.11. Electrical appliances/installations

Appliance casings not only protect the electronics they house but also shield people from the dangers of electric current. Electrical appliances may not be used with open or unattached covers.

Directives from the Federal Inspectorate for Heavy Current Installations (ESTI):

- Electrical work on electrical products and test facilities may only be carried out by appropriately instructed persons. The instructions are to be documented in writing.
- Working on live installations is generally prohibited.
- Protection against contact must be at least IP2X (12 mm, finger-sage = dimension impossible to reach with a finger) for low voltage and IPX3 (2.5 mm, tool-safe = dimension impossible to reach with a tool) for high voltage. Note to the IP-code: Electrical equipment is equipped with suitable types of protection, expressed by IP codes, according to their suitability for different environmental conditions. The abbreviation stands for ingress protection.

6.13. Gas modules (with QR code for teaching video)

6.13.1. Operating gas modules

The opening/closing valve of gas modules must always be turned slowly in the direction of the arrows (prevent pressure shocks)! Unintended increase of pressure in closed vessels must be prevented. Report to the services portal if you have gas taps that are blocked or falling off of their screw connection or gas modules whose pressure can no longer be regulated. Do not waste nitrogen gas unnecessarily; always make sure to use a safe but carefully chosen amount of nitrogen purging gas.
Note: The gas module can only adjust the gas pressure but not the amount of gas. To regulate the amount of gas a dosage valve can be obtained from the HCI-Shop (see picture on the right). Over pressure protection: see chapter 5.6!

6.13.2. Tubing for gas modules

Every gas can react with the tubing material. Therefore, there is a specific rubber blend for each gas. Please be aware of this and use the appropriate tubes for the gas you are using. The respective information can be found on the websites of the gas suppliers.

6.13.3. Tubing for natural gas/propane gas modules

For natural and propane gas, and other flammable gases, only gas tubes certified for these gas types may be used. They can be obtained from the HCI-Shop.

<table>
<thead>
<tr>
<th>Example natural gas: LPG natural gas tube, EN 1762</th>
<th>Example propane gas up to 6 bar: propane gas tube DIN DVGW pressure class 6 bar</th>
</tr>
</thead>
</table>

Vacuum tubes may not be used for gases under any circumstances, as the laboratory service unfortunately often finds to be the case.

<table>
<thead>
<tr>
<th>Allowed</th>
<th>Forbidden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas tubes</td>
<td>Vacuum/natural rubber tubes</td>
</tr>
</tbody>
</table>

Gas tubes always have to be inspected for fatigue cracks and replaced if necessary.

Note: All natural gas/propane tubes have to be secured from falling off with metal clamps.

6.13.4. Gas connections

Note, especially when using flammable gases: all gas connections must be secured with clamps on the side of the media column. For natural gas, specially dedicated tubing is available. If you smell gas, the main gas supply must be turned off immediately and the emergency desk must be informed via 888.

Metal/plastic adapters for gas connections: Always check their O-ring as described in 6.10.4. The gas seal depends on this O-ring. Adapters with broken or missing O-rings can be brought to the HCI-Shop for repair.
Bunsen burner: Correct natural gas tube type, secured with metal clamps!

6.13.5. Handling Lüdi gas cylinders

Make sure that all valves – including the gas modules of the media columns associated with the gas system – are in their base position (zero position) before opening the bottleneck of the gas cylinder or manipulating the gas cylinder in any way. Close all valves before exchanging the gas cylinder and then release the pressure of the gas supply tube before removing. Check the joint ring next to the gas supply tube before reassembly and replace it if necessary. Please also read the manual always included in the delivery. Note: In most gas cylinder stations the control valve cannot be adjusted anymore and is set to 8 bar.
6.14. Pharmacy cabinets

Until 2015 these cabinets were officially called pull-out chemicals' cabinets. Because of new fire safety regulations, they were renamed pharmacy cabinets. In this section, the technical aspects of these ventilated pharmacy cabinets will be explained. See chapter 9 for correct storage and management of chemicals.

Short safety-checklist for the pharmacy cabinets:

Generally: The pharmacy cabinets must not be damaged and must be free of corrosion on the inside. It is necessary to ensure that the moveable parts be pulled out easily without friction or bumps. Also regularly check the cabinets for stability and inner cracks.

The pharmacy cabinets are generally attached to the ceiling grid on their side edges with the braces shown below. This prevents the cabinets from tilting when pulled out. In some cases, the cabinets are fixed with their back to a wall. If you notice any instability in the cabinet, please report this immediately to the e-mail hotline chab-safety@chem.ethz.ch. If necessary, block access to the cabinet until it has been repaired.

<table>
<thead>
<tr>
<th>The chemical storage cabinets must be connected to the exhaust air ventilation system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only the shelf holders shown below may be mounted inside the cabinets:</td>
</tr>
<tr>
<td>The use of these shelf holders is forbidden:</td>
</tr>
<tr>
<td>Each shelf must have such a grey catch-tray as shown here:</td>
</tr>
</tbody>
</table>
6.15. Asecos V-Line Safety storage cabinets with vertical drawers

This safety storage cabinet type was chosen because it ideally fits into the modular laboratory furnishing concept of the HCI building. These safety storage cabinets with vertical drawers have the same dimensions in width and depth as the 45 cm wide pharmacy cabinets, only the height is different. The cabinet is available with double the width as well. Usually there is no space for other safety storage cabinet types (e.g. danger cabinets with hinged doors, unsuitable substructure danger cabinets) in laboratories with 6 workstations. Note: In a V-LINE that is 45 cm wide you can store about the same amount of chemicals as in a 90 cm wide safety cabinet with hinged doors.

Fig.: Safety storage cabinets with vertical drawers from Asecos (V-LINE) next to pharmacy cabinets

Important: The safety storage cabinets with vertical drawers cannot simply be placed and put into operation after delivery or when moving. These must be placed, levelled, and adjusted by an Asecos service technician. Without these adjustments the drawers will not work smoothly.

Intended use:
- These safety storage cabinets with vertical drawers should primarily be used for storing flammable chemicals and solvents, they are, however, not suited for storing acids, bases and other corrosive chemicals.
- Spontaneously flammable chemicals can also be stored in the safety storage cabinet with vertical drawers but take into account the table on combined storage.

Technical details:
- The safety storage cabinets with vertical drawers require an electrical connection (220 V, max. current consumption 0.5 A) and if necessary, in-house locking cylinders can be added.
- The safety storage cabinets with vertical drawers from Asecos are certified to resist outside fire for 90 min
- Pressing a button opens the drawer, it closes again automatically after 60 s when not in use (also in the event of a power outage). A closing cycle lasts 20 s.
- A total weight of 120 kg was anticipated for the drawer.
- If an object or the hand of a user is blocking the drawer when opening or closing, it stops and signals this with a warning tone. The obstacle blocking the drawer adds extra force which changes the electrical resistance of the closing motor and causes it to stop.
- Shelves: The arrangement of the shelves in the safety storage cabinet can be adapted to the current need of the users. Note: To avoid the drawer closing all the time when installing the shelves, press the opening button for a few seconds. The shelves can be inserted at any height and layout with a grid dimension of 25 mm. The shelves can carry 50 kg. Fitting anti-slip mats must be added to the shelves to keep the metal surface free of scratches and leaking chemicals.

- Storage on top of the cabinets: Basically, no wares may be stored on top of the cabinets.
- Climbing on the cabinets: If you climb on top of the cabinet, for example, to reach the ceiling grid, you may unknowingly deform the head of the cabinets. The consequence of this is that the drawer no longer works smoothly. Therefore, prevent users and craftspeople from climbing the cabinets under all circumstances.
- Exhaust air connection: The safety storage cabinets with vertical drawers require an exhaust air connection with at least 10 air cycles/h. An HCI standardized exhaust air connection with 50 m³/h is therefore completely sufficient.

- Blocked exhausts: If the exhaust is blocked, immediately inform our email hotline chab-safety@chem.ethz.ch. To solve the problem a service technician from Asecos must be called. All future cabinets will have an emergency release, the current ones will be retrofitted.
- Power outage: In the event of a power outage the drawers close on their own thanks to their battery.
6.16. **Wall cupboards and laboratory racks**

Storing dangerous chemicals above eye level is not allowed, especially for glass bottles. Only wares containing non-toxic, flammable or aggressive chemicals may be stored on the laboratory racks and wall cupboards. In general, the following applies to storage high up: an approved climbing aid must be available in the rooms. The safety officer must be informed of any wall cupboards or laboratory racks with corroded parts (e.g. hinges, fixtures, etc.).

6.17. **Freezers/refrigerators**

Volatile and heat-sensitive substances should be stored in freezers or refrigerators. All freezers and refrigerators are explosion-proof (no lights inside, thermostat outside). It is illegal to store food and drinks with the chemicals inside a laboratory refrigerator! Marking material for EX-protected refrigerators is available at stickers@ethz.ch.

The freezers and refrigerators must be regularly checked for ice formation. If necessary, they must be emptied completely, turned off, and defrosted (the condensate is to be collected). Repairing a defective freezer or refrigerator is usually not worth it. Replacement freezers and refrigerators can be ordered in the HCI-Shop. Contact the building facility management hc@ba.ethz.ch for the disposal of defective freezers and refrigerators.

If you are storing valuable chemicals or irreplaceable samples in a refrigerator or freezer, connect it to the building automation system. This way, you will be contacted by the emergency desk to move the wares in time, should thawing set in.

6.18. **Equipment**

**General:** Operation manuals must be kept with the equipment. Before using equipment (e.g. network chemistry vacuum pump units, rotation evaporators, laboratory scales, etc.) always read the instruction manual, or get help and advice from a more experienced person!

**For Experiments:** Only tested, CE-compliant laboratory equipment may be used for experiments and for the intended use only (e.g. thermos cans for cryogenic gases, hot air blowers, etc.). The use of hobby and household equipment for laboratory experiments is forbidden.

**Before taking new equipment and apparatuses into operation:** Test them for leaks (water, vacuum, gas connections, etc.). Avoid closed systems because heating, reactions, etc. may cause overpressure! Check cabling, tube connections and seals on any kind of equipment or apparatus regularly, for embrittlement, fatigue or damage. Replace defective parts if needed.
When using equipment at high pressures: Using equipment for synthesis or reactions at pressures above 10 bars in normal laboratories must be approved by the SSHE staff unit. If necessary, use the services of the high-pressure laboratory (see chapter 10.3). Only a high-pressure laboratory can comply with the legal requirements concerning the safety of pressurized equipment.

Broken glass: Never use broken glass parts (risk of injury); dispose of damaged glass parts (glass waste) or send it to the glass-blower shop for repair.

Rotary vane vacuum pumps: Rotary vane vacuum pumps must always be placed in a drip pan. If rotary vane pumps are used in combination with a distillation of solvents or similar chemicals, a condensation-cooling trap is always necessary. This prevents the pump oil from mixing with solvents, water, or other chemicals. Consequences of contaminated pump oil: lower viscosity, and therefore reduced pump lubrication. Due to the sucked up solvent vapors, the vacuum performance successively decreases. Furthermore, contaminated operating oil leads to corrosion in the pump bulkhead (see following images). Users must therefore replace the pump oil on a regular basis. Rotary vane pumps must also be cleaned regularly on the outside, and maintenance is required (e.g. replacement of the vacuum or exhaust hoses, cleaning of the oil mist filter, etc.). Before handing a pump over to the HCI-Shop for repair or maintenance, the pump oil must be drained and disposed of, and a safety clearance form must be filled in, where necessary, declare possible contamination of the pump with toxic or foul-smelling chemicals.

