



# Safety for users

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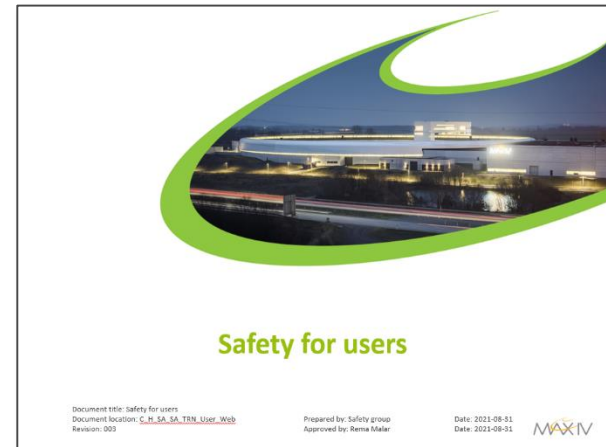
Date: 2021-08-31  
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# Introduction

“Safety for users” (this training) and the successful completion of the associated safety test is required to get basic access to the MAX IV facility and access to the beamline-specific areas of the beamline where you have beam time.

In addition to this training, each user is also required to attend an on-site introduction to the beamline by beamline staff at the start of the beam time.



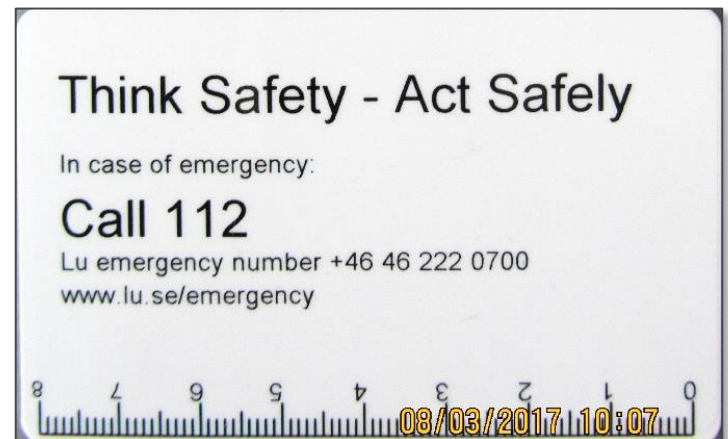
# MAX ID card

After the successful completion of the safety training a MAX ID card can be issued.

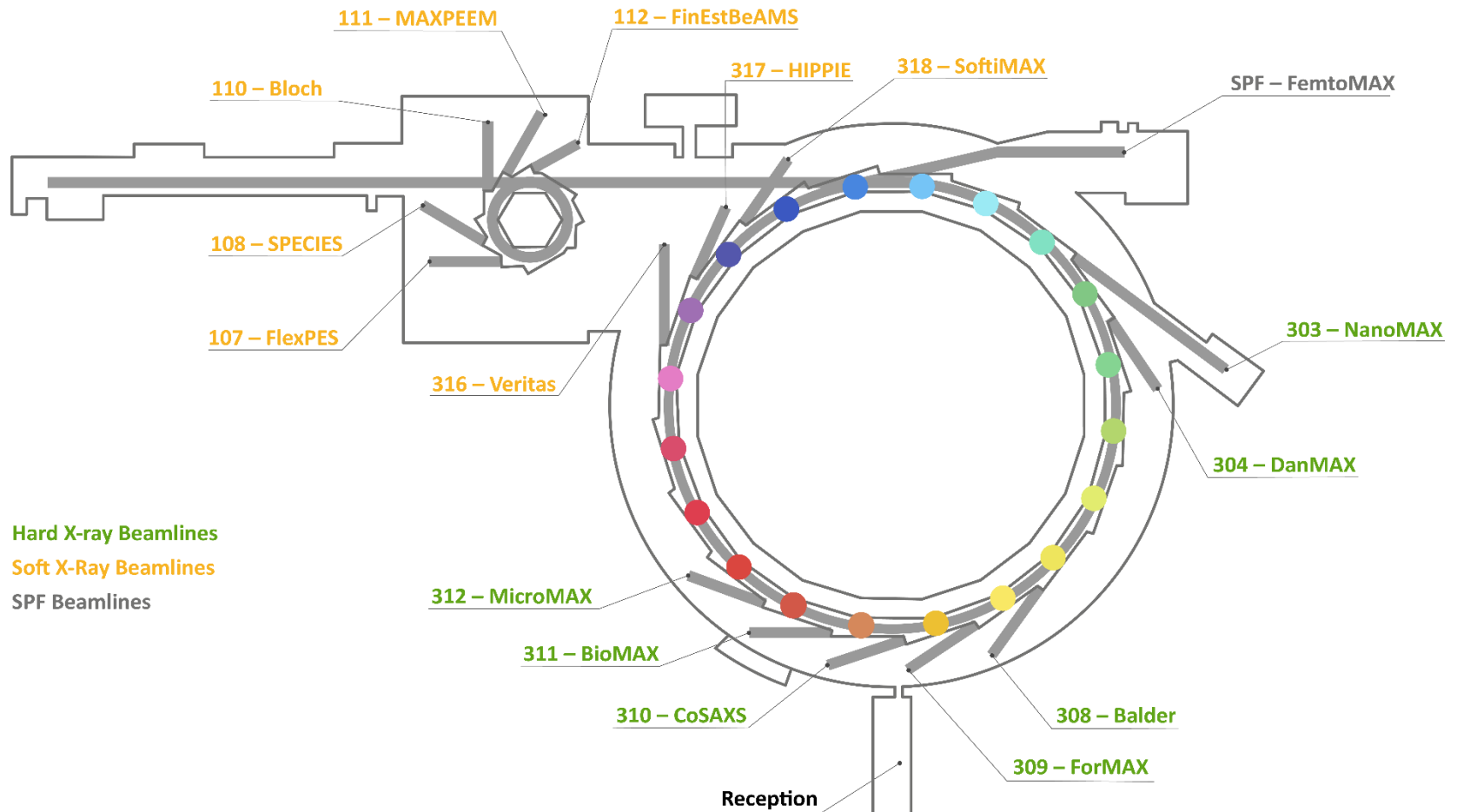
Your MAX ID card is personal. It should be worn at all times while at MAX IV.

