Regulation on the handling of flammable goods in laboratories at Karolinska Institutet

Ref. no. 1–871/2021

Effective date: 5 April 2022

Karolinska Institutet

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Pursuant to Chapter 2, Section 5 of the Higher Education Act (1992:1434), the following is hereby prescribed.

1 Introduction

As part of its activities, Karolinska Institutet (KI) handles flammable goods in quantities requiring a permit, and therefore needs to comply with the Flammable and Explosive Goods Act (2010:1011) (LBE) as regards safe handling requirements. The regulation specifies what is required in terms of handling (including storage) of flammable goods in laboratories at KI and is to be regarded as internal rules.

2 Purpose

The regulation is intended to clarify the measures to be taken to ensure safe handling and is based on the Flammable and Explosive Goods Act (2010:1011). The regulation is intended to support KI supervisors in their mission to prevent, deter and limit accidents and harm to life, health, the environment or property that may result from fire or explosion caused by flammable or explosive goods. It is also intended to serve as project design guidance for new construction, alterations and extensions.

3 Area of application

This regulation applies to all persons (employees, affiliates and students) who perform work with flammable goods in a KI laboratory on campus and covers all handling from the time the flammable goods are received by the organization until the flammable waste has left the organization.

4 Flammable goods definitions

The following are considered flammable goods under LBE:

1. Flammable gas
2. Flammable liquid
3. Fire-reactive goods

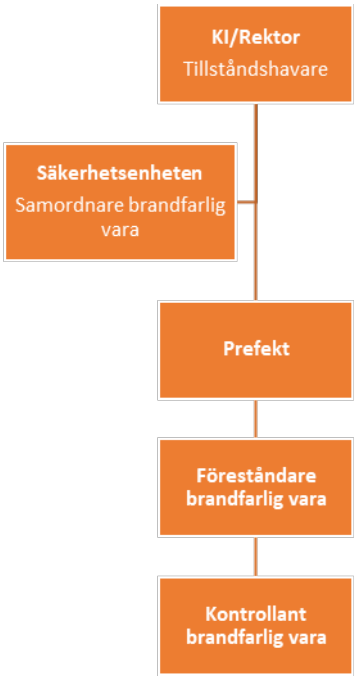
The table below shows the definition of each term.

Term	**Definition**	**Reference**
Flammable gas	Gases or gas mixtures which may be ignited in air at a temperature of 20°C and an atmospheric pressure of 101.3 kPa.	MSBFS 2010:4 Chapter 2, Section 1
Flammable aerosol	Flammable aerosols are generally equated with flammable gases in terms of handling requirements.	MSBFS 2020:1 Chapter 1, Section. 5
Flammable liquid	Liquids with a flash point not exceeding 100°C.	MSBFS 2010:4 Chapter 2, Section 2

Fire-reactive good	Substances, mixtures and items specified in special regulations of the Swedish Civil Contingencies Agency (MSB) or its predecessor. • Hydrogen peroxide, SÄIFS 1999:2 • Organic peroxides, SÄIFS 1996:4 • Ammonium nitrate, SÄIFS 1995:6 • Ammonium nitrate emulsions (ANE), MSBFS 2018:13 • Low-nitrogen nitrocellulose, SÄIFS 1989:5 • Flammable cinematographic film, SÄIFS 1989:4	MSBFS 2010:4 Chapter 2, Section 3

5 Responsibility

Pursuant to Sections 8 and 9 of the LBE, KI must have the appropriate competence in relation to the scope of its activities and the risks posed by the flammable goods handled by appointing one or more supervisors. KI's managerial organization is presented in the figure and text below.



KI's managerial organization

A brief description of each role is given below. Further information on each role is found on the KI Staff Portal.

The permit holder is KI through its senior management, which has overarching responsibility for ensuring compliance with applicable fire and explosion safety laws and guidelines.

The flammable goods coordinator is a resource within the central administration to support and coordinate the flammable goods permit holder, supervisor and monitor. The coordinator also manages KI's formal application for a permit to handle flammable and explosive goods. *Please note that this role is not the same as the Coordinator as defined in SRVFS 2004:7 (see section 6 below).*

The head of department at KI shall ensure that the activities are carried out in accordance with this regulation and that the work is given the necessary priority and resources, and shall demonstrate leadership and commitment in matters relating to the handling of flammable and explosive goods.

The flammable goods supervisor shall ensure that staff are equipped to handle flammable goods in a safe manner and shall monitor this. Supervisors are appointed through further delegation from the head of department in accordance with KI's steering document “Delegation within departments and equivalent”. Within KI, a deputy supervisor shall also be appointed to take the place of the regular supervisor in case of extended absence.

The flammable goods monitor shall support the supervisor and monitor the handling of flammable goods on site and report any deviations to the supervisor. The monitor is appointed through further delegation from their immediate manager in accordance with KI's steering document “Delegation with departments and equivalent”. For each unit/research group handling flammable

goods, there should be at least one designated flammable goods monitor. Research groups co-located in a common area may have one or more designated monitors representing all research groups within that area, if it is possible to monitor all research groups' handling of flammable goods.

