

# Safety and Health — Safety in the laboratory

of the Faculty of Physics

Vienna, 2019-03-12

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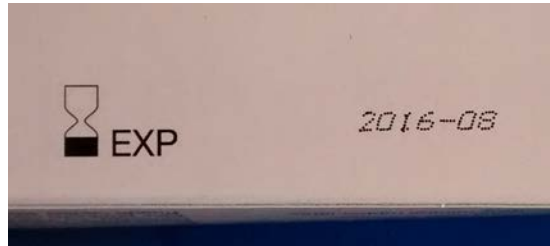
# Handling hazardous substances and chemicals

# Protective equipment in the chemistry lab

- Safety glasses: If the safety glasses cannot be worn over prescription glasses, shields must be used.
- Protective clothing: close-toed shoes, long trousers, long lab coat (cotton).
- Protective gloves: Choose the material according to the specific hazard. (see e.g. [AUVA M 705](#), [DGUV 212-007](#))
- Respiratory protection: single-use masks or respirators (see e.g. [DGUV 190](#))

# Protective equipment in the chemistry lab

- Always check the specification of your protective equipment e.g. expiration dates (e.g. masks), solvent specifications of gloves, wavelength ranges of laser safety glasses, ...
- Exchange old (expired or damaged) protective equipment as soon as possible.



# Dangers to other persons [1]

- All persons working in the laboratories must conduct themselves such that hazards are avoided as far as possible.
- For activities with a high hazard potential, the persons working in the direct vicinity must be informed.

# Cleanliness and tidiness [1]

Cleanliness and tidiness are for the purpose of safety and therefore have top priority. Thus:

- Work materials that are no longer required must be cleaned and put away.
- Work materials that are no longer needed must be removed from the lab bench.
- The lab working space must be cleaned after work is finished.

# Handling hazardous substances

- You need to keep and have read all the material safety data sheets (MSDS) of all substances you are working with.
- These can be found e.g. in the [GESTIS Substance Database of the DGUV](#).
- In case of a chemical accident, the ambulance personnel must be provided with the material safety data sheets of the substances involved.

- Every container must be labeled with a suitable label.
- The label must contain the following information:
  - the composition
  - the owner
  - the corresponding hazardous substance pictogram(s)
- **This also applies to self-mixed chemicals and samples.**
- **Containers and samples without the appropriate label will be disposed of without notice.**



# Handling hazardous substances

- Toxic substances must be stored locked away.
- Chemicals may not be stored above eye level.
- Transport fragile containers in Styrofoam wrapping.
- Substances hazardous to human health and volatile chemicals must be handled under the fume hood.

# Hazardous substances










ECB-Designation	ECB-Pictogram (until 30.5.2015)	Code	GHS-Pictogram (from 1.6.2015 on)
Explosive		E	
Extremely Flammable		F+	
Flammable		F	
Oxidizing		O	
Gases under pressure			

Image source: [Wikimedia \(ECB\)](#), [Wikimedia \(GHS\)](#) (Public domain)

# Hazardous substances











ECB-Designation	ECB-Pictogram (until 30.5.2015)	Code	GHS-Pictogram (from 1.6.2015 on)
Corrosive		C	
Very Toxic		T+	
Toxic		T	
Irritant		Xi	
Harmful		Xn	

Image source: [Wikimedia \(ECB\)](#), [Wikimedia \(GHS\)](#) (Public domain)













# Hazardous substances

ECB-Designation	ECB-Pictogram (until 30.5.2015)	Code	GHS-Pictogram (from 1.6.2015 on)
Environmentally hazardous substances		N	

Image source: [Wikimedia \(ECB\)](#), [Wikimedia \(GHS\)](#) (Public domain)

- The exact definitions can be found in the publication “[Globally Harmonized System of Classification and Labelling of Chemicals \(GHS\)](#)” of the [UNECE](#).
- All hazardous substances, even self-mixed chemicals, **must** be labeled with the correct pictograms.

# Hazardous substances — Combined storage

						
	+	+	0	-	-	-
	+	+	+	+	0	-
	0	+	+	0	-	-
	-	+	0	+	-	-
	-	0	-	-	+	-
	-	-	-	-	-	+

This image is a general overview. Additional information can be found in the material safety data sheets. When in doubt, ask your supervisor.

Image source: [Wikimedia \(GHS\)](#) (Public domain)

# Explosive substances



In addition to the danger of explosion one or more of the following properties may apply:

- The substance itself is unstable
- The substance explodes immediately and completely
- The substance poses a danger of flying splinters when exploding

Fire may, but does not have to be the triggering factor.

Storage conditions must be specific to the substance.