You are not allowed to give or lend your MAX ID card to anyone else or to let anyone in who do not have a MAX ID card of their own.

In addition, users are not allowed to bring visitors to the facility.



# Beamline map





# General safety

# Introduction

The MAX IV Laboratory is a working science lab with several potential hazards.

Your co-operation is needed to ensure a safe working environment. Users are encouraged to report deviations for all aspects of safety.

We want to emphasize the importance of also reporting damage to equipment that you accidentally cause. MAX IV ensures that this can be done without concerns of penalties to the individual user.



# Emergency

In case of an emergency, call:  
**Emergency phone number: 112**

Be prepared to answer:

- Who is calling?  
Name and telephone number.
- What has happened?  
Type of accident.
- Where has it happened?  
MAX IV-laboratoriet, Fotongatan 2,  
Lund.





# Evacuation

Evacuate the building when you hear the evacuation alarm (alarm bells or spoken message).

If possible, bring your experiment to a safe state.

Go to the assembly point. Encourage people you meet to evacuate.

The evacuation alarm is set off by the fire detection system or by manually pressing a fire alarm button.





# Fire safety

Locate nearest evacuation routes, fire extinguishers and first aid stations in advance.

Keep flammable materials at your workplace at a minimum.

Do not block evacuation routes.



# In case of fire, explosion or gas/chemical leak

Rescue those who are in danger

Warn persons threatened by the danger

If possible:

- Turn off nearby electric current and fans
- Try extinguishing the fire with suitable material or a fire extinguisher

Press a fire alarm button to start the evacuation alarm

Evacuate the building. Do not use elevators.

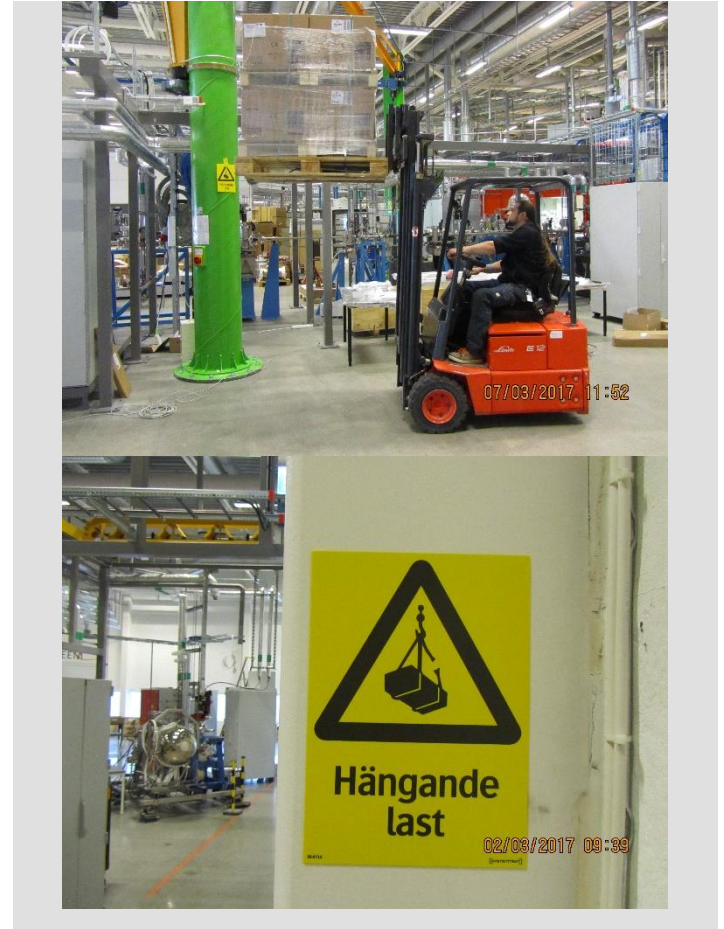
Meet up with the emergency services upon their arrival.



# Trucks, lifts, cranes and on-going construction

Trucks, overhead cranes and other heavy machinery are frequently used at MAX IV – only persons with special training are allowed to operate these machines

- Be aware of your surroundings
- Keep a safe distance from working machines
- Do not walk under a hanging load
- Respect barriers and warning signs – they are there for a reason



# Lasers and magnetic fields

Warning signs are posted outside areas where lasers are used

Blue warning lights are lit when high-power lasers are used in controlled areas

Strong magnetic fields may interfere with electronic devices such as pacemakers

Respect the warning signs.



# Electricity

Only trained personnel are allowed to work with electrical installations

Do not block electrical installations

Do not connect equipment not approved by MAX IV

Never use damaged cords or equipment

Make smart looking connections. Avoid wire tangles and cables lying on the floor





# Security

All the facility's external doors are connected to the burglar alarm

Use only doors with a card reader to enter or exit the buildings

Do not let unauthorized persons inside.



# General safety, fire safety and security

If you have questions or want more information please contact

Björn K Nilsson

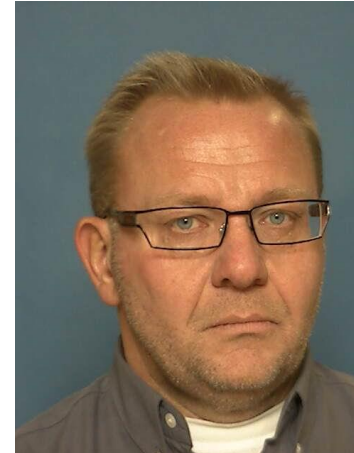
Fire safety officer

+46 (0)730-38 29 42

Stefan Wiklund

Security safety officer

+46 (0)709-32 33 43







# Radiation safety

# Statutory and regulatory requirements

The acts, ordinances and regulations of primary relevance to MAX IV regarding ionizing radiation are listed below for reference (in Swedish).

- Strålskyddslag (SFS 2018:396)
- Strålskyddsförordning (SFS 2018:506)
- SSMFS 2018:1

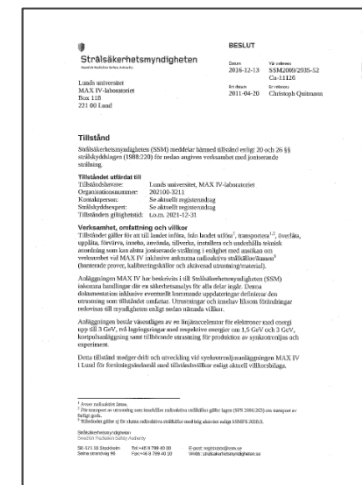
There is also a MAX IV specific licence issued by the Swedish Radiation Safety Authority (SSM) concerning operations at the facility.