6 Coordination responsibility

At a site or premises where several operators with different organization numbers (e.g. KI and Region Stockholm or KI and a private operator) handle flammable gases or liquids, one of them shall be responsible for coordinating the safety work for the handling at the site (according to SRVFS 2004:7).
A coordinator (samordningsansvarig) shall have an overview of the protection work. The coordinator shall also monitor that changes at one operator do not adversely impact the safety of another operator in the same area.

The coordinator can be one of the flammable goods managers, but it can also be another person who is appointed as coordinator under the Work Environment Act (1977:1160). In such case, it is relevant that the coordinator obtains expert support from the flammable goods supervisor.

There must be written documentation of the name, duties and powers of the coordinator.

7 Safe handling

For safe handling and to reduce the consequences of a fire, the following applies.

- A risk assessment must be carried out prior to new work steps.
- Flammable goods shall only be kept out when work is in progress. At other times, flammable goods must be stored in fireproof cabinets.
- The number of potentially explosive atmospheres shall be minimized.
- Open handling shall be carried out in a safe manner.

This applies to all laboratories, but in some existing laboratories it may be difficult to comply fully due to, for example, inadequate building ventilation or lack of space. In these laboratories, additional procedures or measures may therefore be required to achieve safe handling. The KI central flammable goods coordinator must then be contacted by the department's supervisor.

8 Risk assessment for new work steps at research laboratories

Before laboratory work with chemicals is started, there must be an assessment of whether there are any risks associated with the handling/methodology, and whether protective measures and handling instructions are required. There must also be an emergency procedure in place in the event of a spill, accident or fire. Responsibility for carrying out risk assessments lies with the immediate manager, but the risk assessment itself is preferably performed by the person who will be handling the chemicals/using the method.

The risk assessment requirement covers all handling, including storage, transport and waste. Safety, occupational health and safety and the external

environment must be taken into account. Consideration must also be given to the premises, staff and others who may be affected.

Risk assessments shall be documented and signed by the responsible person (manager) and shall be available in a way that allows all workers affected by information in the documents to obtain information from them at any time during working hours. Risk assessments must be reviewed regularly, particularly if new circumstances or knowledge arise.

All individuals concerned at the workplace must be informed of and have knowledge of the risks involved, including by having the risk assessment in a language that all staff understand.

The risk assessment shall cover:

- methodology and premises
- sources of risk such as substances and products, classification of sources of risk, concentration, volume, etc.
- activities and situations associated with risk
- type of exposure (inhalation, skin, etc.)
- personal protection instructions (gloves, ventilation, extinguishing equipment, etc.)
- preventive measures (training requirements, medical examination, etc.)
- accident/spill response (emergency procedure, spill kit, alarm)
- total assessed risk (after measures have been decided, it should be low)
- name of risk assessor (handler(s))
- signature (responsible manager)

9 Requirement for supplementary investigation and classification plan

A supplementary investigation and classification plan must always be performed when the risk assessment shows that an explosive atmosphere may occur during normal handling, as well as for the following handling:

- Fire-reactive goods covered by MSB regulations (hydrogen peroxide, organic peroxides, low-nitrogen nitrocellulose, ammonium nitrate and ammonium nitrate emulsions (ANE)). For hydrogen peroxide, the requirement for supplementary investigation and classification plan applies, only if the volume handled exceeds what is defined as “laboratory work with small quantities” (see section 16 of this regulation).
- Explosive goods.
- Flammable liquid or gas pipework.

The investigation shall consist of identification of sources of risk, estimation of the risk, risk appraisal and proposal of measures. The department's flammable goods supervisor and KI's central flammable goods coordinator shall be contacted if a supplementary risk assessment and classification plan is required. The research group leader is responsible for the implementation of the proposed measures.

10 Open handling

Open handling of flammable goods refers to all uses except transport and clean storage. Chemicals or solutions classified as flammable are subject to the open handling provisions irrespective of their CLP fire class or category.

Open handling shall only take place in a fume cupboard or downflow bench which meets the requirements of Appendix 1. When working in a fume cupboard or downflow bench, electrical equipment shall be connected to electrical sockets which are interlocked with ventilation (meaning that the power to the sockets is cut off if the ventilation of the fume cupboard/downflow bench fails), unless a risk assessment shows that another solution is acceptable (this may be the case if a power failure causes another hazardous situation, in which case the sockets that are not interlocked with ventilation may be used). Sockets which are interlocked with ventilation shall be labelled as specified in Appendix 1.

Open handling in class I or class II safety cabinets is generally not appropriate unless special protective measures are taken; see “General classification plan for laboratories at KI”. Open handling in such cabinets results in EX-rated zones in the room; see “General classification drawings at KI”.

Tapping or pouring of isolated decilitres (test tubes, beakers) may be carried out on a workbench with local extraction system if the user ensures that no ignition sources are within 0.5 m (e.g. electrical equipment and electrical sockets).

Distilling, evaporation and similar operations shall be carried out with indirect heating, unless a risk assessment has been performed which shows that other handling is acceptable.

When tapping or pouring quantities of more than 2,5 litres, the free-falling stream shall be a maximum of 2 dm. A funnel with a long spout may be used to reduce the height of fall. Metal funnels, metal containers and other conductive receptacles shall be provided with a ground connection (e.g. with a grounding clamp).
The flow of flammable liquids through non-conductive materials (e.g. plastic hoses, plastic funnels) should be avoided, as this may create static charge with increased risk of ignition.

