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GENERAL LABORATORY REGULATIONS

of

Universität Heidelberg

and

Universitätsklinikum Heidelberg

(As of 1 October 2018)

OPERATING INSTRUCTIONS

according to section 14 GefStoffV, section 12 BioStoffV and section 12 GenTSV

The General Laboratory Regulations apply to all departments of Heidelberg University and Heidelberg University Hospital where biological or chemical working materials are handled. They come into force on 1 October 2018 and replace the version from 1 September 2005, which was valid until 30 September 2018. Taking into account department-specific working conditions, every department may modify or supplement the General Laboratory Regulations to fit the needs of the respective work environment. Supplementary regulations must comply with the protection objectives of the General Laboratory Regulations and must be documented during the hazard assessment.

The General Laboratory Regulations and their annexes (if required) as well as relevant supplementary regulations must be communicated to all employees and students in every department before they start work and must be made available in printed or electronic form. Employees and students must be instructed orally on the contents of the General Laboratory Regulations. Both employees and students must confirm with their signature that they have taken note of the General Laboratory Regulations, that they have been instructed and that they will observe the regulations.

In addition to these General Laboratory Regulations, the following legislative documents apply: Working Safely in Laboratories (DGUV I 213-851), the regulations on hazardous substances (Gefahrstoffverordnung, GefStoffV), biological agents (Biostoffverordnung, BioStoffV) and the safety of genetic engineering (Gentechnikssicherheitsverordnung, GenTSV), as well as the corresponding technical rules for hazardous substances (TRGS) and biological agents (TRBA). The main contents of these regulations must be communicated to all employees regularly (oral instruction). All regulations as well as further information can be accessed on the websites of the Occupational Safety department: www.uni-heidelberg.de/arbeitssicherheit.

All groups of persons are hereinafter referred to as “employees”.

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I. WORKING HOURS IN THE LABORATORIES

Working time in the laboratories is divided into main working hours and additional working hours:

Main working hours: Mon-Fri from 8 a.m. - 6 p.m.

Additional working hours: Mon-Fri from 6 p.m. - 8 a.m., Sat, Sun, public holidays

Working during main working hours is not subject to any restrictions. This requires sufficient safety staff to be present at all times in case of emergencies (e.g. first-aider, fire safety assistant, safety officer).

Working during additional working hours may be subject to restrictions, for instance the prohibition of hazardous work. Examples for hazardous work are the handling of organisms of risk group 3, handling explosive, extremely flammable or deadly poisonous substances, or handling pressure systems (Carius tubes, autoclaves, pressure containers, high vacuum systems etc.).

Departments (heads of institutes) may modify the main and additional working hours determined by these General Laboratory Regulations through special regulations as long as the protection objectives are upheld.



II. TECHNICAL SYSTEMS

a) Technical ventilation systems

Any work rooms that serve as laboratories must be sufficiently ventilated during operating hours. This is generally achieved through technical ventilation. Depending on the hazard potential of the work performed in the laboratories, additional technical ventilation equipment such as an extraction system at floor level may be required.

1. Technical ventilation of laboratories must be turned on before the start of work. In case an automatic night setback is in place, it must be deactivated if work continues beyond the setback time.
2. Laboratory doors and windows that are permanently open severely affect the total ventilation of the room. They must therefore be closed at all times and must not be wedged or propped open with doorstoppers or similar.
3. Work for which the release of hazardous substances cannot entirely be ruled out must only be carried out in laboratories equipped with a technical ventilation system. Generally, such work must also be carried out in a fume hood (chemical substances) or in a microbiological safety cabinet (biological agents, GMO).



b) Safety equipment

Fire extinguishers and fire alarms, emergency showers and eyewash stations, emergency power-off switches for electricity and gas, acoustic and visual warning signals etc. provide essential help in emergencies. Knowing their location, function and how to handle them correctly, as well as knowing all escape and rescue routes from the hazard area are vital requirements for taking the right steps in case of danger. All individuals working in a laboratory area are obligated to inform themselves about these safety measures. Escape and rescue routes must be kept clear at all times.