Radiation safety related procedures, plans, instructions etc. are part of the MAX IV management system.



**Strålsäkerhetsmyndigheten**

Swedish Radiation Safety Authority



# Risks in a radiation environment

The biological impact of ionizing radiation can be classified as acute or delayed.

- Acute damage occurs at high doses (above 1000 mSv) received over a short period (weeks) and the result is damaged or dead cells. This could lead to reduced functionality or failure of an organ or in severe cases death.
- The risk of delayed damage, i.e. cancer, depends on the received dose. The risk of radiation-induced terminal cancer is 5% per 1000 mSv. The risk also depends on age – fetuses and infants have a higher risk compared to adults.

4800 mSv

Median lethal dose  
(acute damage)

8 mSv

Chest CT scan

3-4 mSv

Average annual dose  
in Sweden

0.3 mSv

Average additional  
annual dose for MAX  
IV employees

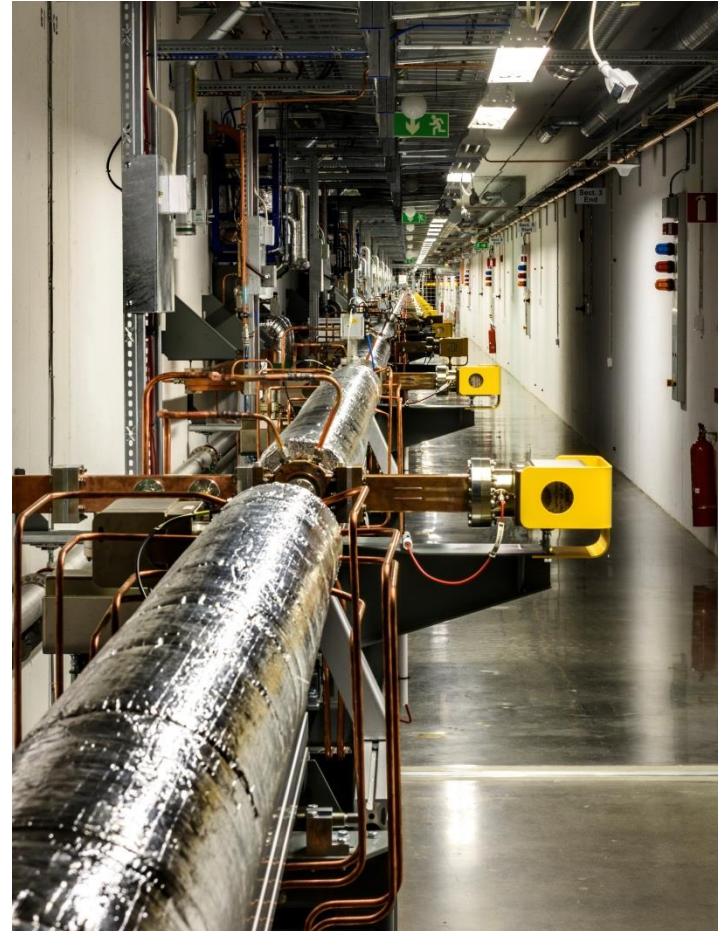
0.05 mSv

Transatlantic airplane  
flight

# Sources of radiation at MAX IV

There are four main sources of ionizing radiation at MAX IV:

- Electrons lost from the accelerators result in gamma and neutron radiation.
- The radiation mentioned above can induce radioactivity in the components of the accelerators and nearby materials.
- Synchrotron radiation, which is used for research at the beamlines.
- The klystrons generate radiation during operation.



# Area designations

Ionizing radiation is produced when the accelerators at MAX IV are in operation. The resulting radiation levels differ between the areas. At MAX IV the areas belong to one of three categories:

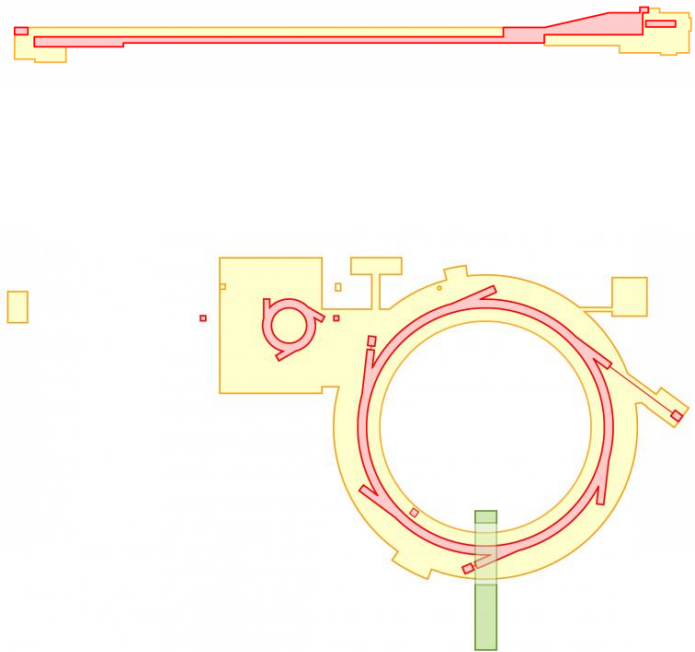
- Controlled areas (high radiation level area)
- Supervised areas (increased radiation levels may be present)
- Non-designated areas

All entry points to controlled (“kontrollerat”) and supervised (“skyddat”) areas are labelled as shown to the right.



# Areas

- In the basement the controlled areas (red) are the gun test room, the linac tunnel, the SPF and the SPF beamline hutch. The remaining areas in the basement are supervised (yellow).
- On the ground floor the controlled areas (red) are the 1.5 GeV and 3 GeV ring tunnels, the beamline hutches, the two entrances to the linac tunnel and the cavity test room. The remaining areas are supervised (yellow), except the main office building, which is a non-designated area (green).



# Dosimeters

A personal dosimeter must be carried in the supervised and controlled areas (the main office building is a non-designated area and is therefore exempt). The personal dosimeter is stored at one of the dosimeter boards when not in use.

Users should typically carry a DIS dosimeter. These can be obtained on the ground floor of the office building, where instructions for use/return are posted.