When working in class I or class II microbiological safety cabinets in BSL3, BSL2 and cell culture labs, spray bottles (flower sprayer type) may be used in exceptional cases for the application of surface disinfectants, where the risk assessment has shown that there is a high risk of contamination in a particular work step. In other types of laboratories, the application of surface disinfectants by spray bottle is not allowed.

11 Storage of flammable liquids

Flammable liquids should be stored in their original packaging with the label still attached, wherever possible. If stored in other packaging, ensure that the new container is properly labelled. At the end of the work, all flammable liquids must be stored in a fireproof cabinet. To ensure order, labels may be used to indicate what is allowed on each shelf.

Single containers (total 2–3 litres/laboratory) of hand and surface disinfectant for daily use may be kept in the front unless fireproof storage is available directly in the laboratory premises. Additional containers of hand and surface disinfectant shall not be stored in the laboratory, and shall be stored in a fireproof manner as described in this section.

Storage shall be as close to the workplace as possible in a fireproof cabinet (laboratory storage), in order to minimize transport within the laboratory. Such transport may in some cases be more hazardous than the use itself.

To minimize the need for explosion-rated zones adjacent to storage areas, storage should be done with tight-sealing lids. Other storage (e.g. test tubes with temporary closures) may only be used if a separate risk assessment is performed.

The following applies to storage in fireproof cabinets for flammable liquids:

- Cabinets shall be fireproof cabinets meeting the requirements of Appendix 1.
- Cabinets located outside the laboratory's shell protection shall be locked to prevent unauthorized access.
- The cabinet may be filled with flammable liquid to the volume for which it is intended.

The following may *not* be stored in a fireproof flammable liquid cabinets:

- Highly combustible materials (e.g. paper, wood, cardboard).
- Flammable gases, with the exception of individual containers of liquefied petroleum gas (LPG) with a total volume not exceeding 1 litre and individual aerosol cans.
- Chemicals with other hazardous properties which are not also flammable (excluding individual small containers).

The following applies to the storage of flammable goods in refrigerators and freezers:

- Refrigerators/freezers shall meet the requirements of Appendix 1.
- Containers in refrigerators and freezers shall have tight-sealing lids or equivalent.

The following may not be stored in refrigerators/freezers intended for flammable goods:

- Chemicals with other hazardous properties which are not also flammable.
- Test tubes with cotton plugs or similar closures which are not tight-sealing.

12 Storage of flammable gas

No cylinders of flammable gas shall be stored openly in the laboratory; storage shall be fireproof. This shall be achieved by storage in a fireproof cabinet suitable for gases.

The following applies to the storage in fireproof cabinets for flammable gases:

- Cabinets shall be fireproof cabinets meeting the requirements of Appendix 1.
- Cabinets located outside the laboratory's shell protection shall be locked to prevent unauthorized access.

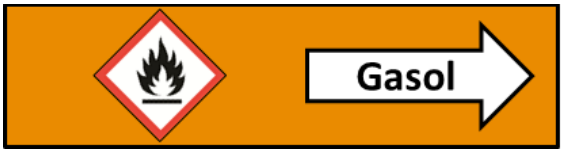
The following may *not* be stored in flammable gas cabinets:

- Highly combustible materials (e.g. paper, wood, cardboard).
- Flammable liquids.
- Halogen compounds.
- Gases which are toxic, corrosive or self-igniting (however, flammable gases with mixed properties, e.g. flammable and toxic, shall be stored as flammable gas).
- Substances which are toxic, corrosive, self-igniting or explosive.

Since it is never possible to empty a gas container completely, used cylinders are also considered flammable and should be stored as indicated above. Empty containers of flammable gas shall be treated as chemical waste.

13 Gas pipes

Gas pipes shall be labelled to show their contents. Standard SS 741 or equivalent shall be followed.



Example of LPG pipeline labelling

Pipeline labelling is appropriate at valves, penetrations, junctions and for longer runs, for example in a corridor. Pipelines shall be constructed and located in accordance with the requirements of Appendix 1.

Flammable gas hoses must only be used where their mobility is required[1] (e.g. connected equipment must be movable), and must be designed for the gas in question. Hoses must be capable of being inspected, and must not be passed through building elements as they are less durable than gas pipes. Hoses need to be checked for leaks when put into service and then annually[2], and any hose that is dry or has surface cracks must be replaced.

Written instructions for the commissioning, operation and maintenance of equipment shall be available unless the handling is simple and the risks are

[1] MSBFS 2020:1, Chapter 6, Section 1

[2] MSBFS 2020:1, Chapter 2, Section 16

easily foreseeable. The instructions shall be provided to the extent necessary to prevent the risk of fire and explosion[3].

14 Analysis equipment using flammable goods

Open handling around the equipment (e.g. filling or draining) shall be considered in view of the possibility of a potentially explosive atmosphere (see sections 19 and 20 on potentially explosive atmospheres in this regulation plus Appendix 1).

The number of pieces of equipment in a fire cell using flammable products needs to be taken into account, so that the quantity of flammable products for the pieces of equipment, when taken together, does not exceed 250 litres. The 250 litre limit refers to the quantity of flammable goods contained *in*, or directly *connected to*, the equipment and required for the normal operation of the equipment. As these quantities cannot be protected against fire in the fire cell, it is important to keep these quantities to the minimum necessary for normal use of the equipment. All other storage of flammable goods shall be carried out in a fireproof manner as specified in this regulation.