1. All laboratories are equipped with fire extinguishers. There are two types:
 - Carbon dioxide fire extinguishers inside every laboratory
 - Powder or foam fire extinguishers in the corridors
2. Used fire extinguishers must be refilled and returned to their place immediately.
3. First aid kits according to DIN 13157 are installed in central locations. Their contents must be checked regularly for completeness and expiration date and refilled or replaced if necessary.
4. Minor injuries which do not need to be reported as an accident or examined by a doctor or hospital must nonetheless be entered into the "Verbandbuch" (first aid log), the "Meldeblock" (reporting form) or the "Dokumentationsblatt für Erste-Hilfe-Leistungen" (documentation sheet for first aid) for insurance purposes.
5. Emergency showers and eyewash stations must be tested for full functionality at least once a month; these tests must be documented. In order to reduce the contamination of the water inside the eyewash station hose, eyewash stations should be rinsed out thoroughly at least once a week or preferably used daily to rinse the laboratory equipment.
6. In areas without tap water of drinking quality, eyewash bottles containing sterile liquids must be provided (observe expiration date). However, eyewash bottles must not serve as a substitute for potential or existing eyewash stations.
7. When storing, retaining or using compressive gases, toxic, oxidizing or explosive gases or cryogenic liquids, safety equipment adequate for the hazard potential and conforming to the current state of the art must be provided and used (gas cylinder cabinets, emergency power-off buttons for gas, gas alarm, etc.). Further provisions are listed under ANNEX 3 - Compressed Gases and Cryogenic Liquids.



c) Refrigerators and cold rooms

1. Only closed containers labeled with name and content may be stored in refrigerators, freezers and refrigeration rooms.
2. It is strictly prohibited to jointly store food and drinks and chemicals in refrigeration rooms, refrigerators and freezers.
3. Flammable liquids that need to be stored cold may only be kept in refrigerators that do not contain any interior sources of ignition. Refrigerators of this kind do not contain any interior lights, automatic defrosting or interior fans, but are equipped with an exterior thermostat. Unless already labeled by the manufacturer, they are to be labeled with a warning sign reading “nur Innenraum frei von Zündquellen” (“only interior free of ignition sources”). The volume of flammable liquids that can be stored inside is limited to 1 liter per substance.
4. Refrigerators that do not fulfill the technical requirements described above are not suitable for the storage of flammable liquids as they bear a risk of explosion. They are to be labeled with a warning sign reading “Aufbewahren entzündbarer Flüssigkeiten verboten” (“no storage of flammable liquids”) to indicate their restrictive use in the laboratory.
5. Refrigerators containing substances that may explode when reaching room temperature must be connected to the emergency power supply.
6. Refrigerators and refrigeration rooms used for the storage of toxic substances, radiochemicals or medication must be kept closed with a lock.
7. Refrigerators and freezers must be defrosted regularly. The substances stored inside should be checked at least once a year to determine whether they are still needed or if they should be given away or disposed of.



d) Hazardous or complex systems and machines

1. In order to ensure safe working conditions in the laboratory, extra operating instructions need to be put in place for machines and systems that need to be handled with special care.
2. These include fume hoods, microbiological safety cabinets, distillation equipment, rotary evaporators, autoclaves, centrifuges, microtomes, robots and lasers. The Occupational Safety department provides help for drafting operating instructions.
3. Employees must be regularly instructed on the use of these machines and systems with the help of the machine operating instructions. These instruction sessions must be documented.



III. GENERAL RULES OF CONDUCT

1. Employees are obliged to care for their own safety and health as well as that of other employees to the best of their abilities.
2. The person responsible for the laboratory area must instruct all employees on all laboratory aspects that are relevant to safety at work and to the division at least once a year. The instruction must be documented.
3. The personal workplace and all community equipment must be kept in an orderly state. The personal workplace in the laboratory should be cleared regularly, i.e. on a daily basis.
4. It is generally prohibited to eat or drink inside the laboratories. This also applies to working places set up for documentation (documentation zones), even if glass walls or doors separate them. In individual cases, the hazard assessment may conclude that drinking from closed bottles is allowed in documentation zones; reasons for this must be given and documented.
5. It is prohibited to work with hazardous substances and to write protocols and other paperwork at the same workplace. Areas for paperwork bordering on areas for laboratory work must be separated from these by means of a suitable splashguard.
6. For work involving intensive documentation (e.g. working on a computer for several hours a day) and paperwork, suitable workplaces must be used. The Occupational Safety department can provide ergonomic advice to help choose a workplace.
7. Special access regulations are required for work involving particularly hazardous substances (substances classified as carcinogenic, mutagenic or toxic for reproduction, biological or genetically modified substances, radionuclides). These regulations must be made visible in the entrance area by putting up according signs.
8. If external persons work in the laboratory (e.g. service technicians for machines and systems, mechanics for construction work, cleaning staff), their safety as well as that of the laboratory staff must be guaranteed. External persons must be instructed on the relevant laboratory area and on potential hazards in the laboratory. The instruction must be documented.
9. In case of special hazards such as laser or UV radiation, strong magnetic fields, specific chemicals that are especially hazardous, radiochemical substances, or biological agents, signs must be put up on laboratory doors or around the workplace. If required, signs indicating necessary protective clothing (see also no. IV) must also be put up.
10. Operating instructions must be written and observed for all work involving biological and chemical hazardous substances or work with hazardous machines.
11. Compressed gas cylinders must be protected from hazardous rises in temperature at all times (danger of explosion). Warning signs reading "Warnung vor Gasflaschen" ("Warning - Gas Cylinders") must be put on entrance doors of rooms in which compressed gas cylinders are installed without protection.
12. Any short or long-term storage or use of compressed gases, flammable, oxidizing, toxic or mutagenic gases or of cryogenic liquids is only permitted under the safety precautions