If you spend more than two months per year at MAX IV, you should carry a TLD. Contact the radiation safety team if this is the case.



DIS



TLD



# Dosimeters in controlled areas

In addition to a personal dosimeter, an electronic dosimeter must be carried within controlled areas such as a beamline experimental hutch. These are available at the entry points.

The electronic dosimeters are always on and you should only check that the battery is OK, i.e. that dose information is shown on the display. The dosimeter shows the accumulated dose in  $\mu\text{Sv}$  since the last reset.

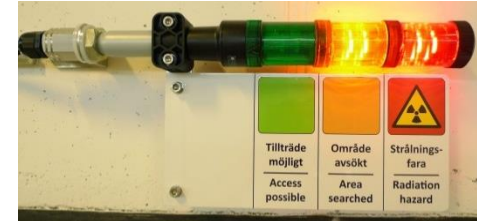


# Access to controlled areas

Controlled areas, i.e. accelerator areas and beamline hutches, are areas where radiation levels may be significant.

All entry points, including concrete doors, leading into a controlled area are marked “Kontrollerat område” (controlled area) and are equipped with information lights above the door.

Instructions are posted at the entrances to the hutches describing how to enter and under what conditions entry is allowed. These instructions must be studied before entry.



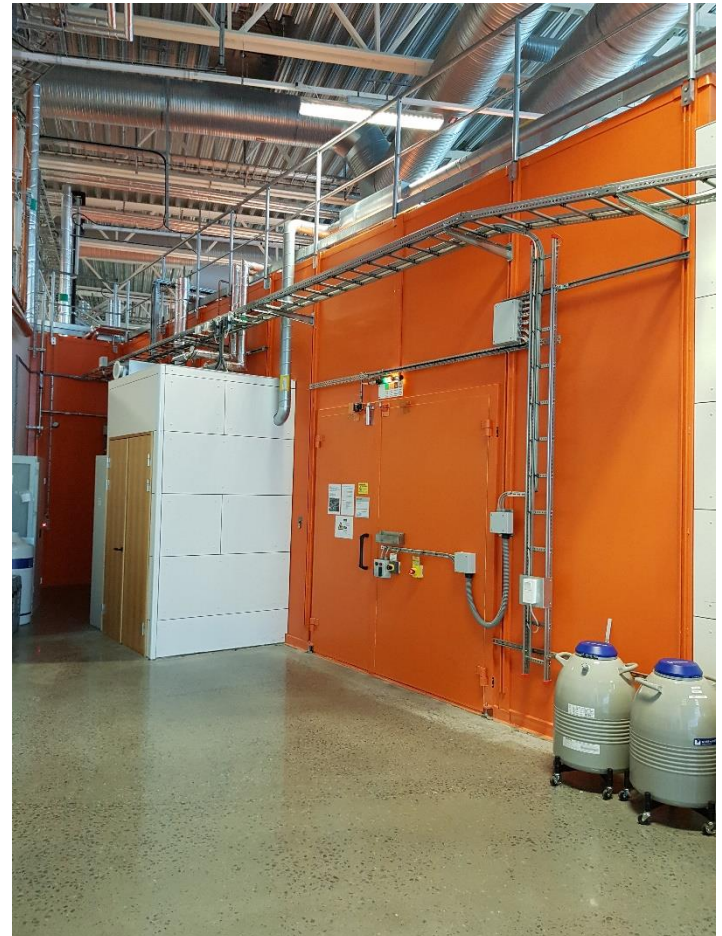
# Access to controlled areas

After successful completion of this training (“Safety for users”) users at hard X-ray and SPF beamlines are allowed to access the experimental hutches at the beamline where they have beam time. Soft X-ray beamlines do not have experimental hutches.

Access to the other controlled areas at the MAX IV facility, i.e.

- optics hutches,
- experimental hutches of other beamlines, or
- accelerator areas

is not allowed.



# Entry to an experimental hutch

The doors to the hutches are locked and a MAX ID card is needed to unlock them. Access is only allowed if the green information light above the door is lit.

The door is unlocked by swiping the access card at the tag reader. The door will not unlock if radiation may be present in the area or if you do not have access. Green and red lights next to the tag reader indicate if the attempt to unlock the door was successful or not.

In the event of an emergency, it is always possible to unlock the door by pressing the black emergency door release button or by turning the emergency thumb turn.



# Inside an experimental hutch

Panels located within the hutch contain sirens and warning lights for radiation hazard (red) and search status (orange).

One of the sirens is active during the search procedure. The other siren is active for 30 seconds when the search has been completed and for 30 seconds when the beam shutters are opened.

If you should see the red lights lit while inside the hutch, you must immediately exit the hutch and tell others to do the same. Press an emergency stop and contact radiation safety on-call after exiting the hutch.





# Inside an experimental hutch

Emergency stops are located inside beamline hutches as well as outside by the entry points to the hutches. The emergency stops shut down all relevant sources of ionizing radiation. Contact radiation safety on-call if you have pressed an emergency stop.

In some hutches additional pull rope emergency stops are installed along the walls.

If an electronic dosimeter alarm is triggered, you must immediately exit the hutch and tell others to do the same. Contact radiation safety on-call in case of a dosimeter alarm.