Analysis equipment shall be positioned so that ventilation can remove any flammable vapours generated by the equipment. Lids shall be used on containers of flammable goods when they are moved.

15 Procedures and equipment for the disposal of spills

Spill disposal equipment shall be provided in each laboratory. The extent of the equipment shall be adapted according to the substances and quantities handled. It shall be easy for staff to find the equipment.

In the event of a major spill or discharge within KI's organization, KI's emergency procedure for this shall be followed.

16 Peroxide-forming chemicals

The check and storage of ethers and other peroxide-forming chemicals within KI's premises shall be in accordance with KI's instructions for handling peroxide-forming chemicals.

Hydrogen peroxide

Hydrogen peroxide is an oxidising substance with corrosive properties which, when mixed with flammable substances, can cause a violent reaction and possibly self-ignition. In concentrations above 20 percent, hydrogen peroxide can decompose dangerously, releasing large amounts of energy. At concentrations of about 90 percent and above, it is detonable. Hydrogen peroxide in the gas phase can become explosive if the peroxide content in the gas phase exceeds 40 percent. The normal decomposition reaction is relatively slow up to 50°C. Temperatures above this cause a more rapid reaction. At low concentrations of hydrogen peroxide (<20 percent), it is considered to be only corrosive and not oxidising. The handling and storage of hydrogen peroxide is regulated in a special regulation (SÄIFS 1999:2).

[3] MSBFS 2020:1, Chapter 2, Section 17

The handling requirements set out below in this section on hydrogen peroxide assume that the amount of hydrogen peroxide does not exceed what is defined as *laboratory work with small quantities* in SÄIFS 1999:2[4]. The definition implies:

- *Maximum 1 litre for concentrations equal to or greater than 80 percent*
- *Maximum 5 litres for concentrations equal to or above 60 percent but below 80 percent*
- *Maximum 50 litres for concentrations below 60 percent.*

Handling requirements in KI laboratories:

- Hydrogen peroxide must be stored separately from flammable gases and combustible materials (paper, cardboard, etc.).
- Storage together with other chemicals shall be restrictive due to the tendency of hydrogen peroxide to react with other substances[5]. A risk assessment shall therefore always be performed regardless of the volume of hydrogen peroxide to be stored together with other chemicals.
- The hydrogen peroxide shall always be placed in its own containment capable of holding the volume of the largest package plus 10 percent of the maximum stored volume (e.g. waste tray).
- The storage temperature specified in the safety data sheet must be followed.
- Containers/cylinders must be fitted with a device to prevent the formation of excess pressure, i.e. have pressure relief (only applicable for concentrations above 20 percent). As hydrogen peroxide has a natural decomposition rate of about 1 percent per year, it is important that the container is handled in such a way that this function is maintained. Original packaging is considered to have the necessary pressure relief.
- Hydrogen peroxide containers should be stored upright, with the pressure relief device (where applicable) facing upwards and in such a way that air is allowed to flow freely around the vessels.

17 Waste management

Waste containing residues of flammable liquids shall be handled and stored as flammable liquids. Waste containers shall be labelled with contents, hazard pictogram, date, consignor and telephone number, and departmental affiliation.

18 Labels and signs

Labels and signs at flammable liquid storage space

Fireproof cabinets, refrigerators/freezers and entrances to storage rooms for flammable liquids shall be marked with hazard pictograms for flammable substances. If fireproof cabinets are located in a storage room, and all storage of flammable goods takes place in the cabinet, it is sufficient if the cabinet is marked.

[4] SÄIFS 1999:2, Chapter 1.3 and general advice to the regulation.

[5] Use section 10 “Stability and reactivity” of the safety data sheet as a guide.

Hazard pictogram for flammable substances

Note that the storage space may also be classified as a potentially explosive atmosphere. In such case, it must also be marked with an EX sign as described in the section below.

Marking of flammable gas storage area

The fireproof cabinet for flammable gas and the entrance to the gas manifold shall be marked with the hazard pictogram for gas under pressure as shown below.

Hazard pictogram for flammable substances

Hazard pictogram for gas under pressure

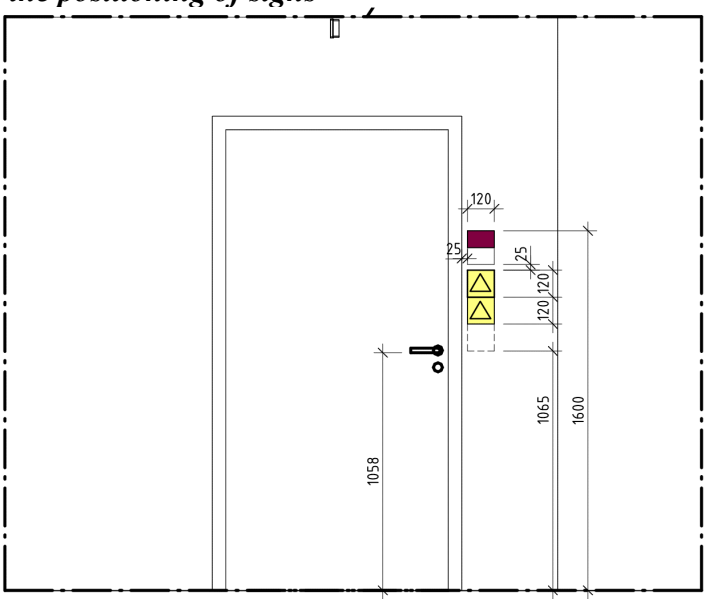
Note that the cabinet or gas manifold is normally classified as a potentially explosive atmosphere and must also be fitted with an EX sign as described in the section below.