Genetic workspace security level 1



No access for unauthorized persons



predetermined for the substance (see Annex 3 for the guidelines on safe handling of compressed gases and cryogenic liquids).

13. Noise reducing headphones should not be worn in laboratory areas with high hazard potential if they prevent the person from perceiving acoustic warning signals. Wearing headphones to listen to music may be banned for security reasons (this is to be determined during the hazard assessment).
14. Hands must be washed (hazardous substances) or disinfected (biological agents) after finishing work and before leaving the laboratory.

IV. LABORATORY CLOTHING

1. In all laboratory areas, employees are obliged to wear
 - protective goggles with side-shields and coverage of the upper eye area
 - a laboratory coat made of cotton or mixed fibers with a high cotton content
 - tight-fitting clothing covering the legs (long pants)
 - closed non-slip shoes.

Employees with long hair may be required to wear a hairnet. Headscarves must be of non-melting material and fit tightly around the head.

2. Superiors must make sure that employees adhere to these clothing regulations and wear their personal protective equipment (at least protective goggles).
3. Employees with glasses must also wear protective goggles in laboratory areas (either with prescription lenses or over glasses with side-shields).
4. Laboratory coats must only be worn in laboratory areas. They must not be worn in places to which people have access who do not work with hazardous substances (e.g. office, cafeteria, lecture hall, library, toilet etc.)
5. Employees handling hazardous substances may be required to wear protective gloves. The gloves must be made of material appropriate for their use. The currently valid recommendations by the Occupational Safety department must be observed.
6. Protective gloves must not be worn outside the laboratory. They must also be taken off inside the laboratory when using the telephone, working on the computer, opening doors, using taps, light switches etc.
7. Respirators may only be worn for special tasks (e.g. working with toxic gases) and only upon approval by the safety officer. Wearers of respirators must be informed and instructed on the areas of use and limits of respiratory protective equipment (material and capacity of the filter, permeation time etc.). The instruction must be documented.



V. CONDUCT IN HAZARDOUS SITUATIONS

In case of danger (release of gases and vapors, leaking of hazardous liquids, fire etc.), the following rules apply:

KEEP CALM

DO NOT NEGLECT YOUR OWN SAFETY WHEN HELPING OTHERS

The following measures are then to be taken:

- If possible, stop experiments which are dangerous or in danger
- Keep coolant in equipment running
- Turn off gas
- Turn off electricity if this does not increase the hazard risk (e.g. do not turn off if this would turn off the cooling system)
- Close doors and windows in case of fire
- Wash eyes and skin with water after any contact with chemicals (emergency shower and/or emergency eyewash)
- Render appropriate first aid measures in case of contact with particularly hazardous substances (e.g. hydrofluoric acid) (see information sheet on emergency measures for hydrofluoric acid "Flusssäure-Notfall-Maßnahmen")
- Warn people in danger
- Take helpless people to safe areas if possible
- Render first aid if necessary
- Call responsible staff:

• Head of laboratory working group	Phone:	
• Safety officer	Phone:	
• Fire department (if necessary)	Phone: 112	(from every telephone)
• Police (if necessary)	Phone: 110	(from every telephone)
• Emergency doctor (if necessary)	Phone: 112	(from every telephone)
• Central technical services (if necessary)	Phone: 7272	(from every telephone)
• Technical emergency service (if necessary)	Phone: 4444	(from every telephone)
• Emergency poison hotline	Phone: 0-030-19240	(only from authorized telephones)
- If the fire department and police are called, the Occupational Safety department (54-12331) needs to be notified. In addition, the officer for biological safety (54-12380, 54-12381) and/or the officer for hazardous substances (54-12330) need to be informed, depending on the type of damage.
- In case of bodily injuries, the emergency doctor has to be called. If transport to a hospital is necessary, the relevant operating instructions, the safety data sheet or other information about the hazardous substance should be provided to the ambulance staff.
- If external rescue forces are called, helpers need to be available to instruct them on access roads (chain of people leading from the access road to the place of deployment).



