

Safety Instructions for GSI
Vacuum Laboratories
(LBH & TES)

This laboratory safety instruction provides principal rules for working in the vacuum laboratory. All activities within the laboratory have to be carried out in a manner consistent with the safety rules that are provided in this laboratory safety instruction.

The main source of danger in the laboratory are represented by:

- a. Compressed gas cylinder (N₂, Ar, He, Kr, CO, H₂)
- b. High voltage (around 7kV)
- c. High current (around 80A)
- d. High temperatures (up to ~ 300°C)
- e. Inflammable materials
- f. Dangerous to health materials
- g. Crane

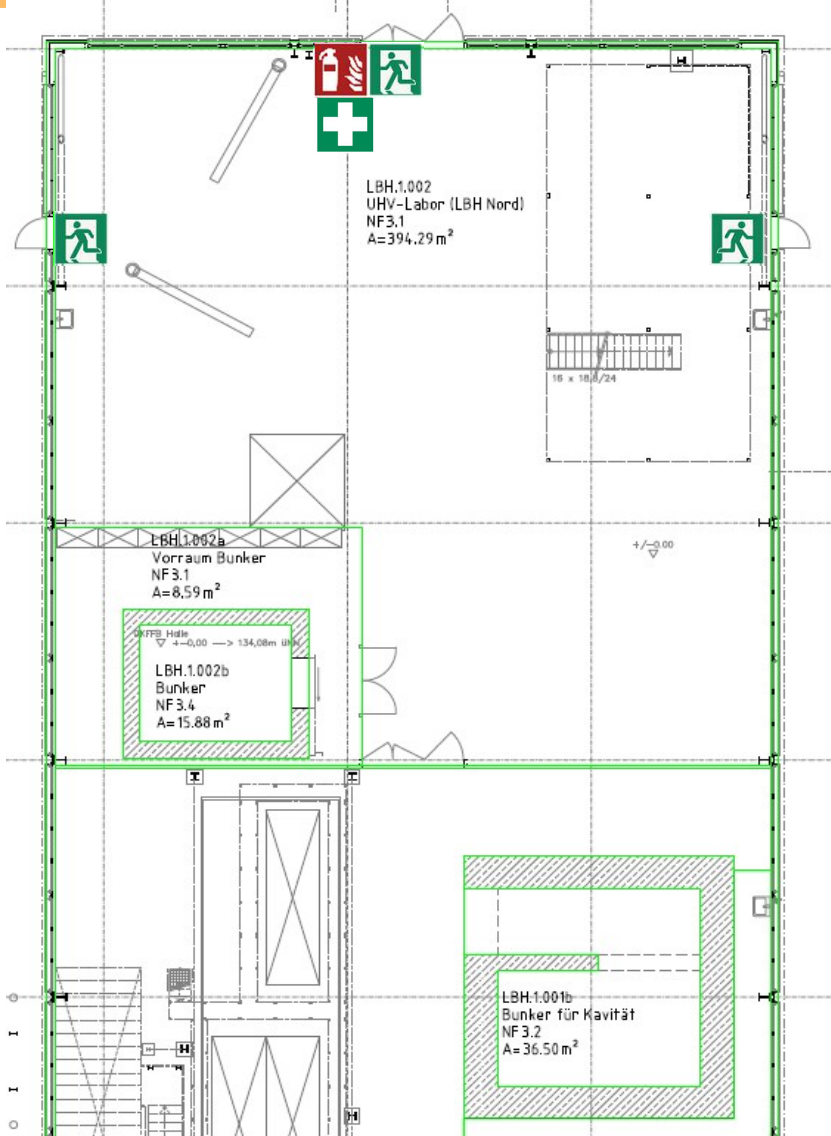
General rules to follow in the laboratory

- While working in the laboratory you must wear safety shoes.
- While working in the laboratory on the vacuum systems, you must wear approved safety gloves – when necessary.
- Do not smoke, eat, or drink in the laboratory (Exemption: LBH Empore)
- Before beginning to work in the laboratory you should be familiar with the procedure you will be following, as well as with any special precautions.
- No unauthorized experiments may be performed. No unauthorized person can enter the laboratory.
- Before leaving the laboratory wash your hands carefully.