Marking of classified potentially explosive atmosphere (EX sign)

Equipment, cabinets or the like classified as potentially explosive atmospheres (see section 21 of this regulation) must be marked with an EX sign as described below.

EX sign

Guidance on the positioning of signs



Examples of positioning and dimensions of signs

Warning signs and EX signs for rooms should be positioned near the door at a height of 1.2–1.6 m so that the information can be easily understood even if the door to the room is open. For flexible sign posting, insert-style sign holders, magnetic signs, etc. can be used.

19 Potentially explosive atmospheres

Most of the flammable products used emit combustible which can form an explosive atmosphere during normal handling. An explosive atmosphere is a mixture of gas or vapour in air which may ignite in contact with an ignition source.

The aim is to minimize the number of potentially explosive atmospheres as far as technically possible in order to reduce the risk and facilitate laboratory work.

KI has assessed which areas may contain an explosive atmosphere. These classified areas must be protected so that nothing that can ignite the explosive atmosphere gets into them. Equipment that can be a source of ignition include mobile phones, electrical equipment or work tools that can become hot. Such equipment must be ATEX certified if it is located or used in a classified area.

Determining which areas may contain explosive atmospheres is called zone classification. The zones are shown on the classification drawing.

- Zone 0 are areas where explosive atmospheres are present continuously, persistently or frequently. An explosive atmosphere can often be expected inside vessels containing flammable liquids.
- Zone 1 are areas where explosive atmospheres are occasionally present during normal handling. For example, this may be an area where minor spills, splashes, evaporation and discharges normally occur.
- Zone 2 are areas where explosive atmospheres occur only rarely and then

only briefly. This could be if there is discharge that is not intended but can still be expected to occur.

Equipment, cabinets, rooms or the like classified as potentially explosive atmospheres shall be marked as described in the previous section.

20 Compilation of general classified potentially explosive atmospheres

This compilation is taken from KI's *General classification plan*. General classification drawings have been drawn up for common sources of risk. These are available on the KI Staff Portal. The classification drawings contain details of classified areas, working procedures and the like. The classification drawing must be posted in the vicinity of the classified area.

Fume cupboard without electrical interlocking and without spill protection	Zone 2 throughout the fume cupboard and in an area 0.5 m out from the fume cupboard opening, extending down to the floor and under the cupboard.	1
Fume cupboard without electrical interlocking but with spill protection	Zone 2 throughout the fume cupboard.	2
Fume cupboard with electrical interlocking but without spill protection	Zone 2 in an area 0.5 m out from the fume cupboard opening, extending down to the floor and under the cupboard.	3
Fume cupboard with electrical interlocking and spill protection	No classification	-
Downflow bench without electrical interlocking and without spill protection	Zone 2 in an area 0.5 m around the downflow bench and above, extending down to the floor.	4
Downflow bench without electrical interlocking but with spill protection	Zone 2 in an area 0.5 m around the downflow bench and above.	5

Downflow bench with electrical interlocking but without spill protection	Zone 2 in an area 0.5 m around the downflow bench at the height of the work surface, extending down to the floor.	6
Handling under local extraction system	Zone 2 in an area 0.5 m around the handling, extending down to the floor.	7
Open handling of flammable liquid	Zone 1 in an area 0.5 m around opening handling and down to the floor. Zone 2 in an area 1 m horizontally around Zone 1.	8
Microbiological safety cabinet class 1 (LAF cabinet)	Zone 1 – 0.5 m horizontally around the cabinet opening, vertically from the floor, and 0.5 m over the cabinet opening Zone 2 – 1 m horizontally around Zone 1	9
Disinfection of surfaces and materials	No classification with normal disinfection.	-
Flammable liquid storage cabinet	Zone 2 in the cabinet and 0.5 m around the opening.	10
Flammable gas storage cabinet	Zone 1 in the cabinet and zone 2 in an area 0.5 m around the door	11
Flammable gas outlet	Zone 2 in an area 0.5 m from the outlet. No classification required for permanent connections.	12
Refrigerator/freezer for storage of flammable goods	Zone 2 in the refrigerator/freezer.	13
Pouring of flammable liquid	Zone 1 in an area 1.5 m around the drum from the floor to 0.5 m above.	14
Analysis machines containing flammable liquids	As specified by the manufacturer and around the filling/draining point (Zone 1 in area 0.5 m and Zone 2 in an area 1 m beyond this), unless otherwise specified by the manufacturer.	15

21 Equipment selection in potentially explosive atmospheres

Only ATEX-certified equipment may be found in potentially explosive atmospheres. This applies to equipment with an inherent ignition source (both mechanical and electrical equipment, e.g. switches, stirrers, etc.).

A supplier must be provided with the classification plan which sets out the requirements for the equipment. The following may be used to assist in the selection of equipment.

After installation, an electrical installation certificate must be provided by the contractor. This document should verify that the equipment and installation meet the requirements of the potentially explosive atmosphere. The supervisor must have access to the electrical installation certificate.