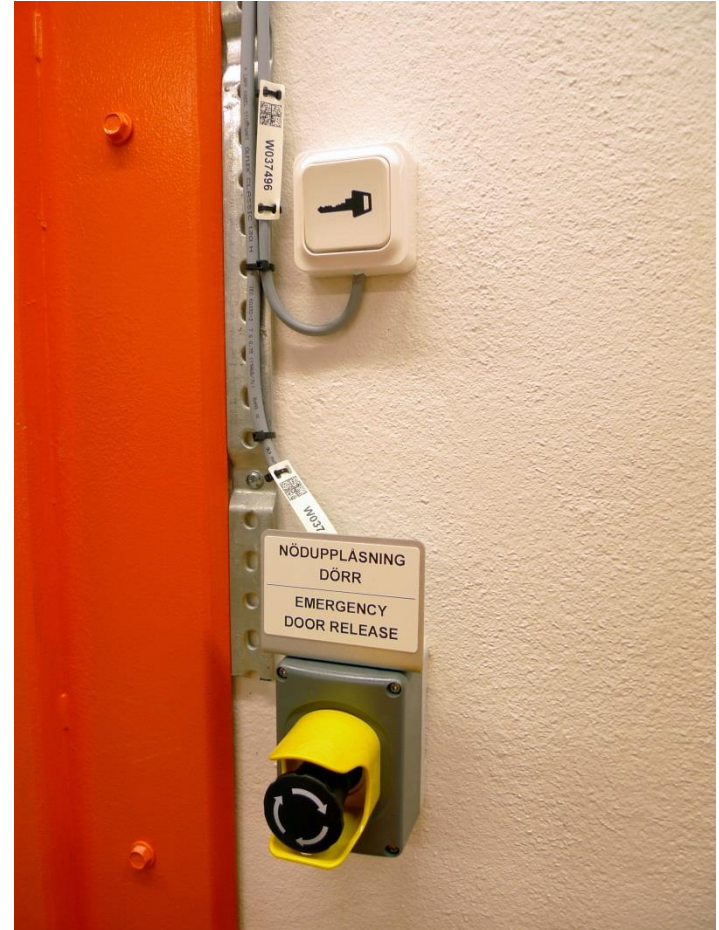
# Exit from an experimental hutch

At the hard X-ray beamlines the doors to the experimental hutch are locked by electromagnetic locks. To unlock the door from the inside, press the button with the key symbol. In the event of an emergency, it is always possible to unlock the door by pressing the black emergency door release button.

At the SPF beamlines, the doors are opened using a standard door handle.

Close the door if you are the last person to exit the hutch.

Return the electronic dosimeter.



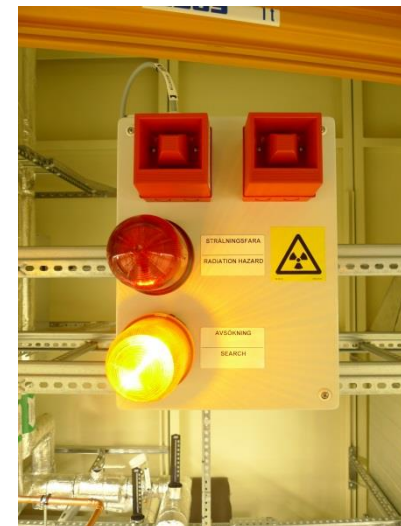


# Search of an experimental hutch

The hutch has to be searched before radiation can be present. An on-site practical training is required to be allowed to search the experimental hutch at the beamline where you have beam time.

The orange warning lights inside and orange information lights outside the hutch flash during the search and are lit when the search is completed. During the search sirens inside the hutch are active.

If you are inside the hutch when someone else starts a search you should quickly exit the area. If this is not possible, you should press an emergency stop, which will abort the search.



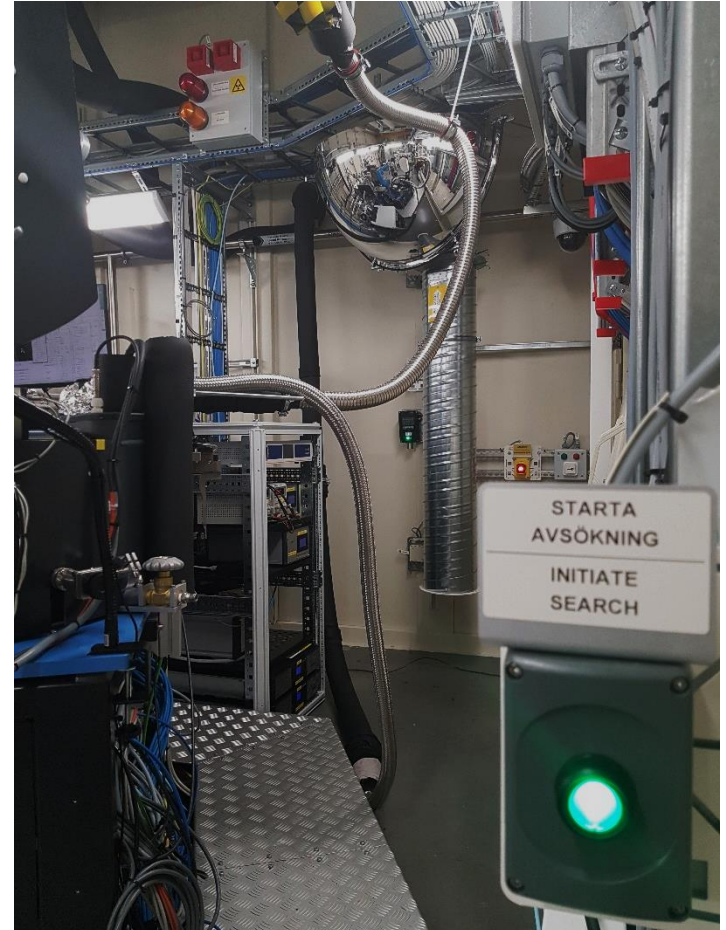
# Performing a search

By performing and completing a search you are personally responsible that no one is left inside the area.

Inform everyone inside the hutch that it will be searched and that they should exit the area.

Close all doors (the main access door that you will use to exit can stay open). If a door is opened during the search, or if the light curtain detects an object, the search is aborted.

Radiation is permitted in the hutch after a 30 second warning period.



# Performing a search

Instructions on how to perform a search are posted at the main entrance to the hutch and presented during the on-site training. The overall procedure is:

1. Press the (green) initiate search button inside the hutch.
2. Ensure that no one is present in the hutch and press the (blue) search buttons as they start flashing.
3. Press the (white) exit during search button, exit the hutch and close the door.
4. Press the (yellow) complete search button.



# User chicane

It is not allowed to open the regular chicanes without a radiological work permit. For temporary cabling a user chicane should be used. The user chicane can only be opened when the hutch is not searched.

Pressing the key button next to the chicane will deactivate the magnetic lock during 10 seconds. Open the chicane while the green light is lit.

Ensure that the magnetic lock is active when the chicane has been closed. It is not possible to initiate a search unless both sides of the user chicane are closed.

Instructions are posted on the chicane.



# Radiological work permits

It is forbidden to modify or remove equipment that may affect radiation safety without prior permission from the radiation safety team.

Examples are shielding material, regular beamline chicanes and equipment related to the personnel safety system. In some cases the equipment is labelled. However, this is not always the case.