VI. PERMANENTLY LEAVING THE FACILITY

Employees permanently leaving a laboratory area must observe the following:

1. The laboratory should be left in a clean and tidy state. Potentially contaminated surfaces in biological laboratories must be disinfected.
2. Chemicals must either be passed on to other people interested in using them (a handover report is required) or brought to the chemical waste disposal. Reactive substances may have to be deactivated prior to this (see also Annex 2: Hazardous substances).
3. Employees leaving the facility must request the termination of their DaMaRIS access (Dangerous Materials Registry Information System).
4. Project managers in the field of genetic engineering must inform the officer for biological safety (BBS) of their departure as early as possible.
5. All keys must be returned to the head of the laboratory working group.

Heidelberg, 28 September 2018

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GENERAL LABORATORY REGULATIONS
of
Universität Heidelberg
and
Universitätsklinikum Heidelberg

(1 October 2018)

ANNEX 1

BIOLOGICAL AGENTS

Biological agents are natural and/or genetically modified organisms. When working with biological agents, the following rules must be observed:

- Only authorized and instructed persons may access the work rooms.
- Instructions on how to operate genetic engineering systems and how to handle biological agents are to be written and put up at the entrance.
- Before starting new work involving genetic engineering, the biological safety officer (Beauftragter für die Biologische Sicherheit - BBS) must be contacted and an authorization procedure initiated, if required.
- All work involving genetic engineering must be documented.
- Windows and doors must be kept closed during work.
- Employees must not wear any jewelery below the elbow, long fingernails or artificial nails.
- No food or beverages may be kept in the laboratory.
- Mouth pipetting is prohibited.
- Aerosol formation is to be avoided.
- Hands must be disinfected and, if necessary, washed after finishing work and before leaving a biological laboratory.
- Cross-contamination must be avoided. Protective gloves and laboratory coats must be taken off when leaving the facility.
- The same applies to touching non-contaminated objects such as telephones, doorknobs, computers or writing utensils. These must never be used while wearing gloves.
- The floor must be kept clear, devices and utensils must be placed on trolleys or tables. Electric cables and multiple sockets must be installed at elevated height.
- The laboratories must be kept clean and tidy. The work surfaces must be cleaned and, if necessary, disinfected daily after finishing work.
- Outside of the laboratories, organisms may only be transported in break-proof, closed and marked containers. Legislation on hazardous goods may apply.
- A hygiene plan must be established for handling pathogenic organisms. Sharp objects or cutting instruments are to be avoided where possible. A "sharps container" must be provided for sharp waste.
- Contamination must be removed immediately in an expert manner.
- Contamination of the eyes must be treated with an emergency eyewash.
- Unforeseen events or accidents must be reported to the officer for biological safety (BBS).

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(1 October 2018)

ANNEX 2

HAZARDOUS SUBSTANCES

I. Introduction

Before handling chemicals, the substances used should always be checked for hazardous substances. Hazardous substances are substances or substance mixtures with dangerous properties which are of physical-chemical or toxicological nature and/or are dangerous to the environment, or all substances with an occupational exposure limit value (OEL, concentration of a substance in the workplace air). Hazardous substances are marked with pictograms and signal words of the **Globally Harmonized Systems of Classification and Labelling of Chemicals (GHS)**.



Danger



Danger



Danger



Warning



Danger



Danger



Warning



Danger



Warning

Handling hazardous substances requires interdependent protective measures that depend on the type of danger (physical-chemical or toxicological) and the volatility and amount. Hazardous substances may only be handled by qualified individuals who have been instructed on how to handle substances of this kind.

