

Information on ATEX to heads of department, laboratory managers and occupational health and safety committees

Guide to handling and storage of flammable liquids and gases at the University of Southern Denmark (SDU)

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1 Introduction

The purpose of the current document is to inform Heads of the Department, Laboratory Managers and the Occupational Health and Safety Group about ATEX rules and it is part of the ATEX concept adopted by SDU's main health and safety committee, which supports SDU's compliance with ATEX requirements.

The main focus of the current document is on areas where flammable liquids and gases are handled and/or stored, as well as places where a significant flammable dust concentration can arise.

2 What is ATEX?

ATEX is an abbreviation of the term ATmosphére ÉXplosive. The Danish translation is 'eksplosive atmosfærer' (explosive atmospheres).

- An explosive atmosphere consists of a mixture of air and flammable substances under atmospheric conditions and after ignition, the mixture permits self-sustaining flame propagation. The flammable substances can be in the form of gas, vapour, dust or flyings.
- Potentially explosive areas are defined as areas where there may be an explosive atmosphere in such quantities that safety and health precautions need to be taken. Explosive atmospheres may occur when working with or storing flammable liquids or flammable gases, as well as in places where significant concentrations of combustible dust can arise.

SDU is required to assess the risk of explosion in workplaces, classify such areas and protect persons present in beforementioned areas.

The obligation is contained in both the Danish Preparedness Act and the and occupational health and safety legislation.

3 Responsibility

In order to prevent formation of an explosive atmosphere under normal operating conditions, the layout and use of laboratories and storage facilities must fulfil the conditions described in zone classification reports and in an extended occupational health and safety (OHS) assessment (ATEX-APV).

It is the department's responsibility to determine zone classifications, laboratory types and storage room layouts as well as to provide proper safety explosion hazard signage.

It is the Department's responsibility to ensure that all employees and students working in the laboratory are instructed in safe working practices and they must be informed of SDU's ATEX standards. Moreover, the department shall ensure that work is performed in a safe manner as well, as described in the ATEX standards.

It is the Department's responsibility to ensure that the necessary risk and ATEX assessments have been performed and the necessary measures have been taken prior to initiating experiments or using installations. In this guide, the practical responsibility lies with the Laboratory Manager.

It is the responsibility of SDU's Technical Services Department to ensure that joint installations, supply systems etc. are assessed and fixed in accordance with the ATEX rules.

Technical measures to counter explosion hazards shall be taken in collaboration with SDU's operations department, through which new or revised ATEX documentation from external experts can be obtained.

When making changes and redesigns, it shall be assessed whether changes are made to existing classifications or if there is a need for a new expert review for the preparation of zone classification reports, zone divisions and ATEX OHS assessments. This assessment shall be made by each Department in collaboration with the Technical Services Department.

The Health and Safety Office and the HR Department in collaboration with the Technical Services Department are responsible for revising the main documents in the ATEX concept every 3 years.

4 ATEX concept

In 2008, SDU's Main Health and Safety Committee adopted a common ATEX concept. The purpose of this concept is to standardize behavioural and physical conditions so that it becomes easier (on a daily basis) to comply with the mandatory requirements regarding the implementation of the statutory ATEX OHS assessment. The statutory ATEX OHS assessment includes a risk assessment together with identification of the precautions to be taken, when explosive atmosphere may occur.

In SDU's ATEX concept, such an initial risk assessment of ordinary laboratory work and storage of flammable liquids and gases has been carried out. The result of this work is the development of 2 standards for laboratories (types 1 and 2) as well as 1 standard for storage (chemical storage).

Furthermore, a number of specialist areas in the form of special chemical or gas storage facilities with separate work functions, which cannot be incorporated into any of the laboratory standards, have either been included in a Special Report or have their own separate ATEX documentation.

The technical measures and behavioural regulations described in the above mentioned standards shall ensure that the risk of occurrence of an unintended explosive atmosphere can be controlled.

Thus, the ATEX concept consists of:

- Laboratory standards (types 1 and 2) with associated zone classification reports.
- Standard for storage rooms with associated zone classification report.
- Areas described in the Special Report and/or where a separate zone classification report has been prepared.
- Proper illustration and placement of the safety signage.
- ATEX folders with basic information for users.
- Guide to handling and storage of flammable liquids and gases at the University of Southern Denmark (SDU) for heads of departments, laboratory managers, occupational health and safety groups, etc.

4.1 Laboratory standards

SDU has prepared laboratory standards for 2 different laboratory types as well as for storage rooms. In general, these can be described as follows:

- Type 1 laboratory: A maximum quantity of 1 litre of flammable liquid or 1 litre of flammable gas may be handled at once. Experiments can be left unattended. A fume cupboard may be installed which meets the requirements in the Classification Report on Type 2 laboratories. In this fume cupboard, dispensing and transfer from containers with up to 5 litres may be carried out, as well as experiments which take into account the restrictions for fume cupboards. The beforementioned activities shall be carried out with respect to the Classification Report on Type 2 laboratories.
- Type 2 laboratory: A maximum of 5 litres of flammable liquid or 1 litre of flammable gas may be handled at once. Experiments in progress must not be left unattended.
- Storage room: Used for separate storage of flammable liquids which will be used in the laboratories. The flammable liquids are kept in ventilated chemical storage cabinets.

For each of the above types, a statutory zone classification report was drafted and approved by the Odense Fire Service. The main pieces of information from the beforementioned reports can be found on the safety signage, that include the terms and conditions which apply to the room in question as well.

The first draft of the zone classification reports dates from 2008 and the last revision is from 2018.

4.2 Special risk areas

Zone classification reports drafted in 2008 and most recently revised in 2019 describe the areas where explosive atmospheres may occur at SDU.

In these areas, flammable liquids or flammable gases are used to a greater or lesser extent, or there are areas where high concentrations of combustible dust can arise.

A separate report has been prepared for these areas (Special Report), identifying which areas are included, where the areas are located and what special risks exist in the area.