7. Handover of office- and laboratory rooms when leaving or moving

Obligation: The building facility management (hc@ba.ethz.ch) is responsible for the allocation of premises (offices, laboratories, warehouses etc.). Assistants are responsible for the handover of students’ laboratories, and group heads for the handover of individual workspaces. If you plan on leaving a room, inform the building facility management team as soon as possible and arrange a handover date. If nothing else is agreed upon, the rooms, wardrobe cupboards, furniture, freezers/fridges, etc. must be handed over cleaned. Chemicals must either be returned for further use (storage room) or disposed of. On the handover date for the rooms, a status rapport must be submitted to the responsible building sector staff according to the following checklist. If they find anything at fault, the user must rectify the situation. After a successful handover, the door lock cylinders will be exchanged for house warden cylinders. If you do not hand over a room or workplace properly, you may have to cover any ensuing costs. Building, office, and laboratory keys must be returned to the Info- + Service Center.
Checklist for the handover of rooms and workstations

The HCI-Shop is responsible for the return of rental equipment, the IT coordinator for the IT infrastructure. For personal administration issues, contact your institute's secretary.

Generally:
- Report peculiarities in the office, the laboratory, or at your workplace.
- Empty and clean your wardrobe, hand over the wardrobe key to the HCI-Shop.
- Clean sinks, empty recycled glass containers and dishwashers.
- Refill unused/inoperative drain siphons and floor siphons with glycerin.
- Check the condition of the natural gas network, turn off its main switch.
- Switch off all unused equipment. However, never use the main electrical switch in the laboratory area (except in emergencies).
- If not agreed otherwise, disconnect all gas cylinders, and return them to the gas cylinder storage room.
- Contact the HCI building facilities management hc@ba.ethz.ch for the disposal of general waste, materials, equipment, bulk waste etc.
- Freezers/Fridges: empty these completely, switch them off and thaw them up (collect the melt water). Dispose of damaged and unusable freezers/fridges.

Laboratory and office furniture:
- Chemical and wall cupboards, substructures, shelves: unless otherwise agreed upon, these must be emptied completely. Check their general condition, the lock mechanism, the hinges, drawers, and shelves. Leave the key in the lock of cupboards.
- Laboratory tables: Unless otherwise agreed upon, dismantle stand setups, and dispose of them. Clean the table surfaces and check them for cracks, broken glass, and defective joint seals.
- Solvent waste disposal units: empty and clean them. Report defects.

Laboratory fume hoods:
- Unless otherwise agreed upon, remove stand setups, and dispose of them.
- Decontaminate the inside of the fume hood from residual chemicals.
- Clean the sash window; test its functionality.
- Check the table surface for cracks, broken glass, and defective joint seals.
- Test the functionality of the ventilation control.
- Test the functionality of the illumination.

Media columns:
- Vacuum modules: report damaged or missing vacuum valves and connection nipples.
- Vacuum networks: Switch off network membrane vacuum pump units, empty condensation traps. If needed, have vacuum pump units serviced. Report damage and dents in the vacuum plumbing. There should be no liquid inside the vacuum hoses.
- Cooling water modules: all cooling water valves must be turned to the '0' position, all flow valves should be closed. Leave and report jammed, not rotatable valves. Unless otherwise agreed upon, disconnect all cooling water connections. Leave and report corroded or jammed cooling water connections. Check the cooling water modules for leaks, if needed close the main cooling water supply valve of the laboratory unit and report the leaks.
- Electrical modules: Test the functionality and stability of the sockets. Report instable or broken sockets.
- Gas modules: test and close the valves. Report defects.

Equipment:
- The following equipment can be returned to the HCI-Shop for repair and/or for service. Rotary vane vacuum pumps must be drained of the pump oil beforehand and a safety clearance form must be filled out. Spare parts are also available from the HCI-Shop.
- Rotary evaporators: check the general condition, leak tightness, and functionality, drain and clean the water bath.
- High vacuum pumps: Check for vacuum performance and general condition; replace oil if necessary.
- Magnetic stirrers: clean, test them and verify their general functionality.

Storing chemicals:
- Check the chemicals for correct storage and storage hygiene. Well-preserved chemicals may be returned for reuse to the storage room.
- Dispose of 'lost', disintegrated chemicals and samples.
Responsibility: HCI building

**The central disposal area** with the different collection points for the HCI building is located in the HCI delivery area. During the ETH opening hours glass waste, electronic waste, scrap metal, construction waste, fluorescent tubes, polystyrene, cardboard, paper, and wood, etc. can be disposed of individually. Big devices and equipment can only be transferred to the central disposal area upon arrangement with the HCI building domain. Suitable pallets have to be used for this purpose.

8.1.1. Disposal of glass waste

Notice up front:

- The HCI building administration is responsible for non-contaminated glass waste.
- The SSHE dpt. is responsible for contaminated glass waste.

**Non-contaminated glass waste:**

At the moment, it is not possible to collect glass waste by color in the HCI building. Chemical bottles made of brown glass and beverage bottles made of glass should whenever possible be disposed of as whole bottles. Waste-glass bottles and glass shards can be disposed of in the HCI delivery area.
Waste glass containers for laboratories can be ordered free-of-charge at chab-safety@chem.ethz.ch.

Contaminated waste glass and glass types, which must not be disposed of in the green collection containers or recycled (the “white containers” mentioned below can be obtained free-of-charge from the special waste disposal point in the HCI):

- **Borosilicate glass** (= chemical- and temperature-resistant glass = glass ware, test tubes in the lab) must be collected separately in the white containers as shown below, sealed, labeled, and subsequently handed over to the hazardous waste disposal. Borosilicate glass disturbs the recycling process due to its higher melting point compared to normal glass. TLC glass plates must also be disposed of in these white containers.
- **Sharps in the form of colorless glass waste**: Pasteur pipettes, test tubes that are contaminated with chemicals, micro pipettes, etc. also need to be collected in the white containers shown below and handed over to the special waste disposal.

8.1.2. Collection points on the floors

On every floor of the HCI building, there is a room with containers, where generally the **normal waste is collected in the container on the left and cardboard and paper are collected in the container on the right**. The containers are usually emptied by a cleaning company on a regular basis. If a large amount of package material needs to be disposed of – e.g. due to a large delivery – the disposal has to be discussed with the building domain beforehand.
8.1.3. PET collection containers

8.1.4. Collection of non-contaminated waste in the lab

The following containers are regularly emptied by a cleaning company. In order to protect the cleaning staff from contamination and injuries, potentially harmful objects, such as syringe cannulas, all kinds of sharps, glass waste, gas cartridges, spray cans, etc., must never be disposed of in there.

Fig.: Waste-paper

8.1.5. Hazardous waste disposal

**Hazardous waste disposal point HCl**

Location: HCl D 276

Opening hours (semester): Monday to Friday: 2 pm – 4 pm

Opening hours (semester break) Tuesday and Thursday: 2 pm – 4 pm

Each group requires a customer card to dispose special waste. It can be ordered by email (sgu-sonderabfall@ethz.ch) or at the special waste disposal point.
8.1.6. Section of the SSHE for hazardous waste disposal

- Accepts correctly labeled hazardous waste in the correct container, at the special waste disposal points for free
- Hands out suitable containers for collecting hazardous waste free of charge
- Ensures adequate disposal
- Appoints the dangerous-goods officer
- Consults on questions related to hazardous waste disposal
- Provides guided tours through the hazardous waste disposal points
- Provides you with informative material

You can find the link to the consultation form you need to fill in on the website of the SSHE dpt.

8.1.7. Single-use canisters for liquid waste – Important notes

The single-use canisters are available free-of-charge in different sizes from 1 to 10 L in the special waste disposal department and are made of polyethylene. The ones for flammable liquids are electrically conducting (black), those for non-flammable liquids are electrically non-conducting (white)! Electrically conducting canisters for flammable liquids have to be grounded when possible. The shelf life of the canisters is in general 5 years from the date of production (see imprinting on the canister).

UN vessels: UN-inspected vessels are approved of by the federal inspectorate for dangerous goods (Eidgenössisches Gefahrgutinspektorat EGI), which confirms that the vessel fulfills all conditions for transporting dangerous goods by road, rail, air and water.

UN number: dangerous compounds and goods possess a UN number, which can be called compound number. This number is an identification number and is an important part of labelling for the transport of dangerous goods.

Note: liquid waste must only be closed with the lid when there are no signs of reactions or overpressure build-up.

Note: The lids of the canisters do not contain a bursting diaphragm, which could release an eventual sudden overpressure build-up!
8.1.8. Filling canisters

Single-use canisters are to be filled with special funnels protected from overfilling. For flammable liquids electrically conducting (black) funnels are used, non-conducting (white) ones for non-flammable liquids. Electrically conducting funnels for flammable liquids must be grounded. For the solvent waste disposal units, the same is achieved with integrated crocodile clips, that have to be attached to the funnel. Note that the canisters must not be completely filled to avoid overpressure through volume expansion (90 to max. 95%; not over the shoulder of the canister). Canisters, which can exhibit different hazards, always need to be stored in safety cabinets with safety tubs or in a hood without ongoing experiments.

8.1.9. Solvent waste

Solvent waste is classified into two main groups: halogenated (halogen > 2%) and non-halogenated (halogen < 2%) solvents. The whole HCI building generates about 60 tons of solvent waste per year with a 1:2 ratio of halogenated and non-halogenated solvents.

The non-halogenated solvent waste is reused as fuel for the cement industry. The halogenated solvent waste is combusted in high-temperature combustion plants.

Recycling: Basically, it can be stated that recycling solvent waste is becoming more and more important. More than 30 different waste solvents are recycled in the 19 distillation plants of the recycling and solvent center in Schweizerhalle. The non-halogenated solvent waste in the HCI is too mixed and thus not suitable for recycling.

Solvent waste is usually collected in 10 L canisters. If there is only a small amount of solvent waste, collect it in 5 L canisters instead. Flammable solvent waste is collected in conducting canisters and non-flammable solvent waste in non-conducting ones.

8.1.10. Halogenated solvent waste – flammable/non-flammable

Flammable and non-flammable halogenated solvent waste must be collected separately. Use conducting canisters for flammable halogenated solvent mixture waste (e.g. diethyl ether/dichloromethane mixtures etc.) and non-conducting canisters for the non-flammable halogenated solvent waste (e.g. dichloromethane, chloroform etc.) for cost reasons.

The user must decide themselves whether a halogenated solvent waste mixture in the group is flammable or not. When in doubt, consider the halogenated solvent mixture waste flammable.
8.1.11. Solvent waste disposal cupboards

Previously the mobile solvent waste disposal stations were used for the disposal of solvent waste in the laboratories. These will be removed from the HCl by the end of 2020. Solvent waste disposal cupboards will be installed where the mobile disposal stations used to be. They are permanently installed and connected to the exhaust air. There, the users can still dispose of their solvent waste, chlorinated and non-chlorinated waste separately, by filling them into the 5 L or 10 L single-use canisters specified by the SSHE dpt. (capacity max. 4x 10 L). The solvent waste is filled into the canisters until they are ca. 90% full through drain funnels with overfill protection mounted on the canisters.

Fig. on the right: The solvent waste disposal in the laboratory after conversion

Solid materials (e.g. silica gel, slag, glass fragments, syringe needles, magnetic stirring rods) as well as acids, bases, special poisonous substances etc. must never be disposed of in these canisters! All liquids that have special risk and/or odor emission potential (e.g. butyl lithium, benzyl chloride, mercaptans, thiols, etc.) must never be disposed of in these canisters either. Dangerous liquid waste must always be disposed of by using a dedicated canister (available in different sizes up to 10 L) and be placed in a well-ventilated location for interim storage, e.g. in a laboratory hood where no experiments are running.

Filled waste canisters must be closed – as long as there is no sign for a chemical reaction or overpressure formation – and transported using a transport trolley with a collection tray and handed over to the hazardous waste disposal point.

If a canister shows any sign of chemical reaction or overpressure formation, it must immediately be placed in a laboratory hood without on-going experiments. For further instructions, contact BUSS (sgu-sonderabfall@ethz.ch) from the SSHE dpt. If an uncontrolled reaction occurs with the potential of bursting the canister, inform 888.