Selection based on zone

- In Zone 0, ATEX-certified equipment category 1G can be used.
- In Zone 1, ATEX-certified equipment category 1G or 2G can be used.
- In Zone 2, ATEX-certified equipment category 1G, 2G or 3G can be used.

Selection based on explosion group

- If the explosion group of the risk area is IIB, materials labelled IIB or IIC may be used.
- If the explosion group of the risk area is IIC, materials labelled IIC may be used.

Equipment selection based on temperature class

- If the temperature class of the risk area is T1, equipment labelled T1, T2, T3, T4, T5 or T6 may be used.
- If the temperature class of the risk area is T4, equipment labelled T4, T5 or T6 may be used.

Note the following when selecting equipment

During installation and use, the certificate may be subject to conditions which must be taken into account. Such conditions are indicated by an “X” at the end of the certificate number of the equipment, e.g. “SP 13ATEX3682X”. The supervisor shall check that these conditions are met.

The accompanying user manual may also contain important information for installation and use.

22 Procedure for work and installation in potentially explosive atmospheres

Procedures for working in potentially explosive atmospheres are given in this regulation, in the safety data sheet and on the classification drawing. For work other than laboratory work (e.g. equipment installation/maintenance) in a classified potentially hazardous atmosphere, the supervisor must assess whether special measures are required to prevent the risk of fire and explosion. These measures may be of a technical, practical or organizational nature. *In most cases, the simplest measure is to eliminate the source of the risk as indicated in the relevant classification plan.*

23 Permits for certain types of work

There are different types of permits that may be required for work in or in connection with the handling of flammable goods:

Work permits in case of risk of fire and explosion (AFS 2011:19 and SRVFS 2004:7)

Before starting certain work (e.g. work in or near an area where an explosive atmosphere may be present, on pipelines or in cisterns), a written work permit must be issued. Special requirements apply to work in potentially explosive atmospheres. This refers to work involving a risk of ignition in or near an explosive atmosphere in which flammable goods are handled.

This refers to any temporary work that may cause ignition of the flammable goods being handled. In a shared workplace, the coordinator (see previous section on coordinator in this regulation) shall approve the work before it is started, with expert assistance being sought from the flammable goods supervisor(s), if different from the coordinator. The work permit shall contain written handling and safety instructions for the work task. The person who is to carry out the work must confirm in writing on the work permit that the instructions will be followed. The employer(s) may appoint one or more persons to issue work permits, who must then have sufficient competence and knowledge of the facts, for example by ensuring that the permit process is clear and functional.

In workplaces where only KI activities are active, thereby eliminating the need for a coordinator as described above, the supervisor shall be responsible for issuing work permits.

The person issuing the permit for work in a potentially explosive atmosphere or prohibited area shall have the authority to close the site at their own discretion if the need arises. Similarly, the permit holder must have the right to impose such requirements as they deem necessary for the work to be performed safely.

Hot work permit

According to the terms and conditions of the insurance companies, a written permit is required for hot work.
Flammable hot work is any work with tools/machinery that generates heat or sparks in any form. Akademiska Hus must be contacted well in advance when a KI organization brings in a contractor to perform hot work. Akademiska Hus is in charge of granting a written permit for such a contractor to perform the work. In order for Akademiska Hus to grant a permit, the person performing the work must present a valid Nordic certificate for hot work. If the hot work is to be performed in or adjacent to an explosion-classified area, the work permit in accordance with the paragraph above must be issued by the Falmmable goods supervisor.

24 Self-inspection of flammable goods handling

Self-inspection shall be carried out on a running basis. Self-inspections shall be documented once a year. A self-inspection involves checking that handling,

equipment, premises and signage comply with the requirements of this regulation. Safety rounds constitute part of the self-inspection.

Appendix 2 contains suggested checkpoints to assist the supervisor and monitor. Please note that the list is not necessarily exhaustive and that the supervisor should add additional checkpoints if necessary.

25 Inspection of flammable goods installations

The supervisor shall follow up that inspections are performed and documented. In some cases, it is the responsibility of the organization to perform inspections via the flammable goods monitors. See the organizational chart in the introduction of this regulation.

Fireproof cabinet

- Measurement that the ventilation flow meets the manufacturer's requirements to avoid explosion classification shall be carried out at least once a year.
- Doors shall be inspected in terms of their ability to close and form a tight seal at least once a year.

Fume cupboards/downflow benches

- Measurement of ventilation flow and functional check of airflow alarm and (where applicable) interlocking of the electrical socket to the air flow alarm shall be carried out at least once a year. Examples of suitable measurement methods are found in standard SS-EN 14175–4, *Fume cupboards - On-site test methods*.

EX-rated equipment and installations

- EX-rated equipment and installations shall be inspected as specified in the manufacturer's instructions as well as the instructions in AFS 2016:4 *Equipment for potentially explosive atmospheres* and SS-EN 60079–17 *Explosive atmospheres – Part 17: Electrical installations inspection and maintenance*.

Gas systems

- There shall be a service agreement with the gas service company (e.g. AGA) that includes them performing annual inspections of e.g. gas pipelines, gas manifolds, connections, regulators, valves and outlets. The service agreement shall also include the replacement of connection hoses, valves, etc. according to the system maintenance instructions.