For some of the areas, a separate zone classification was performed and these classifications were attached to the Special Report.

5 Laboratory experiment conditions

In order to reduce the risk of hazardous/inappropriate experimental set-ups, the Laboratory Manager must ensure that:

1. Prior assessment of risks together with description of risk mitigation measures.
2. Testing and approval of experimental set-ups.
3. Instructing employees in equipment operation, in best practices from a safety perspective and in emergency response measures.

5.1 Prior assessment of risks - ATEX OHS Assessment

A separate assessment of the occupational health and safety conditions shall be prepared in connection with performance of work in explosive atmospheres.

The ATEX APV shall include mapping and assessment of:

- The likelihood of occurrence of an explosive atmosphere and its duration.
- The possibility that there are active ignition sources (including electrostatic charges), occurring at the same time as an explosive atmosphere.
- The equipment and substances which were used, together with the processes and their possible interactions.
- The extent of the expected consequences.

In cases where the above standards and zone classification reports for laboratories and storage rooms can serve as basis of the ATEX APV, only specific assessments of the relevant conditions have to be prepared.

Zone classification reports and a written ATEX OHS Assessment with the occupational health and safety group's endorsement shall be kept in the laboratory unit so that they are accessible to employees and can be presented at the request of fire authorities or the Danish Working Environment Authority. Common Zone Classification Reports for type 1 and 2 laboratories as well as storage rooms can also be found electronically on SDU.net.

5.1.1 The likelihood of the occurrence of an explosive atmosphere

Explosion risks shall be mapped and assessed by competent persons in the field of explosion protection and it shall be done in collaboration with the employees and the occupational health and safety group.

SDU and NIRAS have conducted a survey and assessment of explosion risks under normal operating conditions of laboratories and storage rooms. The results are described in zone classification reports and based on these reports, the current guide was drafted. It can be seen that with the given conditions in the zone classification plans and the current guide, no explosive areas will occur in laboratories and storage rooms under normal operating conditions.

5.1.2 Expected consequences


It cannot be stated that the probability of ignition of flammable gases or vapours in laboratories and storage rooms under normal operating conditions is zero, but according to the classification reports, it is assessed that the probability of this is acceptable and the consequence is minimal. The formation of an explosive atmosphere requires failure of the ventilation system, concurrently with the release and failure of explosion-proof equipment in classified zones.

5.1.3 Conditions to be clarified by the Department regarding ATEX OHS Assessment

Below is a description of the matters that the Department shall explain.

As a guide to this, reference is made to the Danish Working Environment Authority's Guide "At-Vejledning Stoffer og Materialer - C.0.9 on work in connection with explosive atmospheres", August 2005.

5.1.3.1 *Likelihood of the occurrence of an ignition source:*

It must be ensured that chemical storage cabinets and storage rooms, as long as flammable liquids are stored outside the storage cabinets, do not constitute a source of ignition. Electrical installations marked with  II 3G do not constitute a source of ignition under normal operating conditions in zone 2 areas. If this rating plate is not available, a special assessment of the individual installations must be made. This assessment must be carried out by a competent person from the Technical Services Department.

5.1.3.2 *Laboratory equipment and used substances, processes and their possible interaction:*

The zone classification reports take into account the normal use of chemicals in the laboratories, including mixing.

Areas where unstable chemical substances are manufactured, handled, used, stored and transported are not covered by the ATEX rules. The reason for this is that unstable chemical substances, e.g. nitrocellulose is covered by other legislation.

For laboratories, the preparation of unstable chemical substances can be critical, as the consequences of fume cupboard explosion may be substantial. Therefore, for the laboratories where unstable chemical substances or explosives are handled, a separate risk assessment considering the safety of the workers shall be prepared.

5.1.3.3 *Other factors to take into account:*

When assessing new or existing plants and equipment, the following operating conditions must be taken into account in particular:

1. Normal operating conditions, including maintenance work.
 - Are there any factors or equipment in the new plant that require a new risk assessment?
 - Is there a special risk associated with the maintenance of explosive atmospheres or the creation of new ignition sources?
 - Are technical plants and systems, including ventilation systems, gas installations, fume cupboards, etc. maintained so that the risk of malfunction is minimized?
2. Commissioning and disassembly
 - Is there a particular risk of formation of an explosive atmosphere or new sources of ignition associated with the commissioning or removal of plants and systems?
3. Operational failure and predictable malfunctions
 - If operational failure and/ or malfunction occurs, it shall be ensured that system failures, including fume alarms, are rectified immediately so that failures and alarms are detected and proper measures can be taken
4. Improper application which can be foreseen.
 - It must be ensured through instruction, safety signage, etc. that expected improper use of appliances, etc. is limited as much as possible.
5. Written instructions
 - For the laboratory equipment which has an impact on safety, instruction of the employees is mandatory and written instructions describing the use, disconnection etc. of the equipment shall be prepared.
 - The written instructions shall, for example, describe what measures to take if the ventilation system fails in Type 2 laboratories or Type 2 fume cupboards.
6. Hot work
 - In order to perform hot work (e.g. arc welding) in the vicinity of potentially explosive areas, the Technical Services Department shall be contacted. This type of work shall commence only with written permission

given by the Technical Services Department. The main reason for this precaution is that hot work normally produces sparks or fires that could easily become ignition sources for the potentially explosive areas.

5.2 Inspection and approval of experimental set-ups

Prior to the first use of workplaces with explosive atmospheric areas, the laboratory equipment and the experimental set-up's fire and explosion safety as a whole, must be checked.

Before using an experimental set-up, the set-up must be approved by the Laboratory Manager or a designated competent person.

The approval shall be based on this guide, the ATEX OHS Assessment and other assessments of fire and explosion hazards, health hazards and the general working environment. An indicative checklist for approval is attached as Appendix 1.

5.3 Instruction of the Laboratory Test Manager

The Laboratory Manager shall ensure that the person initiating an experiment (the laboratory test manager) has the right competences. The Laboratory Test Manager shall at least have acquired competences in relation to ATEX and have received and reviewed the ATEX leaflet on conditions for working with flammable liquids and gases in laboratories.