In case of technical issues or any deficiencies with the solvent waste disposal, immediately inform our e-mail hotline chab-safety@chem.ethz.ch.
Labelling:

The corresponding self-adhesive etiquettes for labelling canisters are available at the hazardous waste disposal point.

8.1.12. Acid and base waste (= corrosive compounds) & aqueous hazardous waste

Acids and bases as well as other aqueous hazardous waste need to be disposed of and stored separately. Those partially caustic compounds need to be handed in as hazardous waste in the polyethylene canisters to the hazardous waste disposal point. The canisters (available in different sizes up to 10 L) including self-adhesive etiquettes for labelling can be obtained for free at the special waste disposal station. Vessels larger than 10 L are not allowed in the labs. The chemical name of the compound and the address of the deliverer need to be written on the waste label. The accuracy of the information must be confirmed by signing the canister.

Typical aqueous special waste, which needs to be collected separately:

**Acids:**
- Nitric acid
- Hydrofluoric acid – highly dangerous!
- Mixtures of nitric acid and hydrochloric acid (aqua regia); Note: Always needs to be diluted with water to about 50%
- Concentrated acids (always first water, then acid) – highly dangerous!
- Caustic acidic inorganic liquid compounds
- Piranha solution (conc. H\textsubscript{2}SO\textsubscript{4}/conc. H\textsubscript{2}O\textsubscript{2}, 3:1 ratio) – highly dangerous!

**Bases:**
- Caustic basic inorganic liquid compounds

**Aqueous hazardous waste:**
- Strongly malodorous non-flammable liquid waste
- Ethidium bromide containing aqueous waste
- etc.
Waste canisters with non-flammable aqueous waste, as long as it does not exhibit any hazards or odor emissions, can be stored in the laboratories in RAKO boxes (= grey safety boxes). RAKO boxes can be obtained in the HCI-Shop for a symbolic price. Waste canisters with dangerous content have to be stored either in fume hoods without ongoing experiments or in safety cabinets with a safety tub.

Notes: Large RAKO boxes are often used as acid and base baths in the labs. Their content cannot be tipped into corresponding tanks in the hazardous waste disposal anymore (no longer exist) but have to be filled into the 10 L single-use canisters. This more difficult pouring process of the acid and base baths exposes the staff to higher contamination risks with the possible consequence of chemical burns. It is therefore recommended to search for new vessels with drain taps (which need to be resistant to breaking off) as acid and base baths to replace the RAKO boxes.

8.1.13. Local disposal of acid and base waste & aqueous hazardous waste in the laboratories

Non-flammable aqueous waste, if it does not exhibit any dangers, can be disposed of separately into newly drafted mobile disposal stations (with ventilation docking station) locally in the laboratories. Based on the need, those disposal stations can be equipped with 5 L or 10 L single-use canisters (max. 4 pieces) and the canisters can be filled using special funnels (with overfill protection).
8.1.14. Oil waste

Contaminated (water-oil mixtures) and non-contaminated oil waste must be treated separately. Especially oil waste from HV pumps is often contaminated with dangerous compounds from the vacuum lines. Contaminated and non-contaminated oil waste is collected separately and stored in the same kind of polyethylene canisters as all other liquid special waste. The filled waste canisters are to be labelled accordingly and handed over to the hazardous waste disposal.

8.1.15. Solid hazardous waste

Solid waste, which is contaminated with chemicals, can be disposed of in the container types shown below. In principle, they are lockable plastic vessels, which are available for free in different sizes up to 30 L from the hazardous waste disposal department. Here too a separated waste collection is required according to the situation. Halogenated and non-halogenated solid waste is treated separately as well.

Typical waste of this type

- Silica gel waste (dripped)
- Filter waste
- Contaminated syringes (without cannulas), gloves and other utensils of all kinds
- Always dispose of waste contaminated with other highly toxic substances as hazardous waste (e.g. mercury-containing waste, ethidium bromide).
- etc.
8.1.16. Sharps = objects exhibiting danger of punctures or cuts

Some examples for sharps are mandrels, capillaries, scalpels and injection cannulas. They have to be collected in rigid, non-transparent, puncture-proof and firmly sealable, leakage-proof plastic box, which cannot be opened anymore once they are sealed. All labs in the HCI building collect sharps in the **yellow mediboxes** shown below. Mediboxes, which need to be treated in an autoclave, need to be equipped with a temperature-sensitive indicator. Sharps are only disposed of as special waste when the biohazard symbol is no longer visible.

![Image of mediboxes](image1.jpg)

8.1.17. Disposal of chemicals

Chemicals, which cannot be reused anymore and need to be disposed of, need to be handed in in their original containers. Chemical containers, whose content cannot be identified anymore, can only be disposed of in agreement with BUSS from the SSHE dpt. Under certain circumstances an analysis of the non-identified content needs to be done. When disposing of chemicals in original containers, halogenated and non-halogenated as well as organic and inorganic or heavy metal-containing compounds, etc. need to be sorted and disposed of separately. Please contact the section BUSS of the SSHE dpt. in case of any uncertainties.

![Image of chemicals](image2.jpg)

8.1.18. Lecture bottles

**Lecture bottles** are in general not disposed of via the SSHE dpt. They should be either fully consumed or returned to the producer/deliverer. If neither option is possible, contact the CABS section (sgu-sonderabfall@ethz.ch) of the SSHE dpt. for further steps.

![Image of lecture bottles](image3.jpg)
8.1.19. Disposal of gas cartridges

If they are not fully emptied, they pose the following dangers:

- Explosive gas-air mixtures can form due to the evaporating gas - especially in closed rooms and chambers.
- Consumed gas cartridges can still contain leftovers, which can explode upon contact with heat or pressure impacts.
- Heating of the gas cartridges above 50 °C can generate dangerously high pressure, which can lead to leakage or bursting of the cartridge.

**Used gas cartridges** always need to be outgassed in exhaust-air contraptions (it is forbidden to outgas them on the escape balconies). Afterwards, they have to be handed over to the hazardous waste disposal.

8.1.20. Disposal of spray cans

**Dangers:** even if empty, spray can may still contain residuals that could explode upon contact with air or pressure impact.

Spray cans contain products harmful to health or environment, the appropriate hazard symbols are printed on the can. In general, these are insecticides, colors, varnishes, insulating foam, glues, lubricants, etc. If the spray can is used up, it has to be handed in to the hazardous waste disposal.

8.1.21. Biological waste

Note on BL1 waste: Bio level 1 waste is collected in bags without a biohazard label, which can be autoclaved. These have to be disinfected, chemically inactivated or autoclaved before the normal disposal.

Intermediate storage in the lab: Open containers and small bags (up to max. 2 liters) can be stored short-term in the biosafety cabinet, but they have to be disposed of in bigger biosafety bags (biohazard) at least once a week. Full and closed biosafety bags have to be stored in a container. Cell culture media and perfusion solutions have to be safely stored in the labs until their final disposal.

**Transport to the treatment point:** The waste/containers need to be brought to the autoclave in the most direct way possible and the material has to be deactivated immediately and without further intermediate storage.
Treatment methods of biological waste

**Disinfection:** Biological waste of safety level 2 or higher, which contain poisonous and/or carcinogenic chemicals, need to be deactivated first with enough disinfectant and subsequently brought to the hazardous waste.

**Deactivation:** The deactivation of biologically contaminated waste is a central aspect of minimizing the egression of organisms (BSL 2 or higher and genetically modified organisms) from the laboratories to avoid hazards for human beings and the environment. Practicable deactivation techniques are vapor sterilization (autoclaving), chemical deactivation as well as dry heat sterilization. The autoclave has to be loaded and operated by trained staff. Autoclaving protocols need to be collected and archived. The autoclave needs to be serviced according to the maintenance plan. Waste needs to be equipped with a temperature-sensitive indicator before autoclaving. Deactivated waste is only disposed of with the normal waste, if the “biohazard” symbol is no longer visible. The symbol is either removed or covered for this purpose.
Various notes:
- Liquid waste deactivated with javel water or similar compounds or that contains thermally stable antibiotics, have to be disposed of as chemical hazardous waste.
- When storing biological waste, an extremely strong stench of excrements can after only a short time. Therefore, it should be deactivated and disposed of as soon as possible.
- Serological pipettes, pipette tips and pasteur pipettes made of plastic do not have to be disposed of as sharps.

8.1.22. Disinfectant for cleaning surfaces and equipment

In general: only products licensed as disinfectant may be used for this purpose. Disinfectants that kill every type of microorganism do not exist, which is why products with complementary effective ranges may need to be used. Microorganisms can develop resistance to certain disinfectants over time. For this reason, test the continued effectiveness of a substance from time to time or change the disinfectant regularly (e.g. every 2 to 4 months in recurring sequence). When rotating through different disinfectants, check their respective compatibilities.

The exposure time is determined by the penetration of the disinfectant into the microorganism, the interaction with the microorganism and the evaporation time of the solvent. The assumption, that higher concentration yields better results is only partly correct: water often plays an important role in disinfection. Absolute alcohol for example fails at disinfecting whereas alcohol of 60 to 80 % works well. Make sure to only use distilled water for diluting.

Examples of disinfectants:

- **Aqueous alcohol solutions** (ethanol or isopropanol): 70 – 90 % aqueous solution, 70 % (= most commonly used), the exposure time depends on the situation, seconds up to 30 min.
  - Note on ethanol denatured with toluene: Toluene is toxic to reproduction (CMR substance of carcinogenic, mutagenic and toxic to reproduction) and may not be used as a disinfectant or cleaning agent.
  - Disinfection effect: narrow effective range (not effective against bacterial spores, limited effectiveness toward non-lipoid viruses).
  - Dangers: Danger of fire and explosions, skin degreasing, no depot effect due to rapid evaporation.

- **Sodium hypochlorite** (1 - 5% aqueous solution): chlorine formation, exposure time 10 - 30 min
  - Disinfection effect: Broad effective range (bacteria, bacterial spores, viruses)
  - Dangers: instable, hardly biodegradable, irritating to mucous, corrosive to metals

- **Peracetic acid** (0.02% aqueous solution), exposure time of sec to 2 h
  - Disinfection effect: Broad effective range (bacteria, bacterial spores, viruses, fungi)
  - Dangers: instable, partly caustic, danger of explosion at > 15 %
9. Storage and management of chemicals

9.1. Storage

In general: always mind the hazards of chemicals and solvents and minimize them when working or storing the substances!

Rules:

- Instructions on the packaging and if necessary, on the materials safety data sheets of chemicals, substances and preparations must be followed when storing these materials.
- Hazardous materials and preparations as well as their containers must be protected from dangerous influences, especially mechanical ones.
- Hazardous materials and preparations must be well organized and separated from other goods. Food, animal feed and medication must not be stored in their immediate vicinity.
- Materials and preparations which may react dangerously with each other must be stored in separate places; see the following table on combined storage.

- Highly toxic, smelly and corrosive chemicals must be stored in appropriate, vented safety cabinets. These containers must be marked specially among other things with references to the dangers involved in using these chemicals and the required actions in the event of an incident. Larger quantities of liquid containers must be stored in chemically resistant drip pans. Wherever corrosive chemicals are being stored, the chemical cabinets must be inspected regularly for corrosion damage.
- Heed: Completely filled solvent glass bottles may never be closed and stored in this condition; at least 5% empty volume must be left (danger of bursting if room temperature increases).
The following pictures show examples of an unacceptable and illegal storage of chemicals!

9.2. ExpeReact-chemicals database

ExpeReact is a database application that enables users to manage chemicals of multiple work groups in separate storage rooms and laboratories, to order chemicals and to retrieve safety information (MSDS: material safety data sheets). It is specially tailored to the needs of chemists. This allows for the search of chemicals by various criteria: name, structure, structural elements, CAS numbers, characteristics, or location/owner.

More information about ExpeReact can be found at: www.chemexper.com

9.3. Storage room (recycling chemicals in HCI)

Storage room HCI C280/282:

Extra chemicals (new and used) are stored here. They are available to all work groups for free. The stock management is done via the database ExpeReact (www.hci-expereact.ethz.ch.).