Users should not need to perform any such work. If the need should arise, a radiological work permit must be issued together with the beamline staff and the radiation safety team. Contact the beamline staff for more information.





# Local X-ray sources

The end stations of certain soft X-ray beamlines are equipped with local X-ray sources.

Before using such equipment you are required to read the associated local instructions and confirm that you will follow them by signing the appropriate certificate list.



# Additional rules

- It is forbidden to bring radioactive material, sources or any equipment that may emit ionizing radiation (e.g. X-ray tubes, UV lamps) to MAX IV without the prior approval of the radiation safety team.
- Temporarily cordoned-off areas may be employed to protect personnel from exposure to increased radiation levels. Such areas will be marked using radiation hazard signs and access is prohibited.
- Pregnant users are welcome, but can not be required by their employer to come to MAX IV.



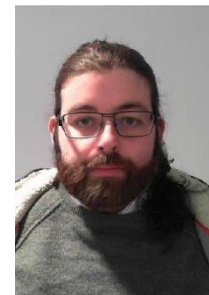


# Radiation safety team

If you have questions or want more information, please contact the radiation safety team.

Radiation safety on-call MAX IV  
(at MAX IV during operation)  
+46 (0)703-97 32 96

Anders Rosborg – *Team leader*  
Stuart Ansell  
Konstantin Batkov  
Magnus Hörling  
Johnny Kvistholm  
Jimmy Malmqvist  
Johanna Paulsson  
Josefin Reftlér  
Brian Wakely





# Biosafety

# Applicable regulations

The regulations below are in Swedish and are listed for reference.

- AFS 2018:4 – Smittrisker
- AFS 2005:6 – Medicinska kontroller i arbetslivet
- AFS 2007:5 – Gravida och ammande arbetstagare



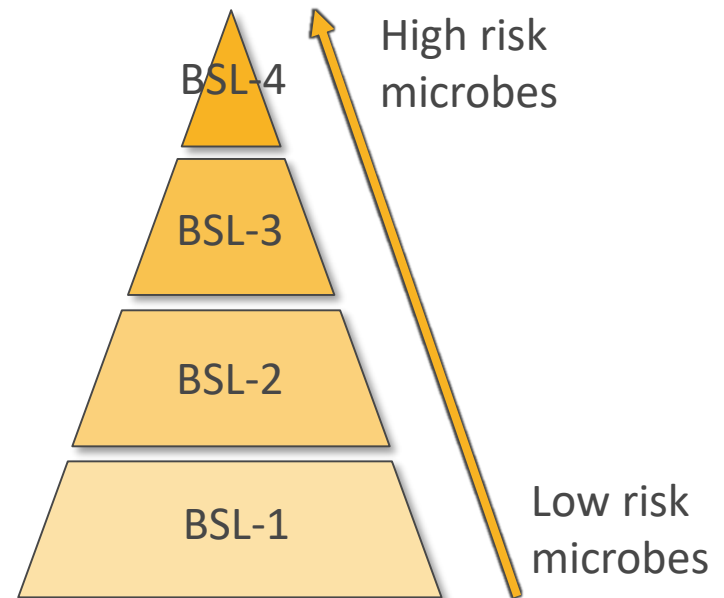
# Biosafety levels

**Biosafety level 4** is the highest level of biosafety precautions.

**Biosafety level 3** is appropriate for work involving microbes which can cause serious and potentially lethal disease via the inhalation route.

**Biosafety level 2** is suitable for work involving agents of moderate potential hazard to personnel and the environment.

**Biosafety level 1** is suitable for work with well-characterized agents which do not cause disease in healthy humans. These agents should pose minimal potential hazard to laboratory personnel and the environment.



# MAX IV: Biosafety level 1

The Biological support lab (Biolab) is open to users and restricted to Biosafety level 1.

It is allowed to handle biological agents fulfilling the criteria for biosafety level 1 at the beamline-attached preparation laboratories but major manipulation of biosamples must be done in the Biolab. Request in access to the Biolab should be made at least two weeks in advance. A separate training from the Biolab manager and approved experimental risk assessment are needed for the access.



Biohazard

# Handling biological agents at MAX IV

- All samples have to be properly labeled and stored in closed containers.
- Only qualified and trained personal are allowed to work with biological agents
- Any incidents or accidents must be reported immediately to the MAX IV Safety group
- If necessary, waste must be decontaminated
- Transportation of biological agents is only allowed with in closed containers that are labeled as Biohazard
- Personal Protection Equipment (PPE) must be used as appropriate
- Hands have to be disinfected and cleaned when leaving the lab or in case of a contamination
- All waste should be discarded through the appropriately designated routes, i.e. sharp, chemical, biological waste containers



# Sample declaration

- All biological samples must be declared in the proposal phase in DUO.
- The samples you bring must correspond to the samples you declared in DUO. This will be checked by your local beamline contact.
- All hazardous samples must be risk assessed and approved by the Safety team. Contact [EST@maxiv.lu.se](mailto:EST@maxiv.lu.se) to receive risk assessment form.
- The users are required to provide ethical authorisation of the research if human samples, cell tissues and their derivatives are to be studied in a proposal
- Any changes of samples must be declared in DUO prior starting the beamtime. All hazardous samples must be declared in DUO and risk assessed two weeks before your beamtime starts. You are not allowed to work with hazardous samples until it has been approved by the safety team.

# Contact information

If you have questions or want more information please contact the biosafety responsible:

Biolab Manager

Yang Chen

+46 (0)722-35 64 46

At MAX IV between 8:30-16:30

[yang.chen@maxiv.lu.se](mailto:yang.chen@maxiv.lu.se)





# Chemical safety

# Applicable regulations

Many regulations in Sweden are in effect for a safe chemical work environment.

Below, the most important are listed for reference:

AFS 2014:43 – Chemical Hazards in the Working Environment

AFS 2015:7 – Occupational exposure limit values

- Local regulations at MAX IV stems from the many regulations and are mandatory to follow during your visit.
- Please adhere to local work instructions, notes and signs posted around the facility.



Folkhälsomyndigheten



Swedish Civil  
Contingencies  
Agency



# Chemical hazard

The term chemical hazard includes both hazardous chemical substances and mixtures when they occur as a chemical product and in other manners.

Other manners may be as exhaust fumes or other air pollution, or in or on a material, plant or technical device.