6 ATEX leaflet

The leaflet for laboratory staff is a summary of the zone classification reports and this guide. The leaflet provides information on working conditions in the two types of laboratories as well as rules for rooms where flammable chemicals are stored.

When the conditions laid down in the leaflet are followed, the risk of forming a dangerous explosive atmosphere will be comparable and acceptable in relation to the working environment that one would otherwise expect to have under normal operating conditions.

7 Signage in laboratories and explosive areas

At the laboratory entrance, signs about the ATEX laboratory type must be posted and stating where the conditions for the work in the laboratory can be found. This may be in the form of SDU's leaflet about ATEX.

7.1 Laboratory signage

At the entrance to all laboratories where flammable liquids are handled in fume cupboards, the laboratory type must be stated on the door. The signage shall be blue and it shall indicate whether 1 or 5 litres of flammable liquid can generally be used in the fume cupboards.

If the laboratory is classified as a Type 1 laboratory, a fume cupboard intended for liquid dispensing and transfer, designed in accordance with the Type 2 laboratory regulations shall be provided with a sign stating that the usage of up to 5 litres of flammable liquid is allowed.

7.2 Explosion signs

Areas where there may be a risk of forming a dangerous explosive atmosphere shall be provided with an EX warning sign.

This applies to chemical storage cabinets and to all entrances to storage rooms with chemical storage outside chemical storage cabinets.

In the storage room with many chemical storage cabinets, EX warning signs may be provided with the subtitle "In all chemical storage cabinets". The sign shall be installed at all doors to the storage room.



8 Two types of experimental laboratories

The requirements regarding the layout and use of the laboratory shall match the inherent risk of laboratory work at the University of Southern Denmark (SDU). When working with very limited quantities of, for example solvents, the risk of forming a hazardous explosive atmosphere is limited and therefore the requirements on working procedures are limited. When working with flammable gases and large quantities of flammable liquids, there is a high risk of creating a dangerous explosive atmosphere. The work condition requirements are thus more stringent both in terms of requirements on safer ventilation and the use of special explosion-proof equipment.

The inherent risk of laboratory work is divided into two levels. In order to provide the same degree of security against the formation of a dangerous explosive atmosphere for people working with different inherent risks, two types of laboratories exist at the University of Southern Denmark (SDU), each meeting different design conditions. There are also different operating conditions for each of the two types of laboratories.

The two laboratory types are referred to as:

- “Type 1 Laboratories” for work involving a limited inherent risk
- “Type 2 Laboratories” for work involving a normal inherent risk

The requirements on layout and use of the two types of laboratories are described in the following paragraphs.

8.1 Laboratory layout

For Type 1 laboratories there are no special requirements, since there is only a very limited inherent risk associated with the laboratory work in this type of laboratory.

Type 2 laboratories shall be designed in such a way that in the centre of the laboratory it is possible to disconnect the power on the power outlets located on the fume cupboard. Thus, the nearest sources of ignition can be removed in case of ventilation failure, spillage or other unintended events.

8.2 Conditions for use of laboratories

Conditions of work in the two types of laboratories are summarized below.

General conditions:

- Open handling of flammable liquids is only allowed in a fume cupboard.
- Flammable liquids may only be present in connection with ongoing experimental set-ups.
- Flammable liquids must be stored in well-ventilated chemical storage cabinets (Zone 2).
- Fixed gas-consuming appliances (e.g. gas chromatographs) must be connected to a pressurized gas installation approved by the Technical Services Department.
- Bunsen burners shall be inspected immediately before use.
- Pressure bottles (e.g. spare bottles) shall be stored in designated storage rooms.
- Pressure bottles frequently used in the laboratory may be stored in the laboratory. If the pressure bottles are used at intervals greater than 2 weeks, they must be stored in the designated storage rooms.

If flammable liquids in closed containers are used in connection with experimental set-ups, these are not considered a risk with regard to evaporation. Therefore, the contents of closed containers are not included.

Type 1 Laboratory:

Special working conditions in Type 1 laboratories

- A maximum quantity of 1 litre of flammable liquid may be handled per experiment.
- The maximum capacity of open containers is 1 litre.
- The use of flammable gas is only allowed in connection with:
 - Temporary manual dispensing of a maximum of 1.0 litre of flammable gas at 1 atm to a container/carboy in fume cupboard. The gas must be used immediately after dispensing so as to

eliminate the explosive atmosphere as quickly as possible. If this is not possible, a separate ATEX assessment shall be performed. Open fire or hot surfaces in the fume cupboards are prohibited and the ventilation system must run at full speed.

- In the event of ventilation failure, the experiment shall be stopped in order to limit spills (e.g. by putting lids on containers and closing fume cupboard doors).
- Experiments may be left unattended – also during nights and weekends.
- In Type 1 laboratories, a fume cupboard may be installed, which is designed in accordance with the provisions of Type 2 laboratories, so that it is possible to transfer liquids from 5 litre containers to smaller containers up to a maximum of 1 litre. Work in fume cupboards carried out in accordance with the provisions of Type 2 laboratories may only be carried out under supervision. If there is a desire to have a Type 2 fume cupboard in a Type 1 laboratory, a qualitative risk assessment must be prepared and it shall explain that the layout of the Type 2 fume cupboard may reduce other risks (such as shorter transport distances for the flammable liquids). This risk assessment must be based on the specific conditions of the individual laboratory and sent to the Technical Services Department, 8888@sdu.dk together with a request to establish or verify the necessary technical prerequisites.

Type 2 Laboratory:

Special working conditions in Type 2 laboratories

Open handling of flammable liquids per experiment shall be limited to a maximum of 5 litres.