Users are responsible for collecting chemicals from the storage room and registering this in the chemical database. To change the owner and location, a computer is available in the entryway of the storage room. For safety reasons this room is equipped with a monitoring camera. Access to the storage room must be agreed upon by the safety officer of the group. They are the only ones with a key, and it must be kept under lock.

Potentially reusable chemicals can be brought to the storage room after contacting the D-CHAB hotline cahb-safety@chem.ethz.ch. Sort the chemicals according to the following rules:

- We will pick up chemicals for reuse by arrangement. Reusing chemicals is not a disposal service and may not be misused or misunderstood as one.
- The containers of the chemicals must be labelled properly or with the original label and must contain over > 40% of the original content.
- The containers, incl. the original cap must be in perfect condition (no cracks, other damage, leaking, etc.)
- The containers have to be free of external contamination (rust, corrosion, other patina).
The storage room will no longer accept the following:

- Standard solvents that can be obtained from the HCl-Shop e.g. chloroform, ethyl acetate, tetrahydrofuran, etc.
- Standard chemicals that can be obtained from the HCl-Shop, e.g. hydrochloric acid, sulfuric acid, caustic soda, sodium sulfate, sodium chloride, etc.
- Chemicals whose expiry date has passed or lies within a year
- Chemicals not stored according to regulations (e.g. at RT instead of cooled)
- Clumped, discolored, decomposing chemicals
- Explosive chemicals
- Alkali metals
- Spontaneously flammable chemicals
- Radioactive compounds
- Biologically active substances/cytotoxic agents
- Large containers, such as barrels, bags, canisters, etc.
- Gas cylinders, lecture bottles
- Ampoules with hazardous content
- Chemicals which can be highly destructive already in small amounts
- Strongly smelly chemicals

Chemicals for reuse may not be stored temporarily in the passage to the storage room C280/282. After pickup, the chemicals for reuse have to be registered and placed in the storage room shelving immediately. If this is not possible, chemicals remain in the laboratories of the work group or are kept under lock in the toxlab.

Please, schliessen Sie den Kompaktschrank nach dem Gebrauch!!
9.4. **Chemical containers and labels**

For permanent and temporary storage of chemicals and samples, used chemical containers and neutral glass bottles (clearly not for food) may be used. Existing labels must be covered completely with a proper product label. New identification labels for solvents must additionally be covered with a transparent plastic protective foil. Chemicals in wash bottles, flasks, Erlenmeyer flasks etc. must at least be labelled with a permanent marker. Solvent drums must be labelled with engraved tags.

Identification of contents for chemicals and samples:
- Product name and/or formula
- User's name
- Filling date
- For hazardous materials: Risk phrases, storage conditions
- For solvent drums: engraved tag with product name and laboratory number

The use of empty food, cosmetics, and medication containers for the storage of chemicals and samples of any kind is forbidden. (Risk of confusion!).

Chemicals can be ordered only with the consent of the group leader or assistant. Newly delivered chemicals, as well as chemicals collected from and returned to the storage room must be recorded in the central chemical inventory systems without exceptions. Never return empty, damaged, unlabeled containers or contaminated chemicals to the chemical storage facility. Larger quantities of liquid containers must be stored in chemically resistant drip trays. The size of the drip tray must be adjusted so that it can hold the content from the largest container in case it breaks.

Only permanently labelled wash bottles are allowed for use with solvents and water. These are available for almost all common solvents (water, ethanol, methanol, isopropanol, acetone, hexane, dichloromethane, heptane, ethyl acetate, etc.). For safety reasons, older, non-permanently labelled wash bottles may no longer be used.

9.5. **Transporting chemicals, dewars and glass bottles within the building**

One of the most common accidents in chemistry and biology are caused by spilling hazardous materials due to grossly negligent transport within the building. While transporting hazardous substances you must ensure that even when falling or colliding the containers cannot break due to the resulting impact. For transporting chemicals (including waste), special safety carrying baskets must be used, and suitable dewars for liquid gases (available in the HCI-Shop). Gas cylinders of > 5 L must be transported with the safety cap screwed on and chained to designated trolleys. Canisters filled with solvents must always be closed and transported in suitable holding crates, which can be obtained from the SSHE staff unit. A stable laboratory cart with a protective rim should also be used.

Chemicals, biological substances, small dewars with liquefied gases, and mobile waste disposal units may be transported with the freight elevator only, and not with the regular lifts. No named substances may be transported in open containers.

Dewar containers and compressed gas bottles (with attached steel cap) may only be transported in the freight elevator and must be strapped/chained to their designated fixtures. Users have to send the freight
elevator unpeopled to the respective floor and collect the goods there. Non-involved people are not allowed to use or enter the lift as long as it contains hazardous goods.

10. Services

10.1. Toxlab D312 and central distillation room D310

10.1.1. Toxlab D312; Link www.toxlab.ethz.ch

Experiments with highly toxic or smelly chemicals must be performed in the toxlab D312. The toxlab D312 may only be entered via the personnel air lock.

Some fume hoods in the toxlab D312 have their own local vacuum supply and a rotary evaporator. Users must bring all other equipment they require themselves and take it with them again.

Infrastructure in the toxicology laboratory D312:

- 1 fluorine/HF fume hood, 1 recirculation filter fume hood, 3 standard fume hoods, 1 fume hood with an exhaust air purification system
- 2 solvent-drying systems for a total of 8 solvents (expandable up to 14 solvents)

- Mobile gas detectors (iNet), ready for use on a docking station monitored online. The following gases can be analyzed with these devices at any time: O₂, CO₂, CO, HCN, HCl, Cl₂, PH₃ and flammable gases. These devices are intended for emergency use but can also be used for preventative purposes. Users must make an entry in the logbook when borrowing a gas detector.
10.1.2. General terms of use for toxlab D312

When performing a certain experimental method in the toxlab for the first time, you must hand in a risk assessment to our hotline that first time (see chapter 5.2). The SSHE dpt. or D-CHAB experts will check the risk assessment and discuss it with the user. Once a user has obtained a permit for their experimental method, users can use the toxlab on their own according to the rules. Use of the toxlab D312 must be registered ahead of time on the website www.toxlab.ethz.ch (except when using the solvent-drying systems or the iNet gas detection in D312). In the web-based reservation you must enter the name of the user, the fume hood you want reserved as well as a short description and the duration of your work. The work groups' safety officers usually have a key for the room D312, when needed, users must obtain the key from them and bring it back again. The work group’s safety officer must know who is working how, when, where and with which hazardous substances in the toxlab. Work in the toxlab is only permitted during ETH opening hours and not outside of them. When someone is working in the toxlab, they must ensure a second person is always available. When working on very dangerous experiments, a second person must be present.

When done, toxlab users are required to leave their workplace and equipment clean and hand over all hazardous waste properly at the central waste disposal facility HCI D276. If you forget to register your use of the toxlab on the website, expect your wares to be confiscated. If you fail to clean your workplace after use, you will be charged at least CHF 600 for the cleaning service. Goods left behind are disposed of or brought for reuse.

10.1.3. Solvent drying system for the HCI

Efficient drying of solvents can be achieved using molecular sieve column packing. For each solvent, there is a corresponding specific column medium, though the manufacturers do not declare the exact composition. Such drying methods drastically reduce the risk of a incident compared to alkali-distillation systems. An important condition for the proper operation of the systems is the use of clean solvents without stabilizer additives. Solvents that are potentially contaminated with peroxides must therefore always be tested for their peroxide content before distillation.

The following solvents may be obtained from the system (all stabilizer-free)
- Tetrahydrofuran
- Diethyl ether
- Dichloromethane
- Acetonitrile
- DMF
- Toluene
- N-hexane
- Dioxane

If needed, the system can be extended by up to 6 more solvents.
Storage containers which match the solvent drying equipment exactly are sold to the work groups in the HCl:

It is not allowed to draw off dry solvents into beakers, vials, etc. Only these specific flasks may be used. The vessels can store a maximum of 500ml of solvent. With a balance the withdrawn quantity of dried solvent is recorded on a PC next to the drying station = basis for internal billing of solvent consumption. The storage vessels are stored and managed by the work groups in the HCl. Note: dried polar solvents are especially hygroscopic. Even if only briefly exposed to air, they absorb water right away (> 100 ppm). Therefore, only fill dried solvents from the drying system (see user manual) into empty, well-washed and well-dried storage vessels. The situation is somewhat less critical for hexane and methylene chloride. At the solvent drying system, storage vessels are permanently connected to prevent humidity from diffusing into the equipment, and to flush the pipeline before the actual filling.

Suggestions for the storage of dried solvents:

<table>
<thead>
<tr>
<th>Storage of vessels under N2-gas:</th>
<th>Only fill dried solvents from the system into well-washed and well-dried vessels. We suggest adding a molecular sieve to all dried solvents (except for hexane).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Molecular sieve for methanol:</td>
</tr>
<tr>
<td></td>
<td>Addition of ca. 10-20 g molecular sieve UOP Type 3A (02573 Fluka). Type 3A is used to keep polar solvents (methanol, ethanol, etc.) dry.</td>
</tr>
<tr>
<td></td>
<td>Molecular sieve for all other solvents:</td>
</tr>
<tr>
<td></td>
<td>Addition of ca. 10-20 g Zeochem molecular sieve type Z4-01. ZEOCHEM® molecular sieve 4A is an alkali aluminosilicate. Type 4A has an effective pore opening of 4 Å, resp. 0.4 nm. Molecules with a kinetic diameter of less than 4 Å can be absorbed.</td>
</tr>
</tbody>
</table>
Drawing off dry solvents from the storage vessels is only allowed using special equipment and under inert gas atmosphere (e.g. using single use pipettes would immediately contaminate the dry solvent with humidity).

The quality of the system’s solvent drying is checked with a Coulometric Karl Fischer apparatus and reported on at regular intervals. The water content for polar solvents is generally < 10 ppm and < 5 ppm for non-polar solvents.

10.1.4. Central distillation room D310; Link www.distillation.ethz.ch

For the recycling and reprocessing of technical or poor solvent qualities, work groups may use the large rotary evaporators in HCI D310. Users have to get trained once; contact the person indicated on the sign on the door. The users must do the entire distilling process themselves, filling the starter vessels with the solvent to be distilled, adding the molecular sieve granulates for the pre-drying, or appropriate salts for the removal of peroxides. Strict safety rules must be obeyed inside this room, to prevent the release of solvent vapors and when working with solvents that contain peroxide and therefore present a risk of explosion.

Infrastructure of the central distillation room D310: 3 large rotary evaporators for the distillation of technical grade solvents or solvent recycling

Removing peroxides from solvents using reducing agents will only be successful if well established instructions are followed, e.g. iron(II)sulfate (e.g. for diethyl ether), copper(I)chloride (for tetrahydrofuran) or tin(II)chloride (for dioxane). Filtration through active aluminum oxide is more universally applicable. Because peroxides are more polar than the solvent, they will be adsorbed to the aluminum oxide. The capacity of the aluminum oxide depends on the type of solvent. Obtain further details from the supplier of the aluminum oxide!

10.1.5. General terms of use for central distillation room D310

Use of the central distillation room D310 must be registered ahead of time on the website www.distillation.ethz.ch. You must enter the name of the user and the large rotary evaporator number in the web-based reservation. The work groups’ safety officers usually have a key for the room D310, when needed, users must obtain the key from them and bring it back again. The work group’s safety officer must know who is distilling how, when, where and with which hazardous substances in D310. Work in the central distilling room is only permitted during ETH opening hours and not outside of them.

Users of the central distillation room are required to leave their workplace and equipment clean after their work and to hand over all hazardous waste properly at the central waste disposal facility HCI D276. If you forget to register your use of the central distillation room on the website, expect your wares to be confiscated. If you fail to clean your workplace after use, you will be charged at least CHF 600 for the cleaning service. Goods left behind are disposed of or brought for reuse.
10.2. **Toxlab C174; Link: www.c174.ethz.ch**

The toxlab C174 consists of two rooms, a biology laboratory (BL2) and a toxlab where mostly cytotoxic agents are handled. These rooms may only be accessed via the personnel air lock.