- Acid spill on aluminium foil (non-hazardous metal) is a classic “hidden” chemical hazard, as the reaction is exothermic and generates flammable hydrogen gas which may ignite/explode.



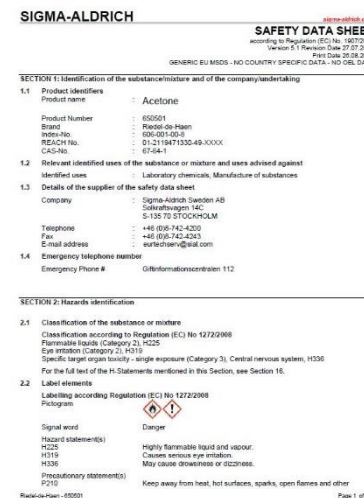
*Hydrogen gas is generated as one of the products between aluminium and an acid.*

# Chemical hazard labelling

Since 1 June 2015 all newly produced chemicals must be labelled and classified according to Classification, Labelling and Packaging (CLP.)

The label on hazardous chemicals, originates from Globally Harmonized System (GHS), consist of several important parts as: hazard pictograms, signal word, hazard statements (H) and precautionary statements (P).

Safety Data Sheets (SDS) are readily available from vendors, and are a necessity when performing a proper risk assessment.





# GHS hazard pictograms

The GHS hazard pictograms consists of 9 pictograms with an explaining text.

- These pictograms will be seen on various places at the facility and it is important that you recognize and understand their meaning.



**Explosive**



**Flammable**



**Oxidising**



**Acute toxicity**



**Serious health hazard**



**Corrosive**



**Gas under pressure**



**Health hazard**



**Hazardous for the environment**

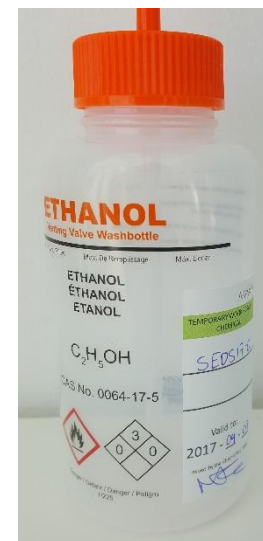
# Permanent chemical hazards at MAX IV

There are several areas with permanent chemical hazards which you need to be aware of:

- Experimental halls (A-, C-, D-buildings)
  - Gas bottles & gas cabinets
  - Aerosol cans
  - 0.5 L organic solvents bottles
  - Truck charging stations
- Gas- and flammable solvent bottles bears a tag with an area specific permit. Do not move these bottles to other areas.
- You are welcome to use chemistry labs at MAX IV. Before gaining access to chemistry labs you need to conduct hands-on training. Please contact [chemsafey@maxiv.lu.se](mailto:chemsafey@maxiv.lu.se) prior to your arrival in order to schedule time for hands-on training.



*Labels on gas- and flammable solvent bottles.*



*Truck charging area sign.*

## Laddningsplats



### Skyddsåtgärder vid arbete med Batterier

#### Explosionsrisk - Knallgas

1. Förbud mot rökning och öppen eld
2. Undvik kortslutningsgnistor
3. Avled statisk elektricitet genom att alltemellanåt beröra jordat föremål
4. Använd isolerade verktyg

#### Frätande vätska

Använd tättslutande skyddsglasögon  
och skyddshandskar

# Sample declaration

- All chemicals/samples must be declared in the proposal phase In DUO.
- The samples your bring must correspond to the samples you declared in DUO. This will be checked by your local beamline contact.
- All hazardous samples/chemicals/gases must be risk assessed and approved by the Safety team. Contact [EST@maxiv.lu.se](mailto:EST@maxiv.lu.se) to receive risk assessment form.
- Always check if a CMR (Carcinogenic, Mutagenic and Reprotoxic) compound can be substituted with a less hazardous. (Check your SDS).
- Any changes of samples must be declared in DUO prior starting the beamtime. All hazardous samples must be declared in DUO and risk assessed two weeks before your beamtime starts. You are not allowed to work with hazardous samples until it has been approved by the safety team.

Proposal submission : 20170054  
Initial sample declaration for proposal purposes

Step 1: General part      Step 5: Attach images  
Step 2: Manage Beamtime Request      Step 6: Results from previous proposals  
Step 3: Manage Beamline Setups and devices      Step 7: Submit proposal  
Step 4: Initial sample declaration for proposal purposes

Add new sample

**Note about 'Sample'**  
Series of related samples may be declared in one form. Also declare the use of additional chemicals, e.g. gases and solvents.

Sample and chemical substance to be used in this experiment

Substance (\*) ?

Chemical formula ?

Description understandable for non-experts in your specific field.

Substance description ?

CAS nr. ? 1234567-89-0

Send the Safety Data Sheet (SDS) for your substance to the

[Click here to send the documentation](#)

Proposal submission : 20170054  
Initial sample declaration for proposal purposes

Step 1: General part      Step 5: Attach images  
Step 2: Manage Beamtime Request      Step 6: Results from previous proposals  
Step 3: Manage Beamline Setups and devices      Step 7: Submit proposal  
Step 4: Initial sample declaration for proposal purposes

Name / substance
Toxic 1

[Edit] [Duplicate]

**Note about 'Samples'**  
If any of the substances will be used in any hazardous activity you are required to send in a risk assessment which explains in detail the hazardous experimental steps and suggested safety mitigations.  
The form can be found [here](#).

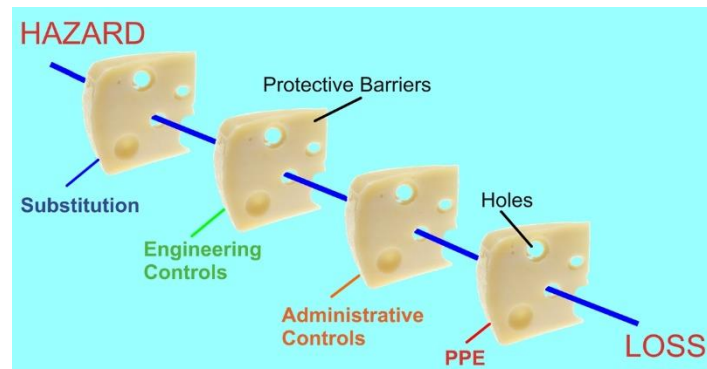
[Add further sample](#) [Continue with submission](#) [Cancel](#)

# Personal Protection Equipment (PPE)

Technical solutions as a fume hood or ventilated point suction are examples of protective barriers for your safety.