- The maximum capacity of open containers is 5 litres.
- Flammable gas shall only be used in connection with:
 - Temporary manual gas dispensing of max 1.0 litre at 1 atm. for container/carboy in fume cupboard. The gas must be consumed immediately after dispensing so that the explosive atmosphere is removed as soon as possible. If this is not possible, a separate ATEX assessment must be made. Open fires or hot surfaces in the fume cupboard are prohibited and the ventilation system shall run at full power.
- In the event of ventilation failure, the test shall be stopped in order to limit spills (e.g. by putting lids on containers and closing fume cupboard doors as much as possible). The electricity supply to fume cupboards shall be cut off (by manually pressing the switch button).
- The Laboratory Test Manager or a person instructed by him/her shall supervise the experiment – also during nights and weekends!

Zone classification of Type 1 and 2 laboratories:

Unclassified in the entire laboratory.

Chemical storage cabinets are assigned to Zone 2 inside the cupboard.

8.3 Use of flammable liquids

Generally, flammable liquids shall be handled with care and only in fume cupboards. Many accidents involving fires and explosions occur due to carelessness with flammable liquids.

The zone classification covers all liquid types regardless of ignition point. Therefore, to make use of the reports as simple as possible, no distinction is made between the flash points of the individual liquids. All liquids with a flashpoint below 40°C or liquids heated to 10°C below the flashpoint are considered as flammable liquids, from which an explosive atmosphere can be formed.

There will be appliances that cannot be installed in fume cupboards, such as HPLC analysers, etc. Due to health hazards the HPLC analysers shall be placed under effective fume extraction units. They do not pose any risk or danger of creating a dangerous explosive atmosphere, as evaporation from the appliances is minimal.

In the laboratories, open fire and heat sources are often used and in order to avoid ignition of the flammable liquids, heating of flammable liquids shall take place with great care and a special care has to be attributed to the heating sources.

Flammable liquids must not be poured while there is open fire in the fume cupboard or when other heat sources are used, e.g. fan heaters etc.

Liquid chemical waste will often be a mixture of several chemicals with different ignition points. To avoid any uncertainty, the waste should be considered as flammable liquids and so it shall be handled with great care.

In Type 1 laboratories, the volume limit is set to 1 litre of flammable liquid in open containers. With this restriction, regardless of the liquid type, no dangerous explosive atmosphere will be formed, even if the ventilation is interrupted. Therefore, experiments in progress can be left unattended. If flammable liquids are handled in closed containers in experimental set-ups, these are not considered a risk regarding evaporation. Therefore, the contents of closed containers are not included. In type 1 laboratories, a fume cupboard may be installed according to the provisions of the type 2 laboratory report. This fume cupboard may only be used for liquid transfer from 5 litre containers to smaller containers so that it can be used in fume cupboards produced in accordance with the provisions of the type 1 laboratory report.

In Type 2 laboratories, the volume limit is set to 5 litres of flammable liquid in open containers. In the event of ventilation failure, spillage or other unintended incidents, it is necessary to respond immediately by stopping the experiment and stopping evaporation from open containers. The possibility of intervention entails/involves a requirement for supervision when conducting experiments in Type 2 laboratories. The duty to attend the experiment is described in more detail below. If flammable liquids are handled in closed containers in experimental set-ups, these are not considered a risk with regard to evaporation. Therefore, the contents of closed containers are not included.

8.4 Usage of flammable gases

Generally, flammable gases can be used in laboratories when this is done with care and under the conditions enumerated in this guide. The use of flammable gas must be done manually in Type 1 and 2 laboratories by discharging gas directly from the pressure cylinder to the container/balloon in the fume cupboard. When this process is completed, the gas supply shall be shut off directly on the gas bottle valve. The gas must be used immediately after it has been discharged and no open fires or hot surfaces are allowed in the fume cupboard during gas discharge and while the gas is in the container/carboy.

In order to prevent any damage caused by the ignition of the gases, the limit for the use of gases is set at 1.0 litre of flammable gas at 1 atm in Type 1 and 2 laboratories.

If the experiment involving flammable gases cannot be kept within the fume cupboard, a special zone classification of the experimental set-up shall be made in each case. A separate zone classification must be performed through the Technical Services Department.

Experimental set-ups involving automatic gas discharge must be approved by the Laboratory Manager. If there is any doubt about safety conditions, the University's Technical Department shall be contacted. The Technical Services Department will communicate with relevant partners who are specialised in fire and explosion protection.

Fixed experimental set-ups connected to fixed gas installations, e.g. gas chromatographs, etc. can be arranged outside fume cupboards when the gas supply runs in fully welded pipes and when the gas-consuming appliance is arranged so that the gas supply is disconnected in case of leaks etc.

If the analysing equipment is not provided with a leak detection system, a gas detector must be installed so that it will interrupt the gas supply when detecting flammable gas in the room.

The pressure-resistant installations shall be inspected and pressure-tested by the installer annually or according to the installation company's regulations. The Technical Services Department shall be contacted if there is an uncertainty regarding whether a gas installation meets the requirements or not.

The use of a Bunsen burner connected to the central gas plant is allowed, provided that the Bunsen burner is inspected before use. Defective burners must be replaced immediately by new ones. If the ventilation system fails in laboratories where the burners are installed, the gas supply shall be interrupted automatically.

9 Zoned areas

When the specified requirements and working conditions are complied with in the given type of laboratory, the formation of an explosive atmosphere in the laboratory itself is not likely under normal operating conditions and thus the laboratory is an unclassified area according to the ATEX rules.

Any zoned areas must be arranged so as to not ignite any explosive atmosphere. The chemical storage cabinets are arranged so that no ignition sources are formed under normal operating conditions. Ignition sources must not be introduced into the chemical storage cabinets. The use of e.g. extra lighting, heat, etc. is subject to the approval of the manufacturer and the Technical Services Department, provided that the equipment meets the requirements described in the Zone Classification Report.

If there is any uncertainty as to whether the chemical storage cabinets are designed for this purpose, the Technical Services Department shall be consulted.

If the entire storage room is classified due to storage outside chemical storage cabinets, electrical installations must be designed as specially secured installations so that they do not constitute sources of ignition. The Technical Services Department shall be contacted if all or part of the room is to be designed as a Zone 2 area.