# Flammable substances



This includes the following substances:

- Flammable gases/aerosols/liquids/solids
- Self-decomposing substances and mixtures
- Pyrophoric liquids/solids
- Self-heating substances and mixtures
- Substances or mixtures which emit flammable gases on contact with water
- Organic peroxides

# Flammable substances — Storage



- Observe all storage conditions and constraints on combined storage for flammable substances.
- The amount of flammable substances outside the storage rooms must be kept as low as possible.
- Potential sources of ignition (Bunsen burners, hot plates etc.) must be kept away from flammable substances.
- Storage only in labeled and ventilated (and if needed, cooled) [VbF](#) cabinets or in the storage room for hazardous substances.
- Flammable substances must be kept in closed containers.

Image source: [Wikimedia \(GHS\)](#) (Public domain)



# Flammable substances — Alkali metals



- Alkali metals are highly reactive with lots of other substances like air, water and solvents.
- Especially heavier alkali metals can self-ignite (spontaneously combust) in air.

**General rule: Usage only after consulting the group speaker, the lab supervisor and with adequate safety measures (shielding gas etc.).**

# Oxidizing substances



This includes the following substances:

- Oxidizing gases/liquids/solids
- Organic peroxides

# Gases under pressure



This includes the following substances:

- Gases in pressure cylinders
- Compressed gases
- Liquefied gases
- Refrigerated liquefied gases
- Dissolved gases

# Gases under pressure — General information



- An O<sub>2</sub> sensor must be installed in non-ventilated rooms. The sensor must be checked yearly.
- Rooms with an oxygen content over 20% are safe, under 19% they are dangerous.
- If a gas alert occurs: Open the window, leave the room and inform the lab supervisor.
- The storage rooms and labs **MUST** be sufficiently ventilated (complete exchange of the air 2 to 4 times per hour) and marked (gas cylinder sticker etc.).

# Gases under pressure — General information



- Gas cylinders must be secured against falling over and stored standing upright, **NEVER** lying horizontally.
- Avoid heating of high-pressure gas cylinders over 40°C (liquefied gases) or 60°C (compressed gases).
- **NO** storing in passage ways for pedestrians or cars or on escape routes.
- **NO** storing together with flammable substances.
- **NO** storing of gas cylinders at the place of usage/in the lab.
- Flammable or explosive gases must be stored in special safety cabinets.

Image source: [Wikimedia \(GHS\)](#) (Public domain)

# Gases under pressure — Transport



- The necessary personal protective equipment must be worn when transporting and handling high-pressure gas cylinders.
- Transport only with a suitable cylinder cart (secured with a chain, standing upright).
- Always screw on the safety valve cap, no transport with a pressure regulator unit.
- Never drag or roll a pressure gas cylinder or slide it over the floor.

# Gases under pressure — Transport



- Transport in the elevator must be done only without people.
- For transport in the elevator, a priority key is used. Please ask in your administrative department where to borrow this key.

# Corrosive substances



This includes substances with one or more of the following properties:

- Substances corrosive to metals
- Can lead to corrosion or irritation of the skin
- Can lead to eye irritation or (severe) eye damage

Working with corrosive substances is **not allowed** without adequate protective equipment specific to the hazard at hand.



# Toxic substances



This includes substances with an acute toxicity through oral, dermal or inhalation exposure.



	Pictogram
Toxic substances of classes 1 to 3 (deadly or toxic in (very) small amounts)	
Toxic substances of classe 4 (deadly or toxic in large amounts), corrosion/irritation of the skin and severe damage to the eye/eye irritation are possible. May damage the ozone layer.	
Substances which are only potentially damaging do not have a warning symbol.	

Image source: [Wikimedia \(GHS\)](#) (Public domain)

# Toxic substances



- Working with toxic substances is **not allowed** without adequate protective equipment specific to the hazard at hand.
- Toxic substances may only be obtained and handled by persons with a poison acquisition authorization (“Giftbezugsbevollmächtigung”).
- Toxic substances must be locked in poison cabinets and be inaccessible to unauthorized persons.