---

**Room C174.1, bio-safety laboratory BL2**

This room is designed for handling biologically active substances (BL2). The room is equipped with a biosafety working bench ready for use, an autoclave, a freezer at -80°C, an incubator and standard laboratory equipment.

---

**Room C174.2, toxlab 2 (cytotoxic agents)**

This room is designed for handling hazardous substances, analogous to the toxlab D312. The room is equipped with standard laboratory equipment and two recirculation filter fume hoods.
10.2.1. General terms of use for the rooms in C174

As described in 10.1.2, the use of these rooms requires a risk assessment. Once a permit for the experiment's execution is present, register the use of the C174 on the website www.c174.ethz.ch ahead of time.

10.3. High-pressure laboratory; Link: www.hochdrucklabor.ethz.ch

10.3.1. Services of the high-pressure laboratory

The high-pressure laboratory is a service laboratory for the HCI. Since the use of synthesis and reaction apparatuses with > 10 bar pressure requires approval from the SSHE staff unit, you should make use of the high-pressure laboratories when necessary. Only a high-pressure laboratory can meet the legal requirements concerning the safety of pressurized equipment.

10.3.2. Internal (ETH) regulations on working with high pressure (most important points)

- Users of the high-pressure laboratories need to hand in a written request (obtain the form from the high-pressure laboratory) in advance for the execution of a high-pressure experiment. The application must also present a user-evaluated risk analysis. The high-pressure laboratory manager then accepts or rejects the request.
- The high-pressure laboratory manager gives users professional technical support.
- Users must comply with the of the HCI laboratory rules, regardless of any conditions.
- In collaboration with the high-pressure laboratory manager, the user must provide an accurate plan for the high-pressure experiment. Subsequently making changes to the experiment users without informing the high-pressure laboratory manager are not allowed.
- Users must agree on appropriate working hours and oversight duties with the high-pressure laboratory manager.

When high-pressure equipment is being used inside a high-pressure cell, access to this cell is forbidden unless it is to fill or empty the pressure equipment with the required gas.

Fig.: Examples of high-pressure autoclaves
10.4. HCI-Shop/Web-Shops

Link to website HCI-Shop: www.hci-shop.ethz.ch

The HCI-Shop is the service center for the basic needs for teaching and research in the HCI. At the shop counter, with your personal barcode card you can obtain your personal everyday office, laboratory, and cleaning materials, as well as frequently used laboratory equipment and chemicals. The HCI-Shop is also responsible for providing basic equipment, consumables and borrowed material for practical courses.

Safety glasses, laboratory coats, single use gloves, hand crème, etc. can also be bought at the HCI-Shop.

Gas cylinder/tank storage:

Gas cylinders can be obtained from the gas cylinder storage, technical solvents from the tank storage facilities. Unfortunately, the flame protection meshes (see arrow in image below) are often missing or have even been removed from the solvent safety canisters, these are absolutely necessary to prevent fire and explosions. Manipulated or missing protection measures are often the reason for severe or even deadly accidents. Therefore, refilling canisters without such meshes is refused!

HCI-Shop repair service:

Defective equipment, such as rotary evaporators, magnetic stirrers, membrane vacuum pumps, rotary vane vacuum pumps and hybrid vacuum can be taken to the HCI-Shop counter for repair. For vacuum pumps, a safety clearance form must additionally be filled out. This form is available at the counter. The pump oil of rotary vane vacuum pumps must be drained by the user before bringing the pump to the counter for repair and disposed of properly. If the warranty has run out, the repair costs will be charged to the affected working group.

Web-shops for the campus:

Several web-shops www.shops.ethz.ch are available on the ETH campus, where materials such as office consumables, stamps, furniture, etc can be placed in the online shopping cart and bought. An account number and a guiding number are required.
10.5. **Central mechanical workshops in the HCI**

10.5.1. **For D-CHAB**

The central mechanical workshop has around 15 employees and offers important support to the high-level research within the department of chemistry and applied biosciences.

10.5.2. **Organization**

It consists of two organizational units, the unit for Physical Chemistry and Organic Chemistry as well as the unit for Chemical and Bioengineering, Inorganic Chemistry and Pharmaceutical Sciences. Both units are independent, reporting to their respective institutes/laboratories. The machinery and equipment are jointly used and there is a strong and close cooperation between the two units.

10.5.3. **Services**

The central mechanical workshop is equipped with state-of-the-art machines and tools and offers a large variety of services to the members of D-CHAB:

- Construction and manufacturing of complex and not commercially available research tools and apparatuses, in close collaboration with the researchers
- Repair and maintenance of research equipment
- Performing welding tasks
- Advice and support in all mechanical questions including the proper choice and purchasing of materials
- Support of the LN₂, N₂- and argon-supply in the D-CHAB through LPC mechanics
- Collaboration with the institutes’ electronics technician

10.6. **The safety parcours HCI C280 and C286**

The safety parcours in C280 and C286 are a part of the training concept for safety representatives and the first-intervention personnel at the HCI. In the safety parcours, both obvious and hidden, often encountered faults concerning safety are on display.

All safety representatives of the HCI must successfully complete the safety trail, which entails finding at least 70% of the displayed faults.

On the website www.safetyparcours.ethz.ch instructors can reserve the safety parcour for training. Entry to the safety parcour is gained with the toxlab key.
10.7. Central filling station for liquid nitrogen

The filling station in in HCI D379.1 consists of 3 cabins:

- cabin on the right: unpressurized filling of dewar containers ≥ 10 L with liquid nitrogen
- cabin in the middle: unpressurized filling of large dewar tanks with liquid nitrogen
- cabin on the left: pressurized filling of large dewar tanks (with QR-code for teaching video)

The filling station involves

- 24h/7d – self-service operation, pressurized as well as unpressurized filling of dewar containers and tanks.
- Automatic booking of self-service with a card reader. Liquid nitrogen cards can be obtained at the HCI-Shop.
- Emergency switches in the filling cabins, in the room and in front of the room. Activate the switch in case of an emergency which will shut down the entire filling system immediately.
- Orange signals oxygen alarm (= early alarm): Stop the filling process and leave the room D379.1 immediately until the problem is solved.
- Red signals oxygen alarm (= main alarm): The room D379.1 may not be entered anymore at all. Leave the area immediately and report abnormalities to the intervention team.

Rules of conduct

- Protective equipment: Everybody is obliged to wear protective equipment (safety glasses with all-round protection, protective gloves against cold, lab coat) and suitable personal clothing.
- Labelling of dewar tanks: All dewar tanks have to be labelled with the workgroup, a contact person and their reachability.
- Outside the ETH opening hours a second skilled person has to be on site during the filling process.
- Specific regulations for pressurized filling: Only people trained by the service staff are allowed to use this station. The use of the pressurized filling station is strictly forbidden to untrained people. Registration for training: chab-safety@chem.ethz.ch
- In case of a building evacuation according to the announcement from the loudspeakers: use of the filling station is strictly forbidden. Follow the evacuation instructions.
- Alarms generated by the filling station: Further use of the filling station is forbidden until the problem is solved. Follow the instructions of the service staff. If the station works properly after confirmation of the error, it may be used again.
11. Authorities/legal basis

11.1. Laws and regulations

On the following website, the current laws and regulations of Switzerland can be found:
Website: www.admin.ch
- Go to the section “federal law” and choose "classified compilation"
- Index A-Z (only available in German; A for Arbeit (work), C for Chemikalien (chemicals), U for Umweltschutz (environment))
- Click on the corresponding information, legal texts and regulations

11.2. Chemicals Act

The new chemicals legislation is designed to protect people and the environment from hazardous chemicals. The new chemicals act and its regulations have been in force since August 1st, 2005. The poison act of 1969 was replaced by this amendment and thus, the five toxicity classes of the old poison act by the GHS-system (see chapter 12) of hazard identification. The following federal agencies are most involved in the Chemicals Act and its regulations: Federal Office of Public Health (BAG), Federal Office for the Environment (BAFU (Bundesamt für Umwelt), previously BUWAL/BWG) and the State Secretariat for Economic Affairs (SECO).

11.3. State Secretariat for Economic Affairs (SECO; Staatssekretariat für Wirtschaft)

SECO is the confederation's competence center for all core issues relating to economic policy. On the domestic front, SECO supports the regionally and structurally balanced development of the economy and ensures the protection of employees. Its workplace inspectors supervise the correct application of the regulations on employee protection issued by the cantons, in particular in the fields of health (labor law) and safety (accidents insurance act) at the workplace.
Website: www.seco-admin.ch

11.4. Federal Office for Public Health (FOPH/BAG; Bundesamt für Gesundheit)

The Federal Office for Public Health (BAG) makes key contributions to ensuring the population is in good health. Its actions are measured by the effect they have on health. The BAG promotes the development of the health care system based on factually sound contributions. It addresses politics, the people, the economy, and science. BAG's work is based upon the individual responsibilities of the people but realizes that in certain areas measures must be taken to protect the people.

BAG also provides the legislation principles and laws for bio safety, radiation safety, laser technology, etc.
Website: www.bag.admin.ch

11.5. Swiss National Accident Insurance Fund (SUVA; Schweizerische Unfallversicherungsanstalt)

- **Organization**: SUVA is an independent company under public law. Its head office is in Lucerne.
- **Field of operation**: SUVA is the main provider of compulsory accident insurance in Switzerland. It insures around 1.8 million employees against the consequences of occupational accidents and occupational diseases and non-occupational accidents.
- **Business operations**: The three core tasks of the SUVA are prevention, insurance and rehabilitation.

SUVA communicates these broad services through its brands
- SuvaPro (occupational safety)
- SuvaLiv (leisure time safety)
- SuvaRisk (premiums and capital investments)
- SuvaCare (claims management and rehabilitation).

Website: www.suva.ch
11.6. Federal Coordination Commission for Occupational Safety (FCOS/EKAS; Eidgenössische Koordinationskommission für Arbeitssicherheit)

The Federal Coordination Commission for Occupational Safety (EKAS) is the central information and coordination office for safety and health at work. It coordinates preventive measures, tasks in the enforcement and uniform application of the rules. Its decisions are binding. Primarily, the cantons and SUVA have to surveil and advise the businesses. SUVA has a specific department "health protection" for this purpose. Secondly, SECO and specific professional organizations contribute to the implementation. Link: www.ekas.ch

Example: The regulations of EKAS prescribe how a laboratory must be built and organized. Further examples of important regulations are instructions on safety at work, handling and storage of flammable liquids, handling, and storage of liquefied gases etc.
12. General safety knowledge

12.1. Globally Harmonized System (GHS)

GHS is the United Nations (UN) supported system for the classification and labelling of chemicals; it is an acronym for “Globally Harmonized System of Classification and Labelling of Chemicals”. The classification according to harmonized criteria should allow the use of the same symbols, and hazard and precautionary statements on labels and in Safety Data Sheets, worldwide.

The GHS contains 9 pictograms, the hazard statements (H-statements) and the precautionary statements (P-statements).

The labelling according to GHS consists of hazard pictogram(s), a signal word, hazard statements, and precautionary statements.

Hazardous substances are classified into hazard classes according to their dangerous properties. There are 16 physical hazard classes in the GHS, 10 human health classes and 2 environmental hazard classes.