The laboratories are unclassified areas because all work with flammable liquids and gases takes place in fume cupboards.

The fume cupboards are also unclassified because, under normal operating conditions, they do not create a dangerous explosive atmosphere. When handling flammable liquids and gases, an atmosphere that can ignite will always form. But with the required conditions on ventilation, quantity restrictions, supervision, etc. the risk of forming of a dangerous explosive atmosphere is acceptably small. However, attention is always required in the laboratories.

General remarks on Zone 1 and 2 areas

In a Zone 1 area, it may be expected that, during normal operation, an explosive atmosphere consisting of a mixture of flammable substances in the form of gas, vapors or mist with air may occasionally occur. Often the dangerous atmosphere is created due to the use of substances, spills, leaks in joints, etc.

In a Zone 2 area, formation of a dangerous explosive atmosphere is rare and only exists for a short period of time. Often the dangerous atmosphere is created due to spills, leaks in joints, etc. The atmosphere is formed from gases, vapors or mist due to evaporation and gas emissions.

Ignition sources must be removed in Zone 1 and 2 areas. This is ensured by using electrical equipment marked as suitable for  II 1 G,  II 2 G or  II 3 G for zone 1 and  II 3 G for zone 2.

The entrance to zones 1 and 2 shall be marked with EX sign.



10 Storage rules for flammable fluids and gasses

Below is a description of the contents of the zone classification report for storage rooms and the requirements for the storage of flammable liquids and gases in university departments.

10.1 Zone classification report – storage rooms

A zone classification report for chemical storage rooms has been prepared and it explains the risk of formation of an explosive atmosphere.

The report enumerates conditions for the layout and usage of the storage rooms. If chemicals are stored outside of well-ventilated chemical storage cabinets, it must take into account that the formation of a hazardous explosive atmosphere in this room has a influence on the entire layout of the room and not only local.

It is assumed that the chemical storage cabinets are well-ventilated and equipped for chemical storage.

Requirements on electrical installations, etc. shall be clarified with the Technical Services Department.

The requirements are specified below:

Chemical storage:

Scope of application:

- Chemical storage cabinets in laboratories.
- Chemical storage cabinets in chemical storages.
- Deposits in storage rooms outside chemical storage cabinets.

Limitations:

- It is assumed that there is no back-up ventilation (otherwise the area will be unclassified).
- Decantation, liquid transfer and dispensing is only permitted in fume cupboard.

Zone classification:

- Generally Zone 2 for chemical storage cabinets.
- Zone 2 area in the entire chemical storage room when storing flammable fluids and gasses outside ventilated cabinets.

10.2 Storage in connection with experiments

Chemicals used in the experiments shall be stored in chemical storage cabinets to the greatest extent possible, but can occasionally be left in fume cupboards in connection with the experiments.

Chemicals that are not immediately used in an experiment shall be stored in chemical storage cabinets. After the work has ended, the chemicals must be returned to the chemical cabinet. The chemical storage cabinets are provided with ventilation facilities preventing the accumulation of dangerous fumes.

Limitations in the amount of flammable liquids relate to the risk of evaporation from open containers. It is therefore assumed that waste bins are placed in locations where they cannot overturn and pose a significant risk of forming a hazardous explosive atmosphere. When not working in fume cupboards, the waste container must be closed.

10.3 Storage of flammable liquids

The legal provisions for storage of flammable liquids are described in “Technical regulations for flammable and combustible liquids”, issued by the Danish Emergency Management Agency on December 6, 2016.

Stores established before this date are subject to the rules in force at the time of establishment.

Flammable liquids are classified according to their flashpoint temperature and are divided into three classes I, II and III.

The volume of flammable liquids is calculated by converting the liquids into storage units which are added up.

1 Storage Unit (SU) is defined as follows:

1 SU:	1 litre of class I	Class I: flashpoint < 23°C
or	5 litres of class II	Class II: 23°C ≤ flashpoint ≤ 60 °C
or	50 litres of Class III	Class III: 60°C < flashpoint ≤ 93°C

Liquids with an flashpoint at or below 93°C are defined as being flammable liquids.

Storage limits in SDU laboratories

There are two storage limit requirements:

1. In each laboratory, a total of 50 SUs may be stored when the laboratory is in a separate room, separated from the hallway and other rooms with a solid door classified as at least EI230 or equivalent.
2. A maximum of 800 SUs may be stored in one fire compartment.

Rooms for the storage of flammable liquids located in connection with or in the laboratories are also included in the total volume of 800 SUs. Central warehouses are not included in the beforementioned volume, as special rules apply to such rooms.

The Technical Services Department can help clarify the location of fire compartment separations.

10.4 Storage of flammable gases

The gas bottles necessary for experiments may be stored in the laboratory, regardless if they contain flammable gases or not. Actual storage of pressure bottles in the laboratories is not permitted, so spare bottles must be stored in a special storage room for pressure bottles.

Pressure bottles stored in the laboratories must be secured against tipping over with a chain or similar and they must not be exposed to excessive heat from stoves, etc. When the gas is discharged, the bottle must be closed at the bottle valve.

Pressure bottles that are frequently in use can be stored in the laboratory, but if the pressure bottles are used at intervals greater than 2 weeks, they must be stored in designated storage rooms. The Technical Services Department can help identify storage rooms that are approved for pressure bottles.

11 Safety signs and information

Each individual university department together with the Laboratory Manager (if there is one), are responsible for setting up the correct safety signage.

11.1 Laboratory signs

At the entrance to all laboratories where flammable liquids are handled in fume cupboards, 'ATEX-type laboratory' shall be indicated on the door and this is done by using a blue sign indicating whether 1 or 5 litres of flammable liquid may be used in the fume cupboards.

If the laboratory is labeled as a Type 1 laboratory, any fume cupboard intended for liquid transfer and dispensing and carried out in accordance with the Type 2 laboratory regulations, must indicate that liquid transfer and dispensing of up to 5 litres of flammable liquid is permitted.