II. Information gathering and hazard assessment

The following organizational requirements must be fulfilled before starting to work with hazardous substances:

- Identification of the most hazardous properties of all substances used
- Identification of potential exposure taking all exposure routes into account
- Identification of potential fire and explosion risks
- Checking substitute substances and substitution of hazardous substances, if possible
- Checking the efficacy of the protective measures
- Registration of all hazardous substances in DaMaRIS (Dangerous Materials Registry Information System); regular update of the entries (at least once a year)
- Provision of all safety data sheets of the hazardous substances used at a suitable place (for access by the employees using these substances)
- Implementation and documentation of a hazard assessment

III. Basic obligations:

In order to ensure that hazardous substances are handled safely, the following requirements must be fulfilled:

- Work rooms and work processes must conform to the state of the art (technical ventilation, at least 25 m³/m²/h (approx. 8 times); work processes with little or no exposure) and be physically separated from public areas (keep doors and windows closed).
- The technical ventilation system must be permanently active during working hours; defects must be clearly identifiable.
- Technical protective measures must be functional and effective and must be checked regularly (fume hoods, safety cabinets, fire extinguishers, emergency showers and eyewash stations, emergency power-off switches, etc.).
- Functional work clothes must be worn (laboratory coats, long clothes covering the legs, closed shoes, hairnet if necessary).
- Personal protective equipment must be provided if necessary and used by the employees (protective goggles, protective gloves).
- Laboratory clothes must be kept separate from normal clothes.
- Basic standards of hygiene must be upheld (e.g. skin protection, prohibition to eat or drink, separation of laboratory work and paperwork, regular cleaning of the workplace).
- Medical support at the workplace is to be offered or provided if deemed necessary (medical-toxicological advice, voluntary or compulsory occupational medical care).

IV. General protective measures:

- Before starting work in the laboratory, all available hazardous substances must be entered into the DaMaRIS registry of Heidelberg University and Heidelberg University Hospital. The list of substances must be kept up to date; the entries must be compared with the actual supplies at least once a year.
- The number of employees (potentially) exposed to hazardous substances must be kept to the minimum necessary for the work.
- Only small numbers and amounts of hazardous substances may be handled or kept at the workplace (i.e. 1 l / 1 kg per substance, not more than 10 l / 10 kg of highly or extremely flammable liquids in the same room).
- Larger amounts of hazardous substances, especially flammable liquids, must be kept in suitable storage rooms or safety cabinets.
- No corrosive substances may be kept in safety cabinets for flammable liquids, unless they are also flammable (e.g. acetic acid). Corrosive acids such as concentrated hydrochloric

acid, nitric acid or sulfuric acid can destroy safety cabinets from the inside within a short period of time.

- Acids and lyes/bases must be kept in special corrosion-proof cabinets for chemicals (acid and lye cabinets).
- Toxic substances must be kept under lock and must not be accessible to unauthorized persons.
- Hazardous substances and chemicals may only be kept in containers shaped and marked in a way that excludes any mix-up with food.
- All hazardous substance containers (including waste containers) must be labeled and marked with the name of the substance and with hazard pictograph(s) according to GHS in a clearly identifiable and unmistakable way.
- For hazardous substances bottled by employees themselves, the simplified labeling method according to GHS is to be used (name of the substance, hazard pictogram(s) with hazard designation):

						
Explosiv	Selbst-entzündlich	Extrem entzündbar	Leicht entzündbar	Entzündbar	Oxidationsmittel	
Explosive	May ignite spontaneously	Extremely flammable	Highly flammable	Flammable	Oxidizers	
						
Lebensgefahr	Giftig	Ätzend/ Korrosiv	Allergisierend bei Hautkontakt	Gesundheitsschädlich	Reizend	Betäubend
Fatal	Toxic	Corrosive	May cause an allergic skin reaction	Harmful to health	Irritant	Narcotic
						
CMR-Stoff Kat. 1	CMR-Stoff Kat. 2	Schädigt die Organe	Kann Organe schädigen	Allergisierend beim Einatmen	Aspiration lebensgefährlich	
CMR substance cat. 1	CMR substance cat. 2	Causes damage to organs	May cause damage to organs	May cause allergy if inhaled	Aspiration toxicity	
Reagiert heftig mit Wasser	Kann gefährlich altern	Im trockenen Zustand explosiv	Entwickelt giftige Gase mit Wasser/ Säure	☐ bei Einatmen ☐ bei Hautkontakt ☐ bei Verschlucken	 Ungeprüfter Forschungsstoff	
Reacts violently with water	Can age dangerously	Explosive in dry state	Develops toxic gases with water/ acid	if inhaled/ in contact with skin/ if swallowed	Untested research substance	

- Hazardous substances stored in breakable vessels may only be transported in safe transport containers (e.g. plastic buckets or metal boxes).
- Operating instructions must be written and made available for all hazardous substances in stock. The instructions can also be provided in electronic form as long as all employees can access them. The hazardous substance registry DaMaRIS is especially suitable for this purpose.