<table>
<thead>
<tr>
<th>Physical hazards</th>
<th>Environmental hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Explosive substances/mixtures and products</td>
<td>1. Hazardous to the aquatic environment (acute and chronic)</td>
</tr>
<tr>
<td>2. Flammable gases</td>
<td>2. Hazardous to the ozone layer</td>
</tr>
<tr>
<td>3. Flammable aerosols</td>
<td></td>
</tr>
<tr>
<td>4. Oxidizing gases</td>
<td></td>
</tr>
<tr>
<td>5. Gases under pressure</td>
<td></td>
</tr>
<tr>
<td>6. Flammable liquids</td>
<td></td>
</tr>
<tr>
<td>7. Flammable solids</td>
<td></td>
</tr>
<tr>
<td>8. Self-reactive substances and mixtures</td>
<td></td>
</tr>
<tr>
<td>9. Pyrophoric liquids</td>
<td></td>
</tr>
<tr>
<td>10. Pyrophoric solids</td>
<td></td>
</tr>
<tr>
<td>11. Self-heating substances and mixtures</td>
<td></td>
</tr>
<tr>
<td>12. Substances and mixtures which, in contact with water, emit flammable gases</td>
<td></td>
</tr>
<tr>
<td>13. Oxidizing liquids</td>
<td></td>
</tr>
<tr>
<td>14. Oxidizing solids</td>
<td></td>
</tr>
<tr>
<td>15. Organic peroxides</td>
<td></td>
</tr>
<tr>
<td>16. Corrosive to metals</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health hazards</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acute toxicity (oral, dermal, inhalation)</td>
<td></td>
</tr>
<tr>
<td>2. Skin corrosion/irritation</td>
<td></td>
</tr>
<tr>
<td>3. Serious eye damage/eye irritation</td>
<td></td>
</tr>
<tr>
<td>4. Respiratory or skin sensitization</td>
<td></td>
</tr>
<tr>
<td>5. Germ cell mutagenicity</td>
<td></td>
</tr>
<tr>
<td>6. Carcinogenicity</td>
<td></td>
</tr>
<tr>
<td>7. Reproductive toxicity</td>
<td></td>
</tr>
<tr>
<td>8. Specific target organ toxicity - single exposure</td>
<td></td>
</tr>
<tr>
<td>9. Specific target organ toxicity - repeated exposure</td>
<td></td>
</tr>
<tr>
<td>10. Aspiration hazard</td>
<td></td>
</tr>
</tbody>
</table>
The hazard classes are divided into categories to indicate the degree of danger, where category 1 represents the highest degree of danger. In exceptional cases, there is an additional subdivision into type classes (organic peroxides) or subclasses (explosives/mixtures and products with explosives).

**Signal words:** Based on the hazard symbols a user can decide, whether it is a hazardous substance of a severe or less severe hazard category.

- **Danger** – signal word for severe hazard categories
- **Warning** – signal word for less severe hazard categories

### 12.2. H- und P-phrases

#### Hazard/H statements

- **H 3 01**
  - laufende Nummer
  - Gruppierung 2 = Physikalische Gefahren
  - 3 = Gesundheitsgefahren
  - 4 = Umweltgefahren
  - steht für Gefahrenhinweis (Hazard Statement)

#### Precautionary/P statements

- **P 1 2**
  - laufende Nummer
  - Gruppierung 1 = Allgemein
  - 2 = Vorsorgemaßnahmen
  - 3 = Empfehlungen
  - 4 = Lagerhinweise
  - 6 = Entsorgung
  - steht für Sicherheitshinweis (Precautionary Statement)

A detailed list of all H- and P-statements can be found on Wikipedia.

### 12.3. Overview of GHS pictograms

- **Explosion bomb** Explosives
- **Flame** Flammables
- **Flame over circle** Oxidisers
- **Gas cylinder** Gases under pressure
- **Corrosion** Corrosives
- **Skull and crossbones** Acute toxicity
- **Environment** Environmental hazard
- **Exclamation mark** Harmful/irritant
  - Harmful to ozone layer
- **Health hazard** Severe health hazards
12.4. Explanation of GHS pictograms

<table>
<thead>
<tr>
<th>GHS 01 – Pictogram: exploding bomb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required with:</td>
</tr>
<tr>
<td>- Unstable explosive substances and mixtures</td>
</tr>
<tr>
<td>- Explosive substances/mixtures and products with explosives of divisions 1.1, 1.2, 1.3, 1.4</td>
</tr>
<tr>
<td>- Self-decomposing substances and mixtures, types A, B</td>
</tr>
<tr>
<td>- Organic peroxide, types A, B</td>
</tr>
</tbody>
</table>

Explanations of pictogram GHS 01:
- Division 1.1: Substances, mixtures and articles which have a mass explosion hazard. A mass explosion is one which affects almost the entire quantity present virtually instantaneously.
- Division 1.2: Substances, mixtures and articles which have a projection hazard but not a mass explosion hazard.
- Division 1.3: Substances, mixtures and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard, but not a mass explosion hazard.
- Division 1.4: Substances, mixtures and articles which present no significant hazard: substances, mixtures and articles which present only a small hazard in the event of ignition or initiation.
- Substances, mixtures, and articles with explosive contents of divisions 1.5 and 1.6 do not have to be labelled in this way.
- Self-reactive substances and mixtures: thermally unstable liquids, solid substances or mixtures liable to undergo a strongly exothermic decomposition even without participation of oxygen (air). There are 7 different types (A – G).
- Type A and B are assigned the pictogram 'exploding bomb'. Type B is also assigned the pictogram 'flame'. Type C, D, E and F are only assigned the pictogram 'flame' and type G does not require a pictogram.
- Organic Peroxides, like self-reactive substances and mixtures, are classified in one of seven categories of types A – G for this class. Type A and B receive the pictogram "exploding bomb", type B also receives the pictogram "flame": Type C, D, E and F only receive the pictogram "flame" and type G does not require a pictogram.

<table>
<thead>
<tr>
<th>GHS 02 – Pictogram: Flame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required with:</td>
</tr>
<tr>
<td>- Flammable gases, hazards category 1</td>
</tr>
<tr>
<td>- Flammable aerosols, hazards categories 1, 2</td>
</tr>
<tr>
<td>- Flammable liquids, hazards categories 1, 2, 3</td>
</tr>
<tr>
<td>- Flammable solids, hazards categories 1.2</td>
</tr>
<tr>
<td>- Self-reactive substances and mixtures, types B, C, D, E, F</td>
</tr>
<tr>
<td>- Pyrophoric liquids, hazards category 1</td>
</tr>
<tr>
<td>- Pyrophoric solids, hazards category 1</td>
</tr>
<tr>
<td>- Self-heating substances and mixtures, hazards categories 1, 2</td>
</tr>
<tr>
<td>- Substances and mixtures, which upon contact with water produce flammable gases, hazards categories 1, 2, 3</td>
</tr>
<tr>
<td>- Organic peroxides, types B, C, D, E, F</td>
</tr>
</tbody>
</table>

New flammability limits for liquids are shown in the following table:

<table>
<thead>
<tr>
<th>Category</th>
<th>Boiling point</th>
<th>Flash point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Extremely flammable</td>
<td>≤ 35 °C</td>
</tr>
<tr>
<td>2</td>
<td>Highly flammable</td>
<td>&gt; 35 °C</td>
</tr>
<tr>
<td>3</td>
<td>Flammable</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Combustible *</td>
<td>-</td>
</tr>
</tbody>
</table>

* not according to the EU-GHS-regulations
GHS 03 – Pictogram: Flame over a circle

![Flame over a circle](image1)

GHS 04 – Pictogram: Gas cylinder

![Gas cylinder](image2)

<table>
<thead>
<tr>
<th>Required with:</th>
<th>Required with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Oxidizing gases, hazards category 1</td>
<td>- Gases under pressure</td>
</tr>
<tr>
<td>- Oxidizing liquids, hazards categories 1, 2, 3</td>
<td>- Compressed gases</td>
</tr>
<tr>
<td>- Oxidizing solids, hazards categories 1, 2, 3</td>
<td>- Liquefied gases</td>
</tr>
<tr>
<td></td>
<td>- Refrigerated liquefied gases</td>
</tr>
<tr>
<td></td>
<td>- Dissolved gases</td>
</tr>
</tbody>
</table>

Explanation for the pictogram GHS 03:

- Igniting (oxidizing) liquids (three categories) as well as igniting (oxidizing) solids (also three categories) must be labelled with the "flame over a circle" pictogram.

GHS 05 – Pictogram: corrosion

![Corrosion](image3)

<table>
<thead>
<tr>
<th>Required with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Corrosive to metals, hazards category 1</td>
</tr>
<tr>
<td>- Skin corrosion/irritation, hazards categories 1A, 1B, 1C</td>
</tr>
<tr>
<td>- Serious eye damage/eye irritation, hazards category 1</td>
</tr>
</tbody>
</table>

Explanations for the pictogram GHS 05:

- Corrosive to metals: The class consists of only one category, the pictogram „corrosive“ must be used here.
- Skin corrosion/irritation: This class includes two categories: skin corrosion - irreversible skin damage -implies category 1 and requires the pictogram "corrosion". It is further divided into three subcategories (A, B and C) based on the occurrence of negative effects depending on exposure time. Substances which cause a reversible irritation are classified into category 2. This health hazard is marked with the pictogram "exclamation mark".
- Severe eye damage/eye irritation: This is split into two categories as well. Severe eye damage is classified as category 1, substances and mixtures with this hazard require the pictogram „corrosive“. Category 2 contains substances which cause eye irritation (changes to the eye which are reversible within 21 days). The pictogram „exclamation mark“ is sufficient.
GHS 06 – Pictogram: Skull and crossbones

Required with:
- Acute toxicity (oral, dermal, breath), hazards categories 1, 2, 3

<table>
<thead>
<tr>
<th></th>
<th>(Lethal)</th>
<th>(Highly toxic)</th>
<th>(Toxic)</th>
<th>(Health hazard)</th>
<th>(Possible health hazard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD50 oral (mg/kg)</td>
<td>&lt; 5</td>
<td>5 – 50</td>
<td>50 – 300</td>
<td>300 – 2000</td>
<td>2000 – 5000</td>
</tr>
<tr>
<td>LD50 dermal (mg/kg)</td>
<td>&lt; 50</td>
<td>50 – 200</td>
<td>200 – 1000</td>
<td>1000 – 2000</td>
<td>2000 – 5000</td>
</tr>
<tr>
<td>LD50 Dust/mist (mg/L/4h)</td>
<td>&lt; 0,05</td>
<td>0,05 – 0,5</td>
<td>0,5 – 1</td>
<td>1 – 5</td>
<td>5 – ?</td>
</tr>
</tbody>
</table>

*does not exist in the EU-GHS

<table>
<thead>
<tr>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
<th>Category 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5</td>
<td>&gt; 5 - &lt; 50</td>
<td>&gt; 50 - &lt; 300</td>
<td>&gt; 300 - &lt; 2000</td>
<td>&gt; 2000 - &lt; 5000</td>
</tr>
</tbody>
</table>

GHS 07 – Pictogram: exclamation mark

Required with:
- Acute toxicity (oral, dermal, breath), hazard category 4
- Skin irritation, hazard category 2
- Eye irritation, hazard category 2
- Skin sensitization, hazard category 1
- Specific target-organ toxicity (single exposure), hazard category 3
- Respiratory path irritation
- Narcotic effects
- Damaging to the ozone layer (signal word Warning)

GHS 08 – Pictogram: health hazard

Required with:
- Respiratory sensitization, hazards category 1
- Germ cell mutagenicity, hazards categories 1A, 1B, 2
- Carcinogenicity, hazards categories 1A, 1B, 2
- Reproductive toxicity, hazards categories 1A, 1B, 2
- Specific target-organ toxicity (single exposure), hazards categories 1, 2
- Specific target-organ toxicity (repeated exposure), hazards categories 1, 2
- Aspiration hazard, hazard category 1

Category CMR 1A: Found in humans
Category CMR 1B: Found in animal models
Category CMR 2: Suspected substances
Explanations for pictogram GHS 08:

- Skin or Respiratory Sensitization: Category 1 = respiratory allergen. Substances which produce an allergic reaction upon skin contact, called skin allergens must be labelled with the pictogram „exclamation mark“.
- Germ cell mutagenicity: This class has two categories. Substances which are known or suspected to produce inheritable mutations in human germ cells fall in category 1. This is subdivided in two subcategories 1A and 1B. Category 2 contains all substances which are of concern for humans.
- Carcinogenicity: Again, there are two categories, where category 1 is subdivided again in category 1A and 1B.
- Reproductive toxicity: A substance is deemed toxic to reproduction if it effects sexual function and fertility or damages the development of progeny.
- Specific target organ toxicity (single exposure): Substances or mixtures belonging to this category have significant non-lethal effects on health upon single exposure.
- Specific target organ toxicity (repeated exposure): Substances or mixtures that impair the function of the human body reversibly or irreversibly immediately and/or with some delay after repeated exposure.
- Aspiration hazard: aspiration means the entry of a liquid, a solid substance or mixtures into the trachea and the lower respiratory tract.