11.2 EX signs

"EX" () signs shall be installed in the following locations:

1. On chemical cabinet doors in laboratories.
2. On doors to chemical storage rooms, where flammable liquids are stored outside chemical storage cabinets.

In storage rooms with several chemical storage cabinets, EX warning signs shall be installed with the subtitle "In all chemical storage cabinets". The sign must be installed on all storage room doors.



11.3 Information signs on laboratory types

The conditions for work in each laboratory must be indicated by proper signage at the laboratory entrances. This allows employees to see which working conditions and rules of conduct apply in each laboratory.

Type 1 Laboratorier

Generelle vilkår:

- Åben håndtering af brandfarlige væsker må kun ske i stinkskab.
- Der må kun forefindes brandfarlige væsker i forbindelse med igangværende forsøgsopstillinger.
- Brandfarlige væsker skal opbevares i velventilerede kemikalieskabe (zone 2).
- Faste gasforbrugende apparater (fx gaskromatografer) skal tilsluttes en af Teknisk service godkendt trykfast gasinstallation.
- Bunsenbrændere skal efterses inden brug. Defekte bunsenbrændere må ikke anvendes.
- Oplagring af trykflasker (fx reserveflasker) skal ske i dertil indrettede depotrum.
- Trykflasker, som hyppigt er i brug på laboratoriet, kan opbevares på laboratoriet. Benyttes trykflaskerne med større intervaller end 2 uger, skal de opbevares i dertil indrettede depotrum.

Særlige vilkår for arbejde i type 1 laboratorier

- Der må maksimalt foregå åben håndtering af 1 liter brandfarlig væske pr. forsøg.
- Max størrelse af åbne beholdere er 1 liter.
- Brandfarlig gas må kun anvendes ved:
 - Manuel aftapning af max 1,0 l brandfarlig gas ved 1 atm. til beholder/ballon i stinkskab. Gassen skal forbruges umiddelbart efter aftapningen så den eksplosionsfarlige atmosfære fjernes så hurtigt som muligt. Der må ikke være åben ild eller varme overflader i stinkskabet og ventilationen skal køre ved fuld styrke.
 - Ved ventilationssvigt standses forsøget og udslip begrænses (fx. ved at lægge låg på beholder og lukke stinkskabslåge).
- Forsøg kan køre uden opsyn også om natten og i weekender

Zoneklassificering:

Uklassificeret i hele laboratoriet.

Kemikalieskabe klassificeres til zone 2 inden for skabet.

Type 2 Laboratorier:

Generelle vilkår:

- Åben håndtering af brandfarlige væsker må kun ske i stinkskab.
- Der må kun forefindes brandfarlige væsker i forbindelse med igangværende forsøgsopstillinger.
- Brandfarlige væsker skal opbevares i velventilerede kemikalieskabe (zone 2).
- Faste gasforbrugende apparater (fx. gaskromatografer) skal tilsluttes en af Teknisk service godkendt trykfast gasinstallation.
- Bunsenbrændere skal efterses umiddelbart inden brug.
- Oplagring af trykflasker (fx reserveflasker) skal ske i dertil indrettede depotrum.
- Trykflasker, som hyppigt er i brug på laboratoriet, kan opbevares på laboratoriet. Benyttes trykflaskerne med større intervaller end 2 uger, skal de opbevares i dertil indrettede depotrum.

Særlige vilkår for arbejde i Type 2 laboratorier

- Der må maksimalt foregå åben håndtering af 5 liter brandfarlig væske pr. forsøg.
- Max størrelse af åbne beholdere er 5 liter.
- Brandfarlig gas må kun anvendes ved:
 - Midlertidig manuel aftapning af max 1,0 l brandfarlig gas ved 1 atm. til beholder/ballon i stinkskab. Gassen skal forbruges umiddelbart efter aftapningen så den eksplosionsfarlige atmosfære fjernes så hurtigt som muligt.
 - Ved ventilationssvigt standses forsøget og udslip begrænses (fx. ved at lægge låg på beholder og lukke stinkskabslåge). Strømmen til stinkskabets udtag afbrydes (manuelt ved afbryder).
- Den forsøgsansvarlige eller en af denne instruerede person skal overvåge forsøget – også nætter og weekender!

Zoneklassificering:

Uklassificeret i hele laboratoriet.

Kemikalieskabe klassificeres til zone 2 inden for skabet.

The university department may obtain information regarding the location of the different laboratory types from the Technical Services Department.

12 ATEX Information leaflet

Employees and students performing work involving a risk of formation of explosive atmospheres must be instructed in safe working procedures. They will receive the ATEX information leaflet and they must read it and understand it.

It is the department's responsibility to ensure that both staff and students are properly instructed.

The ATEX information leaflet describes the requirements for work in the laboratories and it must be accessible to both staff and students.

The department's Occupational Health and Safety Group determines where physical copies of the folder shall be kept as well as the relevant number of copies. Safety signs, leaflets and leaflet holders can be ordered from the Print & Sign Department.

12.1 Laboratory experiment conditions

When experiments involving a risk of formation of explosive atmospheres are in progress, the Laboratory Manager is responsible for ensuring that the experiment is performed in a safe and responsible manner and that the conditions for conducting the experiment are respected.

12.2 Duty to supervise Type 2 laboratory activities

Experiments involving a normal inherent risk shall be conducted in Type 2 laboratories. In order to prevent the formation of a hazardous explosive atmosphere, it is necessary that the Laboratory Test Manager is present throughout the part of the experiment which includes handling of flammable liquids or gases from open containers.

The Laboratory Manager must ensure that the Laboratory Test Manager is familiar with the duty to attend experiments or activities related to experiments and knows how to act in the event of accidents, ventilation stops, spills etc.

If the Laboratory Test Manager cannot be present throughout the experiment, the experiment may be attended by another competent person who has been thoroughly instructed in the procedure for interrupting the experiment, etc.

12.3 General rules of conduct

The laboratory shall be kept clean and tidy.