V. Additional protective measures

- Deadly poisonous or extremely flammable substances handled or kept at the workplace are limited to the following amounts:
 - 500 ml for extremely flammable or deadly poisonous liquids (per substance, max. 10 substances)
 - 100 g for pyrophoric or deadly poisonous solids
 - Lecture bottles for deadly poisonous gases (e.g. CO, H₂S)
- Deadly poisonous or organ-damaging substances may only be handled by qualified persons who have been instructed accordingly.
- Substances with properties of this kind may only be handled in closed systems (e.g. fume hoods).
- In case it is inevitable to use substances of this kind outside of fume hoods, it might be necessary to take measurements in order to prove that the limit values are upheld (or to hand in proof by means of other, equally suitable calculation methods).
- Only qualified persons may enter laboratories where substances of this kind are handled.



VI. Special protective measures for work with substances classified as carcinogenic, mutagenic or toxic for reproduction (CMR substances)

- Any CMR substances handled must be limited to the smallest amount possible.
- Work must only be carried out in closed systems (fume hood, glove box, or similar).
- Hazard areas where CMR substances are handled must be marked with warning signs.
- While handling CMR substances, only qualified persons working with these substances may access these work areas.



Handling of CMR substances
Access only for instructed
persons!

Furthermore, the following rules apply:

- Children under 15 years of age (e.g. school students) must not handle CMR substances, not even under supervision.
- Persons between the age of 15 and 18 years (e.g. older school students, trainees, interns, underage university students) may handle CMR substances in laboratories only under the supervision of qualified staff. Qualified staff are persons who have several years of experience working with hazardous substances in the laboratory.
- Pregnant or breastfeeding mothers must not handle CMR substances and must not come into contact with substances of this kind. The same applies to substances that are toxic and/or toxic to organs. When a pregnancy is reported, the supervisor must release the pregnant person from any laboratory work and transfer her to a safe workplace until a specific hazard assessment of the respective workplace has been carried out to decide whether and under which conditions she can continue to work in the laboratory.

Pregnant or breastfeeding mothers are generally not allowed to work in laboratories where CMR substances or substances that are toxic or toxic to organs are handled.

VII. Special protective measures against physical-chemical exposure, especially fire and explosion risks

- If possible, volatile flammable hazardous substances should only be handled in fume hoods. If this is not possible (e.g. in the case of chromatographic work methods), any release of vapors of these substances must be prevented in order to avoid any ignitable vapor-air mixtures. Suitable measures are forced draft enclosures, source extraction or absorption cartridges for vapors escaping from waste bins.
- Open flames and very hot surfaces (e.g. heat guns) are to be avoided close to flammable liquids and gases. The vent of a heat gun reaches temperatures of over 500 °C, meaning that all flammable liquids used in the laboratory could suddenly self-ignite.
- Numerous organic solvents can form peroxides (e.g. in ethers, aldehydes, ketones, dienes, secondary alcohols). Light, especially direct sunlight, benefits the formation of peroxides, which is why solvents must always be stored away from light. Solvents that are particularly sensitive to the formation of peroxides should be tested for peroxides before use, especially if it is intended to remove the solvents via distillation in the course of the application.
- When bottling flammable organic solvents, electrostatic charges must be avoided. Storage vessels or waste bins with a filling volume of over 5 liters must therefore be conductive.
- Flammable solvents may only be bottled in a fume hood. It is not permitted to set up storage vessels with an outlet tap in a safety cabinet or to bottle solvents from an open cabinet.

VIII. Hazardous work

Any work with hazardous substances that are explosive, extremely flammable, carcinogenic, mutagenic, toxic for reproduction or toxic to a life-threatening degree or any work with machines in a vacuum or under pressure, with Carius tubes and autoclaves, corrosive compressed gases, open flames or heat guns at the highest level or any work involving oxidation, hydrogenation, nitration, ozonolysis, etc. is considered hazardous work.

- Carrying out hazardous work outside of the main working hours prescribed by a department is subject to a specific hazard assessment and a written permission by the respective superior.
- Hazardous work must only be carried out with appropriate safety measures in place (e.g. in a fume hood, behind protective screens, in special laboratories etc.).
- Employees carrying out hazardous work must be instructed on all potential dangers and emergency measures.
- An appropriate emergency plan must be in place. Hazardous work must not be carried out alone. Working times of employees must be coordinated to ensure that at least two employees are present at all times to check on each other regularly. Otherwise, appropriate alternative safety measures must be taken.