# Substances hazardous to human health



Substances with one or more of the following properties:

- Allergenic substances
- Germ cell mutagenicity (mutations in germ cells which can be passed down to descendants)
- Carcinogenicity (cancer-causing)
- Reproductive toxicity (adverse effects on fertility and damage to the unborn child)
- Damaging even on one-time contact
- May enter the respiratory system

Image source: [Wikimedia \(GHS\)](#) (Public domain)

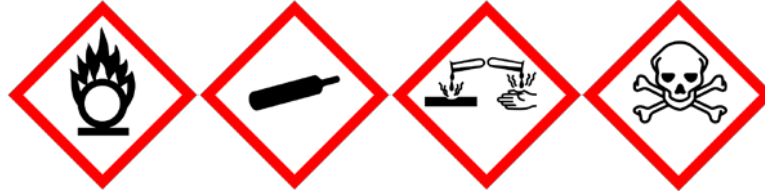
# Environmentally hazardous substances



An environmental hazard is a substance with one or more of the following properties:

- Acute risk to aquatic ecosystems
- Chronic risk to aquatic ecosystems

$F_2$  — Difluor



**Working with  $F_2$  is forbidden in the rooms of the group Physics of Nanostructured Materials because of inadequate safety measures.**

- HF (hydrofluoric acid) is extremely dangerous. Skin contact may make an amputation necessary and might still be deadly even then.
- Peroxymonosulfuric acid (Caro's acid) is a mixture of sulfuric acid and hydrogen peroxide. It is highly explosive.

**Working with HF und Caro's acid is forbidden in the rooms of the research group Physics of Nanostructured Materials**

- Recommendations for cleaning methods: plasma cleaning, flushing with deionized water and air-drying.

# Disposal of chemicals

- Storage containers for solvents must be approved for this purpose and have a volume of 5 liters maximum.
- The substances in the container must be declared on the outside.
- The storage containers must be kept in the collecting tub.
- Never completely screw the lid of the container down while collecting waste so gases can escape.
- Storage containers must be filled to a maximum of 90%.
- Dispose of potentially reactive waste separately as single chemicals.

# Disposal of chemicals

- Halogenated solvents must be disposed of separately from non-halogenated solvents.
- Heavy metals may not be disposed of with the solvent waste.
- Small amounts of water in the solvent waste are not a problem as long as the waste is still combustible.
- Reagents may be disposed of with the solvent waste as long as chemical reactions will not occur and the amount is small.



# Disposal of chemicals

- Chemical waste is collected for disposal twice per year. Please contact [Daniel Gitschthaler](#) (Extension 73803).
- Very small amounts can be disposed of at the “Chemie-Lagerraum” of the Faculty of Chemistry (inner courtyard, near the passage way to Währinger Straße 42) on Tuesdays and Thursdays 14:00–15:00.

# Using the students' machine shop

# Using the students' machine shop

- Responsible: [Stefan Loyer](#) (Extension 72605)
- To get a key you have to:
  1. Successfully complete the course [260081](#).
  2. Sign the form “Workshop regulations of the student workshop”.
  3. Stefan Loyer will verify the form and sign it.
  4. Bring the signed form to the dean’s office (Ms. Hofböck) to receive a key.
- In the students’ machine shop it is **forbidden to work alone**.

# Using the students' machine shop

- Using safety glasses and a hair net (in case your hair could be pulled into the rotary cutter or the drill) is mandatory.
- Use gloves if necessary, but never with rotating parts.
- Never leave the key in the chuck of the lathe. There is danger of death.
- Clean up the machine shop after your work is done.
- Contact Stefan Loyer if parts are missing or cannot be used anymore.

# Ultra-cold environments

# Protective gear in ultra-cold environments

- **NEVER** touch bare pipes or containers with cryogenic liquids (e.g. liquid nitrogen) with your bare skin. Your skin will stick to these cold materials. Even non-metallic material is dangerous to touch at such low temperatures.
- Wearing big, dry leather gloves or cryo-gloves (not tight-fitting) is therefore **mandatory** when handling objects which come in contact with cryogenic liquids or vapor.

# Protective gear in ultra-cold environments

- Wearing close-toed safety boots is **mandatory**.
- Face protection or protective glasses are recommended during the transport and handling of cryogenic liquids.

# Transporting liquid gases and dry ice



- Transport in the elevator must be done only without people.
- For transport in the elevator, a priority key is used. Please ask in your administrative department where to borrow this key.



# Storing/using liquid gases and dry ice

- An O<sub>2</sub> warning sensor must be installed in the room where these materials are kept and used.
- Rooms with an oxygen content over 20% are safe, under 19% they are dangerous.
- If a gas alert occurs: Open the window, leave the room and inform the lab supervisor.
- The storage rooms and labs **MUST** be sufficiently ventilated (complete exchange of the air 2 to 4 times per hour) and marked (gas cylinder sticker etc.).

# Storing/using liquid gases and dry ice

- The volume expansion during vaporization of liquid gases is large (e.g. 700 times for liquid helium and liquid nitrogen).
- Safety valves must **ALWAYS** be defrosted and working. If this is not the case, Dewar flasks and other storage containers may explode.

# Design and content

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