26 Monitoring

The supervisor shall monitor the handling of flammable goods. Checkpoints are provided in Appendix 2 to assist with monitoring.

Appendix 1 – Technical requirements for installations

This appendix sets out technical requirements for installations and is to be applied to tenant adaptations and other construction projects.

Fume cupboard

A fume cupboard in which flammable goods are handled must meet the following requirements:

- A fume cupboard shall be designed in accordance with standard SS-EN 14175 and equipped with spill protection through e.g. a raised edge.
- Exhaust air shall be extracted from both the top and bottom of the cupboard.
- The fume cupboards shall be equipped with an air speed alarm that issues an acoustic and/or visual alarm in case of low air speed (air flow).
- Ventilation conditions in fume cupboards generally prevent explosive gas mixing. However, if ventilation is interrupted, an explosive gas mixture may form in the cabinet. One of the following is therefore required:
    - The fume cupboard must be equipped with an electrical socket clearly labelled “Interlocked socket” that is interlocked with the air speed alarm as described above. Non-explosion-rated electrical equipment may only be used in the fume cupboard if connected to an interlocked electrical socket. Resetting of the interlock shall be done manually.
    - Ventilation for the fume cupboard shall be supplied with backup power that restarts ventilation within 30 seconds of a power failure. Non-explosion-rated equipment may be used and be connected to any electrical socket.
- Electrical sockets, switches and other fixed electrical equipment shall be positioned on the outside of the cupboard and higher than the interior work surface.

Downflow bench

A downflow bench in which flammable goods are handled must meet the following requirements:

- The downflow bench must be designed with a minimum air speed of 0.5 m/s and a flow rate of 300 l/s per m^2 of perforated work surface.
- The downflow bench shall be equipped with an air speed alarm that issues an acoustic and/or visual alarm in case of low duct air flow.
- Ventilation conditions above the downflow bench generally prevent explosive gas mixing. However, in the event of ventilation failure, an explosive gas mixture may form around the work surface. One of the following is therefore required:
    - The downflow bench must be equipped with an electrical socket clearly labelled “Interlocked socket” that is interlocked with the air speed alarm as described above. Non-explosion-rated electrical equipment may only be used in the downflow bench if connected to an interlocked electrical socket. Resetting of the interlock shall be done manually.
    - Ventilation for the downflow bench shall be supplied with backup

power that restarts ventilation within 30 seconds of a power failure. Non-explosion-rated equipment may be used on the downflow bench and be connected to any electrical socket.

- The work surface must have a raised edge so that any spill does not run off the bench.
- Electrical sockets, switches and other fixed electrical equipment shall be positioned 0.5 m over the work surface.

Local extraction system

A local extraction system in which flammable goods are handled shall meet the following requirements:

- The local extraction system shall be designed so that the air flow over the work surface concerned is at least 0.5 m/s.
- The local extraction system shall be positioned so that vapours are drawn away from the workstation and staff. For example, it can be positioned at the rear edge.
- A local extraction system is not normally equipped with an air speed alarm, which means that electrical sockets are not interlocked with the ventilation. For this reason, only explosion-rated electrical equipment (ATEX certified) may be used together with flammable liquids. This applies 0.5 m horizontally around the work surface and down to the floor.
- Electrical sockets, switches and other fixed electrical equipment shall be positioned at least 0.5 m from the work surface.

Refrigerators and freezers

Refrigerators and freezers in which flammable goods are stored must be approved for this purpose, which means that:

- The refrigerator/freezer must have an internal explosion-proof design (ATEX certified) suitable for Zone 2 (equipment category 1G, 2G or 3G), explosion group IIB and temperature class T4.
- Storage in the refrigerator/freezer must be with a tight-sealing lid.
- A refrigerator/freezer in which flammable goods are stored shall be equipped with a hazard pictogram for flammable substances. If the containers are not factory-sealed, there must also be an EX sign.
- The compressor of the refrigerator/freezer must be enclosed or positioned high up.
- The refrigerator/freezer must not be located in a potentially explosive atmosphere. A separate risk assessment is required for such placement.

Fireproof cabinet for flammable goods

Fireproof cabinets must meet the following requirements:

- A flammable liquid cabinet must meet the requirements of standard SS-EN 14470–1, type 60, which corresponds to fire classification EI 60.
- A flammable gas cabinet must meet the requirements of standard SS-EN 14470–2, type G60, which corresponds to fire classification EI 60.
- The cabinet must be yellow in colour.
- The cabinet must have bunding in the form of a bottom panel or individual shelves with retaining edge. The bunding must have a capacity of 10% of the quantity stored, but not less than the volume of

the largest container.
- The cabinet shall be ventilated at a rate of at least 10 air changes in the cabinet per hour, with a pressure drop not exceeding 150 Pa. If the gas is both flammable and toxic, the ventilation must create at least 120 air changes in the cabinet per hour.
- Ventilation ducts do not need protection against the spread of fire and combustion gas (e.g. fire dampers), as the cabinets have built-in fire dampers.

Analysis equipment containing or using flammable goods

Equipment/machinery containing flammable goods must be installed and operated as specified in the manufacturer's instructions. The organization must check with the supplier as to whether the equipment itself can create an explosive atmosphere on the outside and whether this can occur during e.g. tapping, filling, etc. If so, a classification plan must be drawn up for the equipment in question.