IX. Working overnight

Chemical reactions which need to be continued overnight must only be performed in night working rooms designed for this purpose and equipped with according safety systems (smoke or heat alarm system, water monitoring, automatic fire extinguishing system) and with suitable equipment (e.g. magnetic stirrers, contact thermometers, fixed gas and water hoses, safety drip pans). Continuing work of this kind beyond the main working hours is not permitted in standard laboratories.

Exceptions are possible for work with non-flammable reagents that are only stirred at room temperature without any additional heating, cooling or other reactants. The respective head of the laboratory working group is in charge of granting these permissions.

X. Fume hoods

Every person using a fume hood must be instructed on its technical functions. Particularly special fume hoods, such as fume hoods with fume scrubbers for corrosive or highly dangerous acids, require detailed instructions. Working in fume hoods with variable air volume (VAV systems) is also subject to instruction.

The information flyer BGI 850-2a provides a short overview of the functions of laboratory fume hoods. The Occupational Safety Department can be consulted in case of questions.

- The front sash of fume hoods should always be closed if possible. Necessary adjustments may only be made using the adjustment slots (horizontally adjustable screens).
- The sliding screens for exhaust air at the back of older fume hoods models should generally be kept open.
- The fume hoods must be regularly checked if they are still fully functional (older models: paper strips or wool threads, newer models: optical and acoustic displays).
- It is prohibited to sit in front of an open fume hood during an ongoing chemical reaction.
- Fume hoods must be regularly checked by service technicians and labeled as functioning (green label) or malfunctioning (red label). The label contains both the desired air volume and the actual air volume of every hood. Red labeled fume hoods must not be used. Further use may be possible to a limited extent, but only upon consultation with the Occupational Safety Department.
- Any malfunctions discovered by employees must be reported immediately; the defective fume hood must not be used until repaired.



XI. Waste

All types of chemical waste must be collected separately in the designated waste bins. Using canisters or containers other than those provided by the waste delivery points is not allowed.

- If possible, different types of waste should be separated.
- The containers must be clearly marked and kept in a safe place (small amounts up to max. 5 liters in drip pans in the fume hood, larger amounts in a safety cabinet for solvents or in a cabinet for chemicals or acids and lyes).
- Depending on the quality, chemicals in original containers can be reported to the chemicals exchange (DaMaRIS or waste storage) as recyclable materials for further use or disposed of as laboratory chemicals.

- Reactive and especially hazardous substances (alkaline metals, metal hydrides, cyanides, catalysts, acids, lyes etc.) must be deactivated or neutralised before disposal at the delivery points “Zentrales Chemikalienabfall-Zwischenlager” (INF 269) or “Abfalllager im Theoretikum” (INF 367). In case of doubt, the “Zwischenlager” (tel.: 54-8547) provides help as well as an instruction manual on the disposal of reactive waste.
- Biological agents must be disposed of at the incineration plant (clinical waste or infectious waste) or autoclaved before disposal.
- Genetically engineered organisms must always be autoclaved before disposal.

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Universität Heidelberg
and
Universitätsklinikum Heidelberg

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ANNEX 3

COMPRESSED GASES

AND

CRYOGENIC LIQUIDS

I. Compressed Gases

A few facilities of Heidelberg University and Heidelberg University Hospital have access to fuel gas from the urban gas pipeline network (town gas). In all areas without town gas, gas cartridges or individual gas cylinders are used to supply the fuel gas tapping points, mostly by use of liquid gas (propane/butane, "camping gas") as a substitute for natural gas.