<table>
<thead>
<tr>
<th>GHS 09 – Pictogram: Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required with:</td>
</tr>
<tr>
<td>- Acute aquatic toxicity of category 1</td>
</tr>
<tr>
<td>- Chronic aquatic toxicity of categories 1, 2</td>
</tr>
</tbody>
</table>

Explanations to the pictogram GHS 09:

- Category 1: aquatic toxicity: A substance or mixture is considered having aquatic toxicity based upon the following classification criteria:
- Acute aquatic toxicity (short exposure already harms water organisms)
- Potential or actual bioaccumulation: It can have toxic effects over longer time periods, even if the actual concentration in the water is low.
- Degradation of organic chemicals: biotic (through organisms) or abiotic (not through organisms, perhaps through solar radiation). If a substance is not rapidly degraded environmentally, it has the potential to have long-term and widespread toxic effect on the aquatic environment.
- Chronic aquatic toxicity: substances harm aquatic organisms long-term
- Acute aquatic hazardous and chronic aquatic toxic substances of categories 1 and 2 must be labelled with the pictogram „environment“.

Note: See GHS 07 for damaging to the ozone layer.
12.5. **Warning signs**

<table>
<thead>
<tr>
<th><img src="image" alt="Warning: flammable substances" /></th>
<th><img src="image" alt="Warning: flammable substances" /></th>
<th><img src="image" alt="Warning: toxic substances" /></th>
<th><img src="image" alt="Warning: corrosive substances" /></th>
</tr>
</thead>
<tbody>
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<td><strong>Warning</strong>: toxic substances</td>
<td><strong>Warning</strong>: corrosive substances</td>
</tr>
</tbody>
</table>

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<tr>
<th><img src="image" alt="Warning: health hazardous or irritating substances" /></th>
<th><img src="image" alt="Warning: biohazards" /></th>
<th><img src="image" alt="Warning: radioactive substances or ionizing radiation" /></th>
<th><img src="image" alt="Warning: laser radiation" /></th>
</tr>
</thead>
<tbody>
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<td><strong>Warning</strong>: biohazards</td>
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</tr>
</tbody>
</table>

<table>
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<tr>
<th><img src="image" alt="Warning: explosive substances" /></th>
<th><img src="image" alt="Warning: explosive atmosphere" /></th>
<th><img src="image" alt="Warning: gas cylinders" /></th>
<th><img src="image" alt="Warning: gas cylinders" /></th>
</tr>
</thead>
<tbody>
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<td><strong>Warning</strong>: gas cylinders</td>
<td><strong>Warning</strong>: gas cylinders</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><img src="image" alt="Warning: danger zone" /></th>
<th><img src="image" alt="Warning: electricity" /></th>
<th><img src="image" alt="Warning: magnetic fields" /></th>
<th><img src="image" alt="Warning: hazardous optical radiation" /></th>
</tr>
</thead>
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<tr>
<th><img src="image" alt="Electrostatic sensitive devices (ESD)" /></th>
<th><img src="image" alt="Warning: overpressure" /></th>
<th>etc</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrostatic sensitive devices (ESD)</strong></td>
<td><strong>Warning</strong>: overpressure</td>
<td>etc</td>
</tr>
</tbody>
</table>

More warning signs are available on Wikipedia.
## 12.6. Rules and prohibition signs

<table>
<thead>
<tr>
<th>Wear protective glasses</th>
<th>No unauthorized access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear protective clothing</td>
<td>Forbidden for people with pacemakers</td>
</tr>
<tr>
<td>Wear protective gloves</td>
<td>Forbidden for people with metal implants</td>
</tr>
<tr>
<td>Use face protection</td>
<td>No open fires</td>
</tr>
<tr>
<td>Use breathing protection</td>
<td>No smoking</td>
</tr>
<tr>
<td>General signs</td>
<td>No eating and drinking</td>
</tr>
<tr>
<td>Wear solid shoes</td>
<td>Do not extinguish with water</td>
</tr>
<tr>
<td>Use ear protection</td>
<td>No mobile phones</td>
</tr>
</tbody>
</table>

More rules and prohibition signs are available on Wikipedia.
12.7. Safety-related properties in chemistry

Vapor pressure:

The vapor pressure of a substance is defined as the saturation pressure above a solid or liquid substance. It is a measure of how easily the substance passes into the vapor state. Substances with high vapor pressure evaporate more quickly than those with low vapor pressure. The vapor pressure increases strongly with temperature. Therefore, when temperature increases, substances with high vapor pressures reach high concentrations very fast, e.g. in the air, or may cause high pressure in closed containers.

Flashpoint ↔ ambient temperature:

The flashpoint is the lowest temperature of a flammable liquid where under defined conditions vapors can develop in such quantities that the air/vapor mixture above the liquid surface can be externally ignited. If the flash point is below the ambient temperature, there is an inflammation or explosion hazard, if it is above the ambient temperature, an explosion hazard only exists when heated.

**Ignition temperature:**

The ignition temperature is the lowest temperature of a hot surface, at which flammable gases or vapors of flammable liquids mixed with air can ignite under defined conditions. Risk of overheating from oil baths (note the different qualities of oil in the catalogues of the suppliers!), or introduction of water in hot oil baths at over 100 °C (danger of explosion!)

**Ignition sources:**

Hot surfaces, fire, flames, heat, embers, heat guns, mechanically and electrically generated sparks are such sources.

**Explosive mixtures:**

An explosive mixture is present when flammable gases, vapors or mists are in the air in such large quantities (within the explosion limits) that a reaction spreads automatically after ignition. An explosion hazard exists especially in poorly ventilated spaces and containers such as in the sewers, when the vapors of large quantities of spilled solvents, or flammable organic solvents (e.g. diethyl ether, gasoline, etc.) come into contact with an ignition source.

**Explosion limits:**

Flammable vapors, gases or mist, mixed with air, are explosive only within a certain range. Below the lower explosive limit, there is too little fuel available and the mixture is too lean. Above the upper explosive limit, too much fuel or too little oxygen is present, the mixture is too rich, and it burns quietly when on fire. The range between the lower and upper explosive limit is the explosion zone, within this range an explosion hazard exists! When dealing with flammable materials in closed reaction vessels or apparatuses, whenever possible the oxygen-containing atmosphere must be replaced with argon or nitrogen gas.
12.8. **Nighttime and continuous operation**

Reactions and devices without increased safety risk, which stay in operation overnight, must be labelled with a nighttime sign. This nighttime sign must be easily visible at the fume hood window or must be fastened in the vicinity of the experiment or the equipment. Permanent nighttime signs are not allowed; every experiment needs a new nighttime sign. Equipment in continuous operation must be specifically identified with a phone number of the responsible person and with references for what to do in case of an emergency. Equipment in operation without a night sign will be turned off on weekends, public holidays and on weekdays between 10 pm and 6 am.
13. Types of laboratories

13.1. **Biosafety laboratories**

![Warning: Biohazard]

Note: for BL1, warning signs must not be affixed. For BL2 the warning sign is affixed.

The regulations on the protection of human exposure to microorganisms (SAMV) determine what measures should be taken to protect staff when dealing with and being exposed to microorganisms. Additionally, the containment ordinance (ESV) applies to genetically modified, pathogenic, and invasive organisms.

The organisms are classified into four groups. Relevant for the classification is the risk they pose according to current scientific knowledge, i.e. harmful properties, and the probability of these risks coming into effect.

The groups are described as follows:

- **Group 1**: organisms which pose no or negligible risk (e.g. genetically modified, non-pathogenic E. coli phyla)
- **Group 2**: organisms which pose a low risk (e.g. Human Rhinovirus)
- **Group 3**: organisms which pose a moderate risk (e.g. Salmonella Typhi, HIV)
- **Group 4**: organisms which pose a high risk (e.g. Ebola)

When dealing with organisms in groups 1-4, the biological laboratories are classified analogously in biosafety classes L1-L4.

**Criteria for hazard identification and risk assessment:**
- Nature and duration of exposure to microorganisms
- Properties, amount, and conditions of the microorganisms
- Means of transmission of microorganisms
- Information on diseases that an employee could incur due to the exposure
- Allergic or toxic effects of microorganisms
- An employee’s disease found to be in direct connection with work
- The group, to which the relevant microorganisms belong
- Invasive potential

**Safety measures when dealing with organisms:**
- Select organisms that have the least potential risk.
- Ensure that as few employees as possible deal with organisms or are exposed to microorganisms.
- Working procedures and technical measures must be designed so that the spread of organisms is avoided in the workplace as much as possible.
- Procedures for collecting, handling, and processing samples of human or animal origin must be defined properly.
- Special arrangements to manage and limit damage in case of accidents or incidents with organisms must be defined.
- Waste has to be collected, stored and disposed of in such a way that employees are not endangered.
Activities with genetically modified, pathogenic, or invasive organisms have to be announced to the public authorities. Before starting any such experiments for the first time, contact SSHE CABS (cabs@ethz.ch).

The biosafety responsible (BSO) must declare and enforce a ban on eating, drinking, smoking, snuff and makeup in rooms in which there is a risk of contamination by pathogenic microorganisms for the users. In such areas, no food can be kept either.

Protective measures:
- The necessary protective equipment must be properly stored. It should be checked and cleaned if possible, before, and always after use. Before the next use, if necessary, it must be brought into proper condition or replaced.
- Work clothes and personal protective equipment that may have been contaminated by microorganisms, must be taken off when leaving the work area, and stored separately from other clothing prior to implementing the measures listed above.
- Possibly contaminated clothes and personal protection equipment must be cleaned and, if necessary, disinfected.

13.2. Laser laboratories

Definition laser:

Lasers (Light Amplification by Stimulated Emission of Radiation) are radiation sources for coherent, quasi-monochromatic and sharply focused radiation in the visible (and neighboring) range of the electromagnetic spectrum (far infrared, infrared, ultraviolet and x-rays). Basically, every laser is made up of three components: firstly, an active laser medium which mostly determines the properties of the lasers, e.g. a glass, crystal or diode. Secondly, a pumping mechanism which supplies the laser medium with energy, e.g. a flash lamp or an electrically operated gas discharge. Thirdly a laser resonator, a system of mirrors and other optical elements which ensures the feedback and the thereby induced emission of radiation. There are a number of different laser types, depending on the specific build and choice of the components. The types mostly differ in terms of achievable power (from a few microwatts to many kilowatts) and frequency characteristics.

Laser classes: The classification is done according to how dangerous the laser radiation is, higher classes are more dangerous.

<table>
<thead>
<tr>
<th>Laser classes</th>
<th>Key points in brief:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klasse 1</td>
<td>- Under reasonable operating conditions, class 1 lasers are safe.</td>
</tr>
<tr>
<td>Klasse 1M</td>
<td>- Lasers of classes 1M to 4 can damage the eye.</td>
</tr>
<tr>
<td>Klasse 1C</td>
<td>- Lasers of classes 3B and 4 can cause heavy damage to the eye as well as the skin and cause fires.</td>
</tr>
<tr>
<td>Klasse 2</td>
<td></td>
</tr>
<tr>
<td>Klasse 2M</td>
<td></td>
</tr>
<tr>
<td>Klasse 3R</td>
<td></td>
</tr>
<tr>
<td>Klasse 3B</td>
<td></td>
</tr>
<tr>
<td>Klasse 4</td>
<td></td>
</tr>
</tbody>
</table>
Operators of laser equipment class 3B or 4 have to appoint a laser safety officer in writing. They also have to take appropriate measures to ensure that no one can be irradiated inadmissibly even in areas with open access to laser radiation, i.e. that no one is exposed to laser radiation above the maximum permissible irradiation. This safety goal is really only achievable when such laser areas are separated by structural measures and supervised in such a way that only allowed personnel with the necessary protective equipment can enter.