Only the necessary set-ups shall be available for the current experiment and so set-ups from past or future experiments must not be present in the fume cupboard where work is in progress. This requirement has the purpose to ensure that proper clean-up is performed after the completion of each experiment, that no chemicals are left behind from past set-ups and to ensure that there is sufficient working space for the current experiment so that the risk of spills and accidents is reduced.

12.4 Waste handling

It is assumed that waste containers are placed accordingly, on a levelled surface, so that overturning, spills and other unintended incidents are avoided. This reduces the risk of formation of a dangerous explosive atmosphere. When not serving the fume cupboard, the waste container must be closed.

Chemical residues should be treated as flammable liquids to be sure that the chemical residue is properly treated and stored. The rules regarding storage volumes, handling etc. must be respected.

13 Unintended events

In case of ventilation failure, spills or other unintended events, the risk of explosion must be eliminated:

- Stop the experiment.
- Put a lid or the like back on the evaporating surfaces to stop the release of flammable vapours.
- Close the fume cupboard door.
- Switch off the power supply to the fume cupboard (manually in case of an emergency switch). (Only fume cupboards designed according to the requirements on Type 2 laboratories).
- Close the pressured bottle's valve.

If the conditions are no longer under control, the university department's local fire and emergency plan must be followed.

SDU's common emergency procedure is:



Stands om muligt ulykken / Limit the accident

Begræns skaden / Contain the damage

Ring 1-1-2. Oplys: / Call 1-1-2. Tell them:

Hvad er dit navn / Your name

Hvad er der sket / What has happened

Hvor ringer du fra / Where you are calling from

Evakuer området om nødvendigt / Evacuate the area if necessary

Aktiver varslingsanlæg hvis det forefindes / Activate any alarms

Alarmer dine omgivelser mundligt / Alert those in your vicinity as quickly as possible

Benyt nærmeste sikre udgang / Use the nearest safe exit

Ring 6550 8888 og informer SDU / Call 6550 8888 and inform SDU

14 Definitions

ATEX	Abbreviation derived from French term ”ATmosphere EXplosible” .
ATEX OHS Assessment	An extended occupational health and safety (OHS) assessment specifying the measures (technical and administrative) that the company sets up to protect employees from a dangerous explosive atmosphere.
ATEX Directive	EU Directive 1999/92 / EC on minimum requirements for improvements in health and safety protection for workers who may be at risk from explosive atmospheres.
ATEX Leaflet	Leaflet describing the conditions for work in laboratories and requirements for storage of chemicals in storage rooms. The leaflet must be available at laboratories and storage rooms so that employees together with the students, can always up to date with respect to the conditions for handling flammable liquids and gases.
ATEX legislation	Areas where explosive atmospheres may occur are covered by the Danish Emergency Management Agency's Executive Order No. 590 of 26 June 2003 on the classification of hazardous areas and the Danish Working Environment Authority's Order of 10 June 2003 on work in explosive atmospheres.
ATEX Guide	This ATEX Guide is meant for laboratory managers, the occupational health and safety group, etc. which will assist employees in meeting the conditions of work and storage of chemicals in laboratories.
Flammable liquids	Liquids having a flashpoint less than 93°C.
Combustible liquids	Liquids having a flashpoint above 93°C and below 370°C.
Laboratory Manager	Person responsible for planning and implementation of chemical experiments, laboratory analyses, workshop activities etc.
Operating and maintenance organisation	Technical Services Department and Planning and Construction Department at SDU.
Flashpoint	The lowest temperature at which a liquid can form an ignitable mixture.
Laboratory types	”Type 1 Laboratory” for work with limited inherent risk. ”Type 2 Laboratory” for work with normal inherent risk. The conditions for work in the different types of laboratories are described in the zone classification report and summarized in this ATEX Guide and in the ATEX Leaflet.
Normal operating conditions	Normal operating conditions are when a plant, laboratory, etc. is used within its intended scope. The zone classification only covers normal operating conditions, which means that, e.g. breakage of fixed pipe installations, commissioning of installations, use of other products than provided, accidents, etc. are not considered. However, expected accidents such as chemical spills etc. are included. The same goes for start-up/shutdown of plants and systems.

Storage Unit (SU)	<p>1 Storage Unit (SU) is defined as follows:</p> <p>1 SU: 1 litre of class I Class I: flashpoint<23°C</p> <p><i>or</i> 5 litres of class II Class II: 23°C ≤ flashpoint≤ 60 °C</p> <p><i>or</i> 50 litres of Class III Class III: 60°C <flashpoint≤ 93°C</p>
Ventilated chemical storage cabinets	Chemical storage cabinets where there is an air exchange everywhere in the cabinet of minimum 2 times per hour
Zones	<p>The zoned areas are classified according to the frequency at which an explosive atmosphere can be expected to occur under normal operation conditions. The zones are:</p> <p>Zone 0: An area where ignitable concentrations of flammable gases, vapours or liquids are present continuously or for long periods of time under normal operating conditions.</p> <p>Zone 1: An area where ignitable concentrations of flammable gases, vapours or liquids are likely to exist occasionally under normal operating conditions.</p> <p>Zone 2: An area where ignitable concentrations of flammable gases, vapours or liquids are not likely to exist under normal operating conditions. In this area the gas, vapour or liquids would only be present under abnormal conditions (<i>most often leaks etc.</i>)</p> <p>Zone 20: An area where ignitable concentrations of combustible dust are present continuously or for long periods of time or often under normal operating conditions.</p> <p>Zone 21: An area where ignitable concentrations of combustible dust are likely to exist occasionally under normal operating conditions.</p> <p>Zone 22: An area where ignitable concentrations of combustible dust or ignitable fibres are not like to exist under normal operating conditions. In this area, the gas, vapours or liquids would only be present under abnormal operating conditions for a short period of time (<i>most often leaks etc.</i>)</p>
Zone Classification Report	Documentation report explaining the sources of emissions, ventilation conditions, frequency and duration of explosive atmospheres and the extent of the explosive atmosphere.
Open container	Container where there is an open liquid surface from which evaporation can take place to the surroundings.
Open handling	Handling flammable liquids where there is an open liquid surface, either in a bowl or the like, or by decantation, liquid transfer and dispensing.