- 1) Rooms in which fuel gas is distributed to individual tapping points from a central supply system or from gas deposits/gas cylinder cabinets have to be equipped with a gas emergency power-off button outside the room that can deactivate all existing fuel gas supply pipelines.
- 2) Tapping points for fuel gas are equipped with yellow rotary fittings. They may only be used for burners that are suitable for fuel gas. Depending on the gas used, laboratory gas burners require different types of gas outlets.
- 3) Before using a gas burner, all gas-conducting hoses must be visually checked for tightness.
- 4) Town gas is lighter than air and generally exits through the laboratory ventilation. Liquid gas, however, is heavier than air and can accumulate near the floor, where the laboratory ventilation is not as strong. It is therefore always possible that using liquid gas can cause explosive gas-air mixtures to form as a result of uncontrolled gas release.
- 5) Town gas and liquid gas contain odorous admixtures (odorization) so that any leaks in the gas conduction system can be detected immediately. Should you smell gas, all tapping points for fuel gas must be closed immediately, the gas emergency power-off button must be pressed and all employees must leave the area. If the gas odor lingers or is very strong, the fire department must be alarmed and the emergency power-off activated, especially if liquid gas was used and there are reasonable grounds to believe an explosive atmosphere might occur.
- 6) When using methane as a substitute for town gas, employees must bear in mind that methane is not odorized and that leaks are therefore not detectable. Using non-odorized fuel gas is thus to be avoided if possible and may only be handled by qualified staff and with special care. It may be necessary to use gas detectors. Gas burners for methane must be equipped with an automatic gas power-off in case the flame dies (safety gas burner).
- 7) Compressed gas cylinders must be protected from dangerous rises in temperature in order to prevent the steel container from exploding. They must not be operated or be held in readiness without protection in rooms where there is a high risk of fire e.g. due to electric heating devices or open flames, but simultaneously high fire loads such as flammable solvents or highly flammable solids.
- 8) It is possible to temporarily operate compressed gas cylinders without protection in rooms with a high risk of fire, for instance for an experiment, but never permanently. However,

compressed gas cylinders must be removed from such rooms overnight and relocated to a safe place (e.g. safety cabinet or storage room for gas cylinders).

- 9) In rooms without a high risk of fire, compressed gas cylinders containing oxygen, nitrogen, compressed air, noble gases or carbon dioxide may be permanently installed without protection for
- emptying (installed for operation)
 - holding in readiness for emptying (installation will be carried out in the next 24 hours).

The gas cylinders must be secured from falling down by means of a steel clamp or a chain. The storage of gas cylinders has to take place in designated safety cabinets or special storage rooms for gas cylinders.

However, when installing gas cylinders containing asphyxiant gases (nitrogen, noble gases, carbon dioxide), it has to be made sure that no uncontrolled release of gas (e.g. due to an untight valve) would put employees at risk. Noble gases drive out room air, thereby reducing the oxygen content, which may have to be monitored using sensors detecting a lack of oxygen. Carbon dioxide is heavier than air and accumulates near the floor. A concentration of carbon dioxide in the room air of 5 % and above is considered toxic and may have to be detected.

- 10) Rooms in which compressed gas cylinders are installed without protection must have a warning sign on the door reading “Warnung vor Gasflaschen” (“Warning - Gas Cylinders”).



- 11) As a rule, compressed gas cylinders containing gases that are flammable, corrosive, toxic, carcinogenic, mutagenic and/or toxic for reproduction may only be kept and handled in safety cabinets or storage rooms for gas cylinders. Gas cylinders of this kind may only be temporarily operated at the workplace for the withdrawal of gas - ideally inside a fume hood - in case there are no pipelines between the safety cabinets/storage rooms and the workplace.
- 12) In this case the size of compressed gas cylinders should generally be kept as small as possible (lecture bottles, aerosol dispensers).
- 13) Gases that are toxic to a life-threatening degree (e.g. carbon monoxide, hydrocyanic acid, phosgene, hydrogen sulfide) may only be handled in extremely well ventilated rooms. Handling these gases requires a written permission by the superior. Additional safety measures (sensors, warning systems, emergency ventilation etc.) are usually necessary and must be cleared with the Safety at Work department and the hazardous substances officer.

- 14) Compressed gas cylinders may only be transported by means of special gas cylinder carts and with the valve cap screwed on. It is strictly prohibited to carry gas cylinders by hand.
- 15) When using elevators to transport compressed gas cylinders, the external control panel must be used. Persons must not be inside the elevator at the same time!



II. Cryogenic liquids

- 1) Insulated vessels containing liquid nitrogen must always be covered to prevent the condensation of oxygen from the air. The seal must not be airtight because this could cause dangerous pressure in the insulated vessels.
- 2) When bottling and using cryogenic liquids such as liquid nitrogen, appropriate protective equipment must be worn in addition to laboratory clothing (protective gloves against the cold, facial protection). Additional protective equipment (e.g. an apron) might be necessary when handling large amounts or when spilling is likely.
- 3) When using elevators to transport vacuum flasks (Dewar flasks), freezer vessels or storage vessels containing liquid nitrogen or liquid helium, the external control panel must be used. Persons must not be inside the elevator at the same time due to danger of suffocation.