Local work instructions are also a type of safety barrier and its important that these are followed.

PPE is the last line of defense against chemical hazards when all other available options have been executed/implemented.



*Examples on protective barriers to control hazards.*

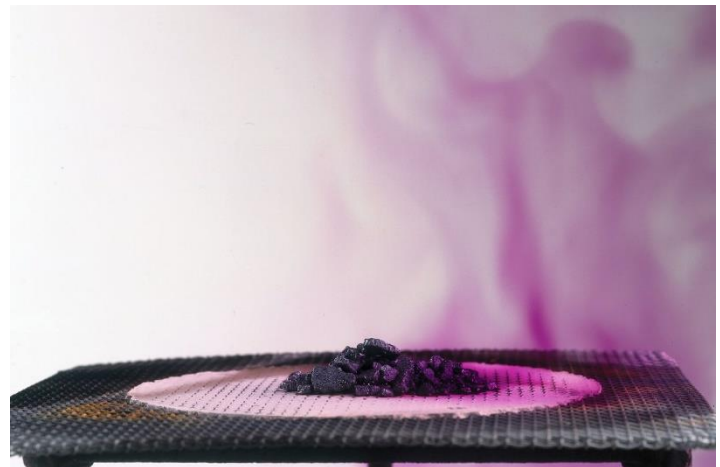


*Examples of signs with advised PPE to use*

# Working with chemicals

Hazardous work with chemicals is only allowed at the chemical labs.

- There are limits on what type of work you are allowed to do at the beamline preparation labs. Always consult with the beamline staff if you are unsure.
- Contact the CS team well in advance, if you require access to the chemical labs.
- Always follow local instructions and special work instructions.
- You are responsible to bring Safety Data Sheets (SDS) for your chemicals.



# Working with gases and *in-situ* experiments

- When working with gases and *in-situ* experiments two persons are required to be present at the beamline. Beamlines must not be left unmanned, when working with gases and *in-situ* experiments.
- Only MAX IV staff are allowed to transport, change and connect gas bottles at the beamline. Contact your local contact when you need a new gas bottle.
- When hazardous gases are in use, there are gas alarms present to warn you in case of any danger. If an alarm goes off, your first action is to evacuate the beamline area. Tell others to evacuate the beamline area and then call your local contact.
- In case of any serious accident, call 112.



*Gas mixing panel and gas cabinet*



# Working with Liquid Nitrogen (LN<sub>2</sub>)

Chemistry labs, preparation labs and experimental hutches are areas where Oxygen deficiency poses a hazard when using Liquid Nitrogen (LN<sub>2</sub>).

- LN<sub>2</sub> is handled in open containers and dewars.
- Always use required PPE.
- In case of any Oxygen alarm goes off, your first action is to evacuate the area out to the experimental hall. Try to keep doors open. Tell others to evacuate the beamline out to the experimental hall and then call your local contact.
- In case of any serious accident, call 112.



# Nanomaterials (NM)

## “Precautionary Principle” for Engineered Nanomaterials

In the absence of complete scientific evidence, the potential threat of research materials on human health and the environment is assumed to be such that *precautionary measures must be taken* until the material is known to be safe.

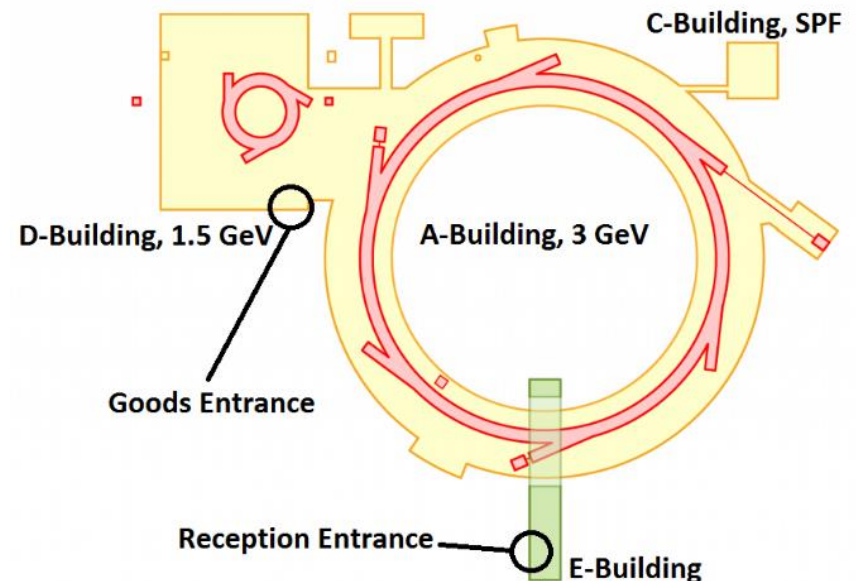
- Bringing NM to MAX IV is only allowed as a liquid suspension or embedded on a solid matrix when brought to the facility.
- Contact CS if you plan to bring NM-samples in any other matrix.



NM-Matrix	Hazard/ Exposure to Human Body	Risk
Dry powder	Fire, explosion and catalytic reactions. Inhalation, skin and ingestion.	High
Aerosol	Inhalation, skin and ingestion	High
Liquid colloids/ suspensions	Spill containment and reactivity. Skin and ingestion.	Moderate
Embedded in solid matrix	Abrasion, machining, grinding, etc. Inhalation, skin and ingestion.	Low

# Bringing or sending chemicals to the facility

- Hazardous chemicals are not allowed in the E-building (main office building) and the reception area. They must be dropped off at the goods entrance and later be picked up from inside the D-building after registration at the reception.
- If you want to send your samples or chemicals before you arrive to the facility you must contact the CS team beforehand who will give you instructions on how to proceed.



# Chemical Safety (CS) team

If you have questions or want more information, please contact the CS team.

Chemical safety officer

**+46 (0)705-25 92 34**

At MAX IV between 8:30-16:00

Email us: [chemsafety@maxiv.lu.se](mailto:chemsafety@maxiv.lu.se)

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**+46 (0)703-452 698**

Susanna Johnmark

**+46 (0)730-728 769**