Appendix 1 – Checklist for approval of experiments

Planning of experiments

- Has an extended occupational health and safety assessment - ATEX OHS Assessment - been prepared ?
- Have preventive measures been taken; preferably aimed at the source and working collectively?
- Has the experimental set-up been approved by the Laboratory Manager?

Instruction

- Has the employee been instructed in the use of hazardous substances and the risk of formation of explosive atmospheres?
- Does the employee know how to react in an emergency situation, e.g. if the ventilation system is interrupted, in the case of spills or other unintended events, which could create a dangerous explosive atmosphere?
- Is a competent person supervising experiments in Type 2 laboratories?

Flammable liquids

- Are unused chemicals placed in chemical storage cabinets?
- Are more than 50 storage units of flammable liquids stored in the laboratory?
- Do more than 800 storage units contain flammable liquids in the fire compartment?
- Have waste bins been emptied before commencing the experiment? Waste must be removed after completion of the experiment.
- Are waste containers closed and placed properly to prevent spill, overturning, etc.
- Are all chemicals labelled according to the labelling rules?

Gas installations

- Have gas installations and systems been approved by the Technical Services Department?
- If more than 1.0 litre of flammable gas is discharged, a separate ATEX assessment is required.
- Have pressure bottles that will not be used within 2 weeks been relocated to a storage room for pressure bottles?
- Have Bunsen burners been checked before use? Defective burners shall be replaced.

Ventilation

- Check if the ventilation system is functioning properly.
- Check the extraction in the fume cupboard. In the event of an alarm in the fume cupboard, terminate the experiment.

General rules of conduct

- Check that there are no experimental set-ups from past or future experiments in the fume cupboard.
- Are open flames and hot surfaces (e.g. heat gun) removed from the fume cupboard when handling flammable liquids or gases (e.g. decantation and discharge)?

- Are set-ups outside fume cupboards restricted to closed systems during fume extraction (e.g. HPLC analysers, etc.)?
- Are laboratories clean and tidy?
- Has defective laboratory equipment been replaced?
- Have occupational health and safety conditions been taken into account when planning experimental set-ups (lifting, working postures etc.)?

Choice of laboratory

- Can the laboratory be used for the experiment in question, cf. limitations on the use of Type 1 and Type 2 laboratories?
- Is it possible to disconnect the power to the fume cupboards in Type 2 laboratories?

Maintenance works etc.

- Is maintenance work carried out, e.g. hot work (welding, etc.)?
- Has written permission from the Technical Services Department been obtained?

Type 1 laboratories

General conditions:

- Open handling of flammable liquids is only allowed in a fume cupboard.
- Flammable liquids may only be present in connection with ongoing experimental set-ups.
- Flammable liquids must be stored in well-ventilated chemical storage cabinets (Zone 2).
- Fixed gas-consuming appliances (e.g. gas chromatographs) must be connected to a pressurized gas installation, which is approved by the Technical Services Department.
- Bunsen burners shall be inspected immediately before use. Defective Bunsen burners must not be used.
- Pressure bottles (e.g. spare bottles) shall be stored in designated storage rooms.
- Pressure bottles frequently used in the laboratory may be stored in the laboratory. If the pressure bottles are used at intervals greater than 2 weeks, they must be stored in designated storage rooms.

Special working conditions in Type 1 laboratories:

- A maximum quantity of 1 litre of flammable liquid may be handled per experiment.
- The maximum capacity of open containers is 1 litre.
- The use of flammable gas is only allowed in connection with:
 - Manual dispensing of maximum 1.0 litre of flammable gas at 1 atm to a container/carboy in fume cupboard. The gas must be used immediately after dispensing so as to eliminate the explosive atmosphere as quickly as possible. Open fires or hot surfaces in the fume cupboards are prohibited and the ventilation system must run at full speed.
- In the event of ventilation failure, the experiment shall be stopped to limit spills (e.g. by putting lids on containers and closing fume cupboard doors).
- Experiments may be left unattended – also during nights and weekends.

Zone classification:

Unclassified in the entire laboratory.

Chemical storage cabinets are assigned to Zone 2 inside the cabinet.

Type 2 laboratories

General conditions:

- Open handling of flammable liquids is only allowed in a fume cupboard.
- Flammable liquids may only be present in connection with ongoing experimental set-ups.
- Flammable liquids must be stored in well-ventilated chemical storage cabinets (Zone 2).
- Fixed gas-consuming appliances (e.g. gas chromatographs) must be connected to a pressurized gas installation approved by the Technical Services Department.
- Bunsen burners shall be inspected immediately before use.
- Pressure bottles (e.g. spare bottles) shall be stored in designated storage rooms.
- Pressure bottles frequently used in the laboratory may be stored in the laboratory. If the pressure bottles are used at intervals greater than 2 weeks, they must be stored in designated storage rooms.

Special working conditions in Type 2 laboratories

- Open handling of flammable liquids per experiment shall be limited to a maximum of 5 litres.
- The maximum capacity of open containers is 5 litres.
- Flammable gas shall only be used in connection with:
 - Temporary manual gas dispensing of maximum 1.0 litre at 1 atm. to a container/carboy in the fume cupboard. The gas must be consumed immediately after dispensing so that the explosive atmosphere is removed as soon as possible.
- In the event of ventilation failure, the test shall be stopped to limit spills (e.g. by putting lids on containers and closing fume cupboard doors as the situation permits). The electricity supply to fume cupboards shall be cut off (by manually pressing the switch button).
- The Laboratory Test Manager or a person instructed by him/her shall supervise the experiment – also during nights and weekends!

Zone classification:

Unclassified in the entire laboratory.

Chemical storage cabinets are assigned to Zone 2 inside the cabinet.