Note that a classified potentially explosive atmosphere normally occurs at least 0.5 m around the outlet. The organization must check with the supplier as to whether the equipment has an explosion-proof design (ATEX certified) if necessary.
Equipment must not be subjected to pressures for which it is not designed, i.e. the equipment must only be connected to outlets/regulators that provide a pressure that the equipment can withstand. If equipment may be subjected to pressures for which it is not designed, regulators need to be fitted with overflow valves or similar devices that discharge into the open.

Flammable gas pipeline

Flammable gas pipelines shall be designed for the gas in question and shall preferably be laid in one piece all the way from the storage site to the consumption site. Any joints shall be made in a visible position so that leaks can be easily identified. Approved joining methods shall be used. The pipeline shall be visually labelled with type of gas, relevant hazard pictograms and the direction of flow (see details above in the section “Storage of flammable gas”). The pipeline shall not be positioned where it is likely to be affected by external factors. However, if this cannot be avoided, collision protection or protective plates shall be used if necessary. Pipelines positioned in walls, floors or ceilings shall be placed in protective pipework, with any plastic sheathing removed at the penetration. At penetrations of building elements, it is important to preserve any fire classification so that the structural fire protection is not weakened.

Appendix 2 – Checklist for supervisor's/monitor's self-inspection of flammable goods

Fume cupboards and downflow benches in which flammable goods are handled	**Yes**		**No**	**Own comments**
Do fume cupboards/downflow benches have spill protection through e.g. a raised edge?	☐		☐	
Has a functional check been performed?	☐		☐	
Is there interlocking of electrical sockets?	☐		☐	
Is there a classification plan for the fume cupboard?	☐		☐	
Open handling	**Yes**		**No**	**Own comments**
Does the handling of flammable goods at a workbench with local extraction system occur only in isolated decilitres (test tubes, beakers)?	☐		☐	
When handling flammable goods at a workbench with local extraction system, is this done in such a way that no sources of ignition (e.g. electrical equipment and electrical sockets) are within 0.5 m?	☐		☐	
Are flammable goods handled at any spot that does not have safety ventilation?	☐		☐	
Are containers larger than 5 litres conductive or semi-conductive, i.e. made of materials that conduct electricity?	☐		☐	
Are containers larger than 5 litres that are not made of conductive or semi-conductive materials equipped with protective grounding?	☐		☐	
When tapping or pouring quantities of more than 2,5 litres, is the free-falling stream no more than 2 dm, and is tapping/pouring done with a metal funnel/container with protective grounding?	☐		☐	
Potentially explosive atmosphere	**Yes**		**No**	**Own comments**
Are all classified potentially explosive atmospheres marked with an EX sign?	☐		☐	
Is a correct classification drawing available?	☐		☐	
Storage of flammable liquids	**Yes**		**No**	**Own comments**
Does storage take place in fume cupboards or on downflow benches?	☐		☐	
Does storage take place in cabinets according to SS-EN 14470–1, type 60, which corresponds to fire classification EI 60?	☐		☐	
Does combined storage of gas, corrosive or toxic substances take place in the cabinet, with the possible exception of small individual containers in accordance with this regulation?	☐		☐	
Are combustible materials stored in the cabinet?	☐		☐	
Are flammable goods stored in refrigerators/freezers in accordance with this regulation?	☐		☐	
Are refrigerators/freezers used to store flammable liquids labelled with the pictogram for flammable substances and an EX sign?	☐		☐	
Is there spillage in the cabinet?	☐		☐	
Are the quantities stored consistent with what the cabinet is approved for?	☐		☐	
Peroxide-forming chemicals	**Yes**		**No**	**Own comments**
Are ethers and other peroxide-forming chemicals handled as specified in KI's instructions for the handling of chemicals that can form explosive peroxides?	☐		☐	
Gases	**Yes**		**No**	**Own comments**

Are flammable gas cylinders stored openly in the laboratory?	☐		☐	
Are flammable gases stored in fireproof cabinets with marked with the hazard pictogram for gas under pressure and an EX sign?	☐		☐	
Are there written instructions for the commissioning, operation and maintenance of gas installations?	☐		☐	
Do all relevant staff know where the shut-off valves of gas installations are located?	☐		☐	
Are outlets free of damage and clearly marked to indicate the type of gas and whether the tap is in the open or closed position?	☐		☐	
Are shut-off valves closed for outlets not in use?	☐		☐	
Is there a minimum distance of 0.5 between outlets and electrical equipment or other potential sources of ignition?	☐		☐	
Are flammable gas pipelines adequately marked?	☐		☐	
Is the correct type of hose used for the gas being used?	☐		☐	
Are there any gas hoses with surface cracks?	☐		☐	
Analysis equipment	**Yes**		**No**	**Own comments**
Is there open handling around the equipment (e.g. filling or draining) such that a potentially explosive atmosphere may occur? Is there a classification drawing for this?	☐		☐	
Does the quantity of flammable goods in equipment located in the same fire cell together exceed 250 litres?	☐		☐	
Disposal of spills	**Yes**		**No**	**Own comments**
Is spill disposal equipment available, and is it adapted to the substances and quantities handled?	☐		☐	
Is there a sign posted at the spill kit?	☐		☐	
Is waste disposal carried out according to procedure?	☐		☐	