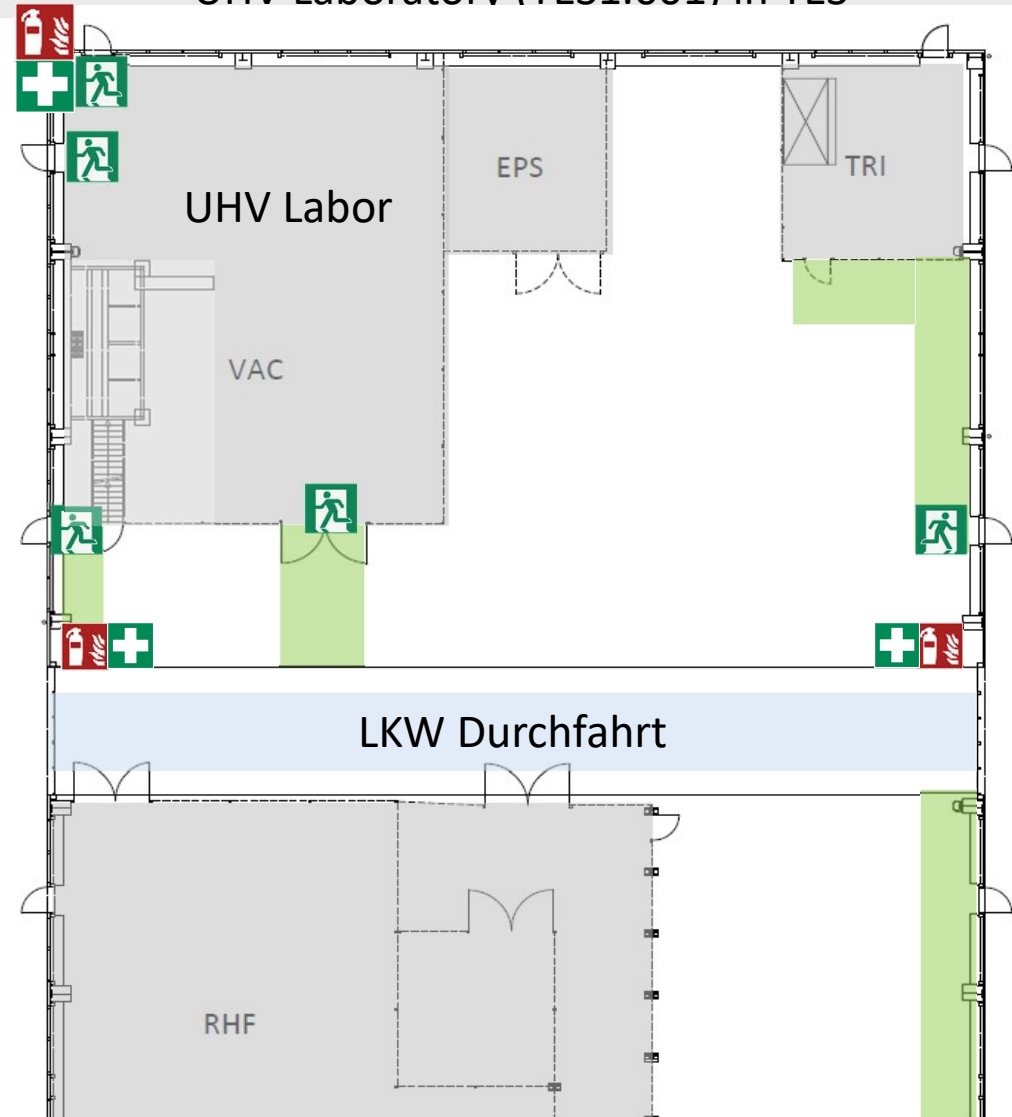


Escape route, fire extinguisher, first aid

UHV Laboratory LBH.1.002 North



UHV Laboratory (TES1.001) in TES



Compressed Gas Cylinders and Hazardous gases



In the UHV laboratory following gases in compressed gas cylinders might be used: N₂, Ar, He, Kr, CO, H₂

Compressed gas cylinders can be extremely hazardous when misused, and they can present a variety of hazards due to their high pressure and/or content.

Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards.

Gases used maybe:

- Flammable or combustible



- Corrosive



- Explosive



- Poisonous



- Inert



- Acidic



- Reactive



- Combination of hazards



Careful procedures are necessary for handling the various compressed gases, cylinders, regulators or valves used to control gas flow, and the piping used to confine gases during flow.

Compressed Gas Cylinders: handling and use

Before cylinders are used, the following precautions should be taken:



- Cylinders must be secured at all time to prevent tipping.
- The cylinder should be placed so that the valve handle at the top is easily accessible.
- Make sure the cylinder is equipped with the correct regulator
- Flammable gas cylinder valves should not be opened more than $\frac{1}{2}$ turns of the spindle, and preferably no more than $\frac{3}{4}$ of a turn. This reduces the risk of explosion and allows for the cylinder valve to be closed quickly to cut off the gas flow.
- Inspect the regulator and cylinder valves for grease, oil, dirt, and solvent. Never use grease or oil to lubricate regulators or cylinder valves because they can cause an explosion.
- When using toxic or irritating gas, the valve should only be opened while the cylinder is in a working fume hood.
- Fire extinguishing equipment should be readily available when combustible materials can be exposed to welding or cutting operations using compressed cylinder gases