Laser laboratories must be marked with laser warning lamps. If laser devices are running, the laser warning lamp in front of the laboratory lights up. When the light is on, the laboratories may only be entered with the laser safety officer.

Personal protective equipment:

The staff has to be equipped with the necessary personal protective equipment such as laser safety goggles. Ideally, the laser safety goggle is available at the entryway.

Laser pointer:

Owning a dangerous laser pointer is forbidden. Laser pointers of laser classes 1M, 2M, 3R, 3B or 4 and unmarked laser pointers may no longer be used as of June 1st, 2019. Laser pointers of class 2 are the exception, they may be used inside until June 1st, 2021.
13.3. Isotope laboratories

Warning: radioactive substances or ionizing radiation

13.3.1. Isotope laboratories

According to the activities inside them, isotope laboratories are divided into working areas C, B and A:

**Working area C:** An activity from 1 to 100 licensing limits according to the radiological protection ordinance

**Working area B:** An activity from 1 to 10,000 licensing limits.

**Working area A:** An activity from 1 licensing limit to an upper limit determined during the licensing procedures.

Entry to the isotope laboratories is only admitted to those who have received an appropriate introduction (including internal teaching) from a radiation protection expert. Non-authorized people (incl. service personnel) may only enter the isotope laboratory accompanied by a radiation protection expert.

The delegated radiation protection expert and license holder are responsible for the safety and operating procedures in the isotope laboratories.

13.3.2. Handling radioactive substances

Handling includes extraction, production, machining, distribution, installation, usage, storage, transport, disposal, removal, introduction and execution and every other type of passing on.

In particular this means

- Handling radioactive substances and equipment, apparatuses and objects that contain radioactive substances and could emit ionizing radiation
- Events that could increase radioactivity in the environment

All work posing danger of ionizing radiation require authorization (BAG, SSHE dpt.) and has to be carried out in the designated isotope laboratories.

Even work with radioactive substances under the licensing limit (e.g. small activities with tritium-labeled compounds) may only be performed in the HCI building after discussing it with the SE management (chab-safety@chem.ethz.ch) and the BUSS section of the SSHE dpt. (sgu-umwelt@ethz.ch). This kind of work in the HCI building needs to be carried out in the isotope laboratories, to ensure adequate training of the user, especially when it comes to waste disposal.

The person handling the radiation source or responsible for it must take all necessary measures to comply with the dose limits.

13.3.3. Disposal of radioactive substances:

Handle radioactive substances in such a way that you keep waste to a minimum. Therefore, the volume of actual hazardous waste must be minimized by strictly separating active from inactive material. Waste from an isotope laboratory may only be measured and declared inactive waste by a radiation protection expert or someone from the BUSS section (operational environmental and radiation protection)
To avoid unnecessary risks during transport, mostly short-lived isotopes (half-life < 100 days) should be stored in the isotope laboratories or the decay storage of the BUSS section until they have decayed (are inactive). A requirement for this is correct labelling declaring what isotope it is, the activity and the time until the waste can be disposed of inactively.

The radiation protection expert always has to discuss the legal release of radioactive substances with low activity into the environment via wastewater with the BUSS section.

However, scintillation liquids of inactive samples may never be disposed of in the wastewater. They are collected separately and handed over to the hazardous waste disposal (contact sgu-umwelt@ethz.ch if you have questions).

Radiation warning signs, barrier tapes labeled "radioaktiv" (radioactive) and hazardous goods stickers indicating radioactivity may never be thrown in the trash directly. Prior to disposal they must be made unrecognizable (e.g. by cutting them up, drawing over them, etc.).

13.4. X-ray laboratories

The operation of x-ray machines (incl. closed systems with full protection) requires authorization from the BAG; contact the BUSS section of the SSHE dpt. (sgu-umwelt@ethz.ch).
14. First aid for accidents in the laboratories

**Accident: someone is injured and requires help!** Basically, always alert via **888** (see leaflet on page 2)!

Leave patient(s) where they are when possible (the first aid team will come to you).

Secure dangerous zone, protect yourself.

Taking pictures or videos of incident and accident locations and spreading them on social media platforms is not allowed. No information or statements may be made to the media about incidents and accidents within ETH.

**Look ➔ Think ➔ Act**

**Look**
- Make an overview of the situation
- Keep calm
- What happened?
- Who is involved?

**Think**
- Look for hazards
- Accident history
- Available means
- Number and type of patients

**Act**
- Act safely
- Protect yourself
- Secure the accident site
- Lend first aid

Some basic knowledge is a requirement for **first aid**, the following leaflets serve this purpose.

Protecting yourself is a priority: Do not expose yourself to gases and vapors and do not touch contaminated clothing with bare hands!

Ensure a discreet surrounding if you have to take off your clothes. Keep extra clothes on hand.

And finally: secure contaminated clothes in such a way that they do not pose any danger (bucket, bag or something similar).

**Courses/Training courses:**

The SSHE dpt. offers first aid training courses to ETH members. ETH members can acquire first aid knowledge in these courses or refresh the knowledge they already have. These courses were established for ETH members interested in the topic but not aiming for an education or participation in the ETH emergency response office.
Leaflet for chemical burns

Chemical burns on skin:

- Immediately remove contaminated clothes from the injured person (avoid endangering yourself).

- Rinse contaminated body parts with plenty of running water (min. 10 minutes), do not neutralize.

- Cover open chemical burns sterilely or with a clean cloth.

- Always inform the emergency desk (call 888), if necessary, also contact Tox Info Suisse (call 0145)

Chemical burns in eyes:

- Always inform the emergency desk (call 888).

- Rinse the injured eye with plenty of running water or the eyewash bottle, making sure the uninjured eye isn’t also hurt. Whenever possible, rinse the whole eye for 10 – 15 min, i.e. also under the eyelid. It’s easiest to do this in a team of two, though the injured person should help as much as possible, e.g. by lifting the eyelid.

- If instructed by the emergency response officer: bandage over both eyes (immobilization).

- Visit the eye clinic of the Universitätsspital.

- Eye showers that can be pulled from the basin: Rinse them regularly until the water is no longer contaminated
14.2. Leaflet for burns

BURNS: First degree: reddening
Second degree: blisters
Third degree: charring

First and second degree burns:
- Cool immediately with running water; note: only cool burns that have a max. palm-sized area on the limbs. Do not cool burns on the torso.
- Do not open up blisters.
- Do not apply cremes, powder, oil or similar things to the burn or scald.
- Immediately visit a doctor or hospital independent of the severity of the burn in case of burns in the face, joints, genitals or burns covering more than 10 % of the body, also contact them should questions arise.

Second degree covering larger skin area and third degree:
- Inform emergency desk (call 888).
- Cool immediately with running water; note only cool burns that have a max. palm-sized area on the limbs. Do not cool burns on the torso.
- The water doesn’t have to be ice-cold (beware of cooling); soften the water jet before it hits the injured body part (using palm etc.)
- Only remove (cut open) clothes from burns/scalds when they do not stick to the body.
- Do not apply cremes, powder, oil or similar things to the burn or scald.
- Cover open burns sterilely or with a clean cloth for transport (possibly Al-coated dressing)
- Protect against heat loss.
- Danger of shock!
Inhalation of gases/vapors/aerosols

- Retrieve and take injured people into the fresh air; make especially sure to protect yourself (respirator mask)!

- Inform the emergency desk (call 888)! If possible: immediately request the safety data sheet of the poisonous chemical causing the emergency.

- In case of respiratory arrest, follow the reanimation guidelines, see 14.5 Leaflet for respiratory arrest.

- If needed, contact Tox Info Suisse (call 0145). They can tell you whether resuscitation (mouth-to-mouth or using a mask) should be performed (only by someone adequately trained).

- Important: the ventilation mask does not protect from poisonous gases. But if the patient throws up, the vomit will not reach the mouth of the responder thanks to the one-way valve.

- For your own safety, you can reanimate without resuscitation.

- Elevate the upper body if the patient is conscious, otherwise use the recovery position for transport.

- Gas poisoning (nitric gases, Br₂, HF!) often leads to secondary injuries, after the condition of the injured person improves short-term. Always ask Tox Info Suisse for advice!

- Emergency kits for HF-poisoning are available from the emergency desk.
14.4. Leaflet 2 for poisoning (digestive system, skin contact)

Leaflet 2 for poisoning (digestive system, skin contact)

Absorption of poison through the digestive system

- Secure the poison, make sure to protect yourself.

- Contact the emergency desk (call 888). If needed, call Tox Info Suisse (call 0145) for instructions on first aid measures. Immediately request the safety data sheet of the poisonous chemical causing the emergency.

- First aid measures according to the instructions from Tox Info Suisse.

- Immobilize and protect from heat loss.

- Treat ever ingestion of an unknown chemical as if it were a poison.

Poisoning through skin contact

- Immediately remove the injured person’s clothes (protect yourself) and rinse affected skin parts with a lot of water (possibly with soap), maybe both at the same time. Do not use hot water, do not rub strongly.

- Contact the emergency desk (call 888). If needed, call Tox Info Suisse (call 0145) for instructions on first aid measures. Immediately request the safety data sheet of the poisonous chemical causing the emergency.

- First aid measures according to the instructions from Tox Info Suisse.
14.5. Leaflet for respiratory arrest

Leaflet for respiratory arrest

ETH zürich
Reanimations Algorithmus für die Anwendung auf den ETH Geländen

**Situation Sicher?**
Strom, Intoxikation, Absturz, Gewalt ...

**JA**
ansprechen, anfassen, Schmerzreiz
Bewusstlos?

**JA**
fehlende oder abnorme
Atmung?

**JA**
nach Hilfe rufen
Alarmierung

Defibrillator holen oder über
Alarmzentrale anfordern

30 Thoraxkompressionen 100-120/min.
gefolgt von 2 Beatmungen
oder durchgehend
Thoraxkompressionen ohne Beatmung

Defibrillator trifft ein, einschalten und
Anweisungen des Geräts folgen

**Thoraxkompressionen**
- flache, harte Unterlage
- Druckpunkt Mitte des Brustkorb und in der untern Hälfte des Brustbeins
- 6 cm tief (Kinder 1/3 Brustkorb durchmesser)
- komplete Entlastung
- minimale Unterbrechung der Kompression

**Defibrillator anwenden**
- Haut trocken, haarlos
- keine Gegenstände unter den Pads
- genaue Positionierung der Pads
- minimale Unterbrechungen der Thoraxkompressionen bei
  handieren an Defibrillator

Patrick Lehmann, 30.07.2019
14.6. Leaflet for open wounds or bleeding

Leaflet for open wounds or bleeding

Bleeding in general:

- Do not touch or wash out wounds without gloves, do not remove foreign bodies from the wound.

- Cover the wound sterilly or with a clean cloth, apply a protective bandage, only disinfect if no further treatment by a doctor is necessary.

Severe bleeding:

- Inform the emergency desk (call 888).

- Place the patient in a sitting position or even better, lay them down.

- Lift and keep the bleeding body part up.

- Apply some pressure by hand if clotting is insufficient (make sure to find the right pressure point on the body part).

- Apply pressure bandage with thick absorbent pad.

- If the first pressure bandage proves to be insufficient, apply a second pressure bandage one on top of it.

- Lift and keep the bleeding limb up, keep it still.

- Watch out for shock symptoms! Keep the patient warm and monitor them.

- Do not tie off circulation if a pressure bandage isn’t possible, apply pressure directly to the wound.