Compressed Gas Cylinders: handling and use



- Use appropriate material, such as chain, plastic coated wire cable, commercial straps, etc., to secure cylinders.
- Only properly trained personnel should handle compressed gas cylinders.
- Back off the pressure adjusting screw of the regulator to release spring force before opening the cylinder valve.
- Open the valve slowly and only with the proper regulator in place. Stand with the cylinder between yourself and the regulator (cylinder valve outlet facing away) when opening the cylinder valve.
- Never leave the valve open when equipment is not in use, even when empty; air and moisture may diffuse through an open valve, causing contamination and corrosion within the cylinder.
- Do not refill a cylinder, mixing of residual gases in a confined area may cause a dangerous reaction.
- Never use compressed gas to dust off clothing, this could cause injury to the eyes or body and create a fire hazard. Clothing can become saturated and burst into flames if touched off by an ignition source such as a spark or cigarette.
- Never keep the regulator under pressure when it is not in use.
- Valve protection caps should remain in place until ready to withdraw gas, or connect to a manifold.

Hazardous gases: handling and use

- Cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders connected to a closed system.
- Do not force connections that do not fit.
- Close the cylinder valve and release all pressure before removing the regulator from the cylinder.
- Use the cylinder valve for turning gas off, not the regulator.

Workers should wear safety glasses and safety gloves when handling and using compressed gases, especially when connecting and disconnecting regulators and lines.



Compressed Gas Cylinders: moving cylinders

- Never drag, slide or roll a gas cylinder. Always use a cylinder cart or basket.
- Always have the protective cap covering the valve when transporting the cylinder.
- Never transport the cylinder with the regulator in place.
- Make sure the cylinder is secured to the cart before moving it.
- Do not drop cylinders or strike them against each other or against other surfaces violently.
- Do not use the valve cover to lift cylinders; they could be damaged and become unattached. If the cylinder is dropped on a hard surface it can cause an explosion.

➤ Hazardous gases: first aid

- **After inhalation:** Have some fresh air.
- **After clothing contact:** Take off moistened clothes, clean with suitable agents or store it outside.



Handling and use of Liquid Nitrogen (LN₂)

- Avoid eye or skin contact with this substance.
- Never handle LN₂ with bare hands.
- Use cryogenic gloves, which are designed specifically for working in freezers below -80°C and for handling containers or vials stored in these freezers.
- Cryogenic gloves need to be loose-fitting so that they can be readily removed if LN₂ splashes into them.
- Always use appropriate eye protection.
- Do not use or store LN₂ in confined areas: a leak in such an area could cause an oxygen-deficient atmosphere.
- Never store a cryogen in a sealed, airtight container at a temperature above the boiling point of the cryogen; the pressure resulting from the production of gaseous carbon dioxide or nitrogen may lead to an explosion.



Handling and use of Liquid Nitrogen (LN2)

- LN2 should only be handled in approved containers: ***Do not transport in uncovered containers***
- Do not leave open containers unattended.
- There is an increased risk of explosion and fire.
If air comes into contact with liquid nitrogen (e.g. open Dewar vessels), atmospheric oxygen can condense into the nitrogen. Over time, liquid oxygen can accumulate in the nitrogen and react explosively when it comes into contact with flammable substances.

➤ **Liquid Nitrogen: first aid**



- In case of exposure to cryogenics or dry ice, remove any clothing that is not frozen to the skin. Do NOT rub frozen body parts because tissue damage may occur. Obtain medical assistance as soon as possible.
- Place the affected part of the body in a warm water bath (not above 40°C). Never use dry heat.

Ion Getter pumps

- ✓ The ion getter pumps (IP) may only be operated with an associated operating device that supplies the IP with the high voltage. If damage is detected on the high-voltage connection of the ion getter pump, on the operating device or on the high-voltage cable as well as its insulation, the high-voltage supply must be switched off immediately.
- ✓ When working on ion getter pumps, always ensure electrical safety and suitable grounding.
- ✓ All work on the unit must be carried out by trained personnel only! Improper use can lead to life-threatening injuries!



Dangerous electrical voltage until 7 kV



Strong magnetic field



Danger of crushing

Ion Getter pumps

- ✓ The ion getter pumps have magnets with a strong magnetic field. Electronic devices and data carriers can be damaged or destroyed by them. A minimum distance of approx. 20 cm must be maintained.
- ✓ Special care must be taken when assembling/disassembling and handling the magnets. Due to the strong magnetic fields, fingers and hands may be crushed if the magnets attract each other or come into contact with other magnetic parts!



Dangerous electrical voltage until 7 kV



Strong magnetic field

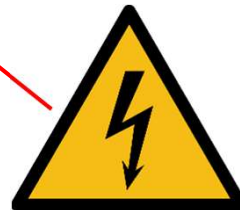
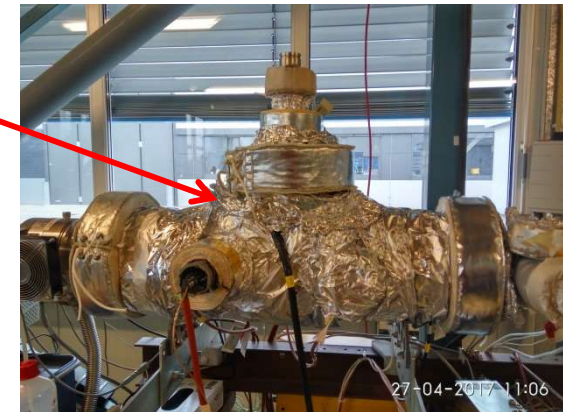
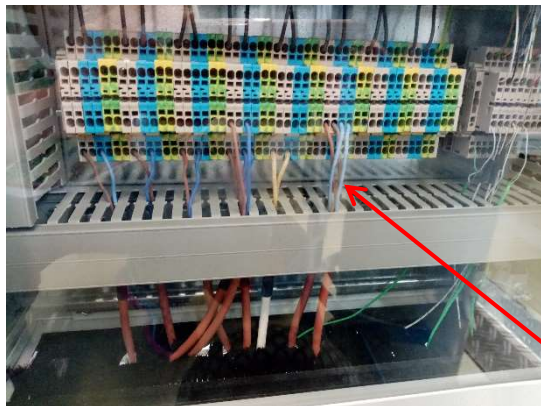


Danger of crushing



Bakeout of the Vacuum Systems

Bakeout of vacuum systems are performed frequently in the vacuum laboratory. The heating temperature can reach up to 300°C. During this process, the risk of burning and of high voltage up to 400 V AC shock are present.



During bakeout of vacuum systems the test benches are locally locked and marked with the corresponding warning signs.

Flammable Materials

- Flammable materials are also present in the laboratory, e.g. NEG pumps in the form of cartridges (e.g. SAES CapaciTorr), NEG/ion getter combination pumps (e.g. SAES NexTorr) and NEG wafer modules (e.g. SAES SORB-AC) if they are not operated correctly.
- In the case of NEG pumps: Air must not suddenly enter the vacuum system during activation or the regeneration process. Such a process can lead to oxidation of the getter material if the temperature of the getter is above 100°C and the oxygen pressure is higher than 0.1 Torr. At higher getter temperature and higher oxygen pressure, oxidation may take the form of a combustion reaction, which in any case is slow and progressive and not explosive.

 In this case, the surrounding vacuum chamber may also become **hot**.



The cranes in the vacuum laboratory may only be operated by trained personnel who have completed the GSI crane training annually.

When working with cranes, the operating instructions "Lifting gear" must be observed.

Dangerous to health materials: working with Beryllium



Vacuum acceptance tests of Beryllium windows are sometimes carried out in the vacuum laboratory and the tests can be performed just from trained personnel.

- No tests are allowed before reading, understating, and signing the to documents: **"Betriebsanweisung gem. §14 GefStoffV für Beryllium"** and **"Verfahrensanweisung zur Bestellung und Einsatz von Beryllium"**
- The test of Beryllium components can be carried out just into the foreseen setup
- Use always a mask, lab coat, glasses, and gloves while mounting the Be windows



Commissioning of measuring set-ups

Very often the measuring set-ups are modified or newly built. Please pay attention to:

- cables



- vacuum pipes



- pumps



- etc.



Working with pressurized air

Safety glasses must be worn when handling compressed air. Serious injuries occur when a jet of compressed air penetrates the human body. Make sure that the people around you will not get harmed.



Workplace accident



After accidents at work only medical doctors with a special license of the Accident Prevention & Insurance Associations are entitled to perform a curative treatment ("Durchgangsarzte"). You will find an updated list of these physicians in the area of Darmstadt in the GSI website: www.gsi.de/Unfall.

After the consultation with the medical doctor, you must inform your supervisor how long you will be incapable of working. If you cannot work for more than 3 days, the accident has to be reported to the Accident Prevention & Insurance Association. You have to inform the safety engineers as soon as possible, so that this notification can be reviewed within three days.

Small injuries due to accident in the work place do not need to be reported, if they do not result in an absence from working of more than 3 days. In this case it is sufficient to record the accident into the first aid kit log book, which you will find in any first aid kit. By doing this, it could later prove the connection between the injuries resulting from an accident and your working activity, if the healing would not be reached, or if more consultations would be necessary.

Please report any accident as soon as possible to the safety engineers.

Ich habe die Sicherheitsunterweisung (General instruction_English.pdf) für das Vakuum Labor (LBH&TES) der Abteilung Vacuum Systems (VAC) gelesen und verstanden.

Name:

Datum:

Unterschrift: