
CHALMERS
Process Laboratories
Lab & Safety Manual
MC2
Microtechnology and Nanoscience
November 2004
3rd edition

Contents

This manual is, to our knowledge at the time of writing, complete and in agreement with the requirements of the authorities and Chalmers University of Technology, and describes the potential dangers connected with the usage of the Process Laboratory. Questions and comments regarding the contents of this manual are greatly appreciated and should be directed to the lab manager.

Safety declaration

The management of the Process Laboratory has taken every reasonable measure to ensure that the laboratory is a clean and safe work environment.

While inside the laboratory, it is the responsibility of every user and staff member to always behave in a professional and safe manner.
Anyone who violates the lab usage or safety regulations, or in any way exposes himself/herself or others to danger, will be denied access to the laboratory by the decision of the executive management.

1.0 Welcome to the Process laboratory!

The Process Laboratory at the Department of Microtechnology and Nanoscience, Chalmers University of Technology, offer unique possibilities to perform advanced processing. This is on the condition, however, that all users have sufficient knowledge on how to behave and act in our Process Laboratory environment. This primarily regards the safety and work conditions, but also the maintenance of laboratory cleanliness.

This document can be considered a reference as well as an instruction manual on the basic usage of the Process laboratories. The document is applicable in equal respect for Chalmers employees as well as temporary and long-term guests and governs the safety as well as the rules which must be followed for continued usage of the Process laboratories. ***All lab users are expected to have read and understood these rules.***

In this brief booklet, we have tried to document the pertinent aspects required for the general use of the facility. To define a complete framework for all possible situations is impossible, but with the help of this manual, we are trying to address and describe the most important rules and safety regulations.

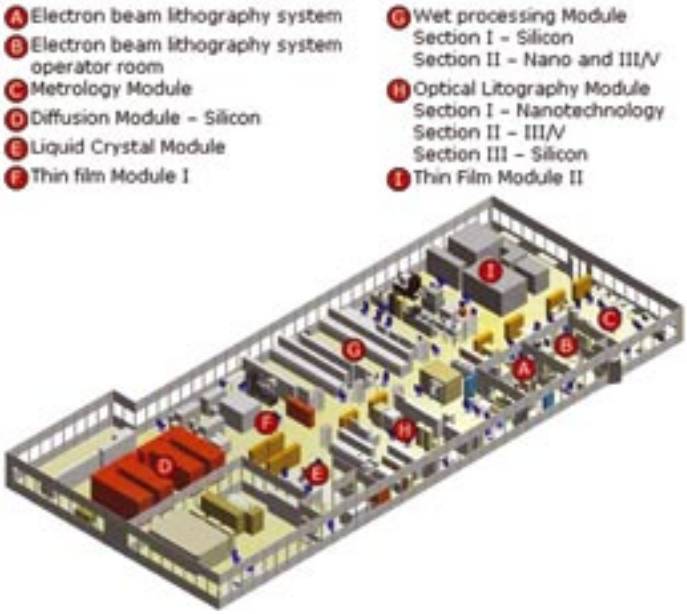
The Process Laboratory was created by, and is primarily intended for, the users from the Department of Microtechnology and Nanoscience. The Process Laboratory was created primarily as a resource for the five different Research Laboratories at this department - Applied Quantum Physics Laboratory, Microwave Electronics Laboratory, Photonics Laboratory, Quantum Device Physics Laboratory and Solid State Electronics Laboratory. As a work place, our intention is to make the laboratoriy as informal and attractive as possible. Of course, we also want you, and everyone else that will use this resource, to be able to do as qualified research as possible.

The users´ suggestions, criticism, and comments regarding the facility, its personnel, equipment, maintenance and management, are always welcome. Direct your suggestions and comments to a person connected to the management group that has your greatest confidence. It may be someone in the lab group, a member of the MC2 department executive group, your project advisor, or the head of your laboratory.

As a new user of the Process Laboratory, you will be required to attend a training course intended to teach you the correct working methods and techniques in the cleanroom. For a new user, it may be difficult to memorize all the rules and regulations, and it is therefore very important that you read this introduction before you attend the course. The course contains a great deal of detailed information, and it is inevitable that a lot of questions will arise afterwards. You may ask these questions to the contact persons listed at the end of this document.

It may be worth remembering that the Process Laboratory can be considered as the best-equipped university lab in the world, which gives us tremendous possibilities for the future. Again, we wish to welcome every new user to fruitful and rewarding work in our facility.

2.0 About the process laboratories



The facility for microtechnology processing and nanoscience consists of a number of laboratories that have a great number of users. These users will, provided that a certain set of rules are followed, have access to the facility around the clock. The facility contains delicate equipment with a value of several tens of millions of crowns (millions of dollars) as well as chemicals and gases that are a potential danger if they are handled incorrectly.

The facility is divided into areas with different cleanroom classes according to the following assignment: Process Lab 1 with lockers and gowning area, Process Lab 2, MBE Lab, dicing/CMP room, chemical handling room. (The word "cleanroom class" means that the areas have a controlled environment with a specific particle count per volume of air.)

Process Lab 1 ("the cleanroom"), Class 3-6 according to ISO 14644-1 standard (class 1-1000 Fed Std 209E), is primarily intended for projects with a set of well-defined process steps, where no contaminating processes are present. This lab has all relevant equipment to handle processes for:

Microwave Processing
Nano Processing

This makes the facility a first-class university laboratory for micro- and nanotechnology processing, well suitable for advanced research as well as for commercial projects. The total area of Process Lab 1 is approximately 1000 m^2. Temperature and relative humidity are well defined to 21±1°C (±0.1 °C at the new e-beam location) and 43±3% RH, respectively.

Process Lab 2 (also called "the training lab") has a cleanroom class of 7-8 (10 000 - 100 000) and is primarily intended for projects where users want to try new process steps, or if "quick-and-dirty" experiments should be performed. The relatively simple gowning procedure and cleanroom dress standard, the more relaxed cleanroom behaviour standards, and the simple equipment makes it possible to get your processes done quickly. The lab is also suitable for new users who want training and practice on cleanroom behaviour and processing. It includes 3" Silicon processing, general thin film deposition, simple photolithography, and assembly. Process Lab 2 also contains a special area for High T_c superconductors and other functional oxides (laser ablation). The total area of Process Lab 2 is approximately 240 m^2.

The MBE, dicing/CMP, and chemicals handling rooms are smaller rooms of designated cleanroom classes prepared for special use. The MBE room is for production of III-V materials, the CMP room for preparation, dicing, and polishing of semiconductor devices and materials, and the chemicals handling room for the preparation and limited storage of special chemicals for the cleanroom.

3.0 General information

3.1 Introduction for new users

All users of the process laboratories must attend a set of introductory lectures in order to get sufficient knowledge to be able to work safely and efficiently in the lab. This education is given within MC2 by the Process Laboratory staff. The course will cover the basics on cleanroom behaviour, chemical safety, and the emergency systems, such as how the alarms and evacuation plans are organised.

The course is normally given when needed or once a month with preferably around 10 persons at a time. Applications for user introduction can be found on the web site: http://processlab.mc2.chalmers.se

3.2 Access

After attending the training course, the user's key-card (issued through the user's own group/department) is activated for access to all cleanroom areas. Please note that an activated key-card does not mean free indiscriminant access to the lab equipment. In addition to the key-card, a ***"driver's license"*** is needed for each piece of equipment before a user is allowed to use it. The driver's license is issued by the person within the lab group staff who is responsible for the specific equipment, only after the user has been given proper training on how to use it. Entrance is possible through the main entrance at level 3 (MC2 building, section D) outside Process Lab 1, or at level 2 (section A) outside Process Lab 2.

Please note that entrance to Process Lab 1 is ***only*** allowed through the main entrance at D3, while other areas may be accessed through either alternative. For access to areas other than Process Lab 1, the entrance at A2 is preferred, since this reduces the load on the visitor's corridor. To simplify the logistics of cleanroom garments, the general rule is that ***you should exit where you entered***.
The key-card gives access only to these two entrances. All other doors are locked and secured by alarms in order to ensure a proper, protected, internal shell. More detailed information about how to enter the cleanroom areas, as well as about equipment driver's license issues, is given later in this document.

4.0 Rules and regulations

4.1 The safety policy

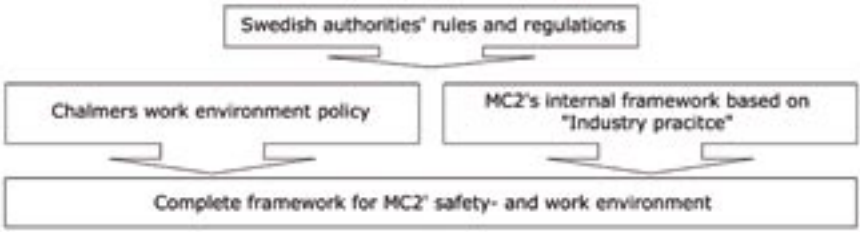
All activities within the Process Laboratory facility are governed by the Swedish authorities´ regulations regarding safety and work environment. These regulations, together with the authorities´ recommendations, are the framework for the lab worker's rights, and prescribe programs for training, control, and other measures taken by Chalmers and the Process Laboratory. In addition to the rules and regulations from the authorities, the Process Laboratory has developed an internal set of rules, based on "industrial practice", i.e. the collective international competence from similar facilities worldwide. Therefore, the user can be ensured that the rules controlling the work in the Process Laboratory is well founded, and that each individual rule is based on long-term industrial and research experience. The framework is, of course, well adapted to the general safety and work environment policy at Chalmers.

It is beyond the scope of this short document to present a complete coverage of the frameworks mentioned above. All information regarding this is available in the document "safety structure" which is available in the bookshelf facing the "Direktorn" room outside the lab group offices (level D2), and in the lab manager's office.

The internal framework, primarily intended for local safety and environmental issues specific to lab activities is described in more detail in section 9 of this document.

The figure below illustrates how the safety and work environment issues are handled:
"Chalmers arbetsmiljöpolicy" is described within the Chalmers home page:
http://www.adm.chalmers.se/Intern/Arbetsmiljo/arbm.html.

The lab manager is responsible for executing and maintaining the framework and recommendations described above. Any questions regarding your rights in this respect may be presented directly to the manager.



4.2 User responsibilities

Users who have attended the necessary courses are granted time limited "driver's licenses" for access to the cleanrooms and equipment.

These licenses are not permanent; any action by the user that violates the safety or function in the various process areas may cause the user to be denied access over a limited time or, in extreme cases, permanently. These issues are handled by the Dean and lab manager and are judged individually.

It is assumed that every user

- has read and understood this document
- has attended the training course given for new users
- carefully follows the rules and regulations for cleanroom work
- doesn't lend or copy keys or keycards for the facility
- follows the directives given from the lab staff
- maintains a proper personal hygiene
- acknowledges the established work and access hours
- pays attention to the information updates issued
- acts in a professional manner
- registers his/her e-mail address to the administrator (see section 11.0)

Users with experience from smaller Process laboratories may see the Process Laboratory regulation framework as complex and over-worked. However, both the size and cleanliness level of the facility calls for rigorous safety rules and cleanroom discipline. In the end, it is the user who benefits from a safe and functional work place.

4.3 Facility staff responsibilities

The lab staff has the following functions and responsibilities:

- To give advice and suggestions regarding process issues.
- Execute projects according to process plans.
- Ensure that safety, cleanliness, and equipment standards are maintained.
- Perform service and maintenance.
- Maintain booking systems and other administrative functions connected to the lab.
- Train new users in cleanroom behaviour and dress code.
- Inform users via e-mail about changes related to the Process Laboratory.

Please note that it is NOT within the responsibility of the lab staff to:

- Clean the equipment after other users.
- Execute process steps without prior approval from the project manager.
- Attend other user's processes.
- Execute other tasks connected to a project without prior approval by the project manager.

4.4 Alarms

All work with gases and chemicals carries to a potential risk for the user. In order to reduce the risks, Process Laboratory has employed an advanced system for detection of dangerous gas leaks. The system is supervised and maintained, according to a strict procedure, by the maintenance staff. The gas detection alarm, as well as the general fire alarm, is indicated by red flashing light in combination with an acoustic signal. In addition to the gas and fire detection alarms, a ”process alarm” is installed. It detects conditions not dangerous for humans, but immediate danger for a product, equipment, or the facility. A blue flashing light in combination with a repeated, short, acoustic signal indicates this process alarm.

In the event of a fire or gas alarm, the cleanroom should be evacuated immediately in a manner described by the current evacuation plan. Leave the lab through the nearest emergency exit. Do not worry about getting the cleanroom clothing dirty as these can be washed later. All users must promptly move to the point of assembly, located at Kemigården (the upper yard outside the chemistry building). Please see Appendix 1.

5.0 The organisation

Regarding the general organisation of the Department of Microtechnology and Nanoscience and the Process Laboratory, we refer to the website: http://www.mc2.chalmers.se/

The Process Laboratory is headed by a lab manager. The main task for the group is to maintain and improve the processes and equipment park in the lab and presenting a resource for both internal Chalmers research groups and external users.

The laboratory hires specially trained personnel for the cleaning of the laboratories and other areas within the facility. Although the people within this group are not formally members of the lab group, they are nevertheless an integral part of the lab. As a user, you will meet them every now and then (average 2 full time employees) as they work. It is very important that you respect their work and that you don't try to make them do things that they are not assigned to do. The person responsible for the cleaners' tasks, within the MC2 lab organisation, is the group leader for Service and Maintenance .

6.0 Lab usage

6.1 Approved users

In order to use Process Laboratory equipment, the user must have been trained for the specific equipment, and subsequently been granted a usage license for it by the person within the lab group who is responsible for the equipment. Therefore, you should never touch any equipment that you have not been trained for. In addition to the risk of damaging the equipment, you also run the risk of hurting yourself! It is also important to know how the specific equipment is used by others. The fact that **you have a license to use the equipment does not mean that you are free to introduce any strange or non-approved materials without contacting and getting approval from the person responsible for the equipment.** Contamination in one piece of equipment may easily spread and "cross-contaminate" a complete process line, and cause costly and time consuming service work. Special care regarding choice of materials is important when working with high temperature process steps, vacuum and plasma equipment.

"Driver's licenses" for specific equipment are issued by the person within the lab group who is responsible for the equipment. A list of equipment and the corresponding name, e-mail and telephone number for the persons responsible is presented on the web site: http://processlab.mc2.chalmers.se/

However, to have a driver's licence is only the first step to be an experienced user. In many cases it is necessary to have a more extensive training period before you are able to handle the equipment by yourself in an optimal way. To find out how to become this experienced user, you must discuss with your supervisor together with the tool responsible person in order to determine a plan for this "experience period". Such a plan varies from equipment too equipment and person to person. **To find out the best and safest way to use a tool is a common responsibility of your supervisor and the tool responsible. Only experienced users may use the process equipment in the laboratory by themselves.**

6.2 Lab access hours

Approved users have access to the lab 24 hours a day, all year, with the exeption of certain holidays. When the lab is closed, an announcement is always displayed under ”News” at: http://processlab.mc2.chalmers.se

The lab group staff has normal working hours, displayed on the Chalmers web site: http://www.adm.chalmers.se/Intern/Personal/Personalhandbok/arbetstid.html

However, the usage of special equipment or instruments may be limited to normal working hours, or when personnel from the lab group are on duty. In particular, this limitation applies to the usage of chemicals. When a user wants to work in the lab outside normal working hours, e.g. late at night, the ”lab buddy” system must be used. This procedure is defined in section 6.4.

6.3 Visitors

Occasional visitors can be taken to the visitor’s corridor around Process Lab 1, which offers a good view of the lab area. Lab users may give this type of tour for small groups without prior approval by the management of the Process Lab. However, as a guide, you are always responsible for the safety and behaviour of your visiting group. Visitors may only enter Process Lab 1 as an exception, and then only after prior approval by the Process Laboratory manager. Prior to the visit, these guests must be given a short introduction to cleanroom behaviour.

Other parts of the cleanroom area such as Process Lab 2, dicing/CMP, MBE Lab, and the chemical preparation room, are always possible to visit, provided that the persons working in these areas are not disturbed or hindered by the visit.
Mobile (cell) telephones may not be brought into the cleanroom areas. Lockers for valuables are available at level D3, both outside and inside the step-over benches.
It is very important that you instruct your visitors on the following subjects, applicable to the different cleanroom areas:

Visitor’s corridor:
Do not try to get the attention of people working in the cleanroom.
You may jeopardize their safety by distracting them.

Because the visitor’s corridor is a part of the cleanroom,
the following procedure is mandatory:

- Visitor’s street clothing, bags, etc., should be stored at the rack or lockers inside the main entrance at level D3.
- Shoe covers should be applied at the step-over benches. There are additional lockers for small items in this area.
- Visitor’s cleanroom coats and hair covers should be put on in the ”visitor’s gowning room”
- The visitor’s air lock can fit 3 persons at the time for transfer into the visitor’s corridor. Please observe that the doors are interlocked.
- When exiting, reverse the procedure.

Process Lab 1:
Requires special permission from the lab manager. All guests must be informed about safety rules and cleanroom behaviour. For information on the cleanroom gowning procedure, see section 8.2.

Process Lab 2 and MBE Lab:
Instruct your guests not to touch anything. All movements should be performed in a controlled way. For gowning procedure, see above ”Visitor’s corridor”.

Dicing and CMP room:
Ensure that all visitors wear protective glasses. Protective glasses are available at the room entrance.

Chemical preparation room:
Normally not accessible for visitors. However, the activity may be viewed through a window in the door. Occasionally, the Service and Maintenance manager can grant permission for visitors.

If you want to show your visitors other areas outside the cleanroom area, you may of course do so. A tour through the media basement (sub-fab) is usually appreciated. For this, you need to contact someone in the lab group, preferably the Service and Maintenance manager. The best way is to enter the basement after a tour in the visitor’s corridor. The visitors may remove their cleanroom coats and hair covers in the area near the air lock, but keep their shoe covers on. You and your visitors can then, with the assistance of the lab group member, open the door to the staircase leading down to the media basement. When the visitors have passed this point, they may remove their shoe covers and follow you down to the media basement. After passing through the media basement, the group must exit through the corridor from goods entrance, passing by the chemicals storage rooms, through the media tunnel, and take the elevators up to the ”Canyon” level. You will then guide the visitors back to the main entrance at level D3, where they can pick up their stored belongings.

6.4 The back-up (”lab buddy”) system and the authorities’ rules of working alone in a lab (ensamarbete)

The laboratories are normally open, 24 hours a day, seven days a week (see section 6.2). However, some processes may not by used outside the normal working hours, weekdays 8-17. Special processes, (such as some MOS and III-V processes involving highly toxic gases) may under no circumstances be used outside normal work hours (unless authorised lab personnel are present).

Other equipment/systems may be used outside normal work hours only if one additional approved user, a ”lab buddy”, is present. This approved lab buddy must be present in the lab (or very close by) to be able to assist you in the event of an accident. The lab buddies must be in close contact with each other (NOT by mobile telephone!) to make this system work efficiently. The lab buddy system should be applied especially when you are about to use chemicals in the process benches after normal work hours. Additional procedures and restrictions may be applied to special equipment. You will be informed about this when you get your ”driver’s license” training. The back-up person must be knowledge able about the Process Laboratory, its safety functions, and alarm systems. It is therefore up to the MC2 management to approve back-up personnel. You should report to the service and maintenance manager or the lab manager if you intend to work outside normal working hours, and who your lab buddy is.

Is working alone in a laboratory allowed?
The authorities have also set up rules concerning working alone in a lab (ensamarbete). The Swedish Work Environment Agency (Arbetsmiljö Verket) proclaims the following concerning working alone in a laboratory;

The following statement is found in §4 of the Employee Protection Committee's regulations on working alone (AFS 1982:3): "If there is evident risk of accidental personal injury occurring while working alone, then the worker must be assured quick access to help in the case of an emergency. If acceptable safety cannot be assured through alternative means, then the work can only be carried out if another person is present."

There are no rules concerning working alone in the Employee Protection Committee's regulations on laboratory work with chemicals (AFS 1997:10), however § 2 does require a risk assessment to be carried out for all laboratory work in cases where dangerous materials are either used or formed. The risk assessment shall include, among other things, measures which need to be followed in order to assure that the work can be carried out safely. Sufficient preparedness for accidents must also be in place before any laboratory work can begin.
The risk assessment is key in determining whether or not work can be carried out alone in the laboratory. It must demonstrate a safe environment as well as that help can be readily obtained without having a second person present.

6.5 Storage

Each frequent user of the facility will be assigned a limited storage space in Process Lab 1 and 2. This personal storage space is a slot in a steel wire rack shelf, with a corresponding tool box. The boxes are intended for temporary storage of work material such as tweezers, personal items, cleanroom pens and notebooks, etc. The main purpose for this is to limit the amount of items and materials on work surfaces in the laboratory, and it is the responsibility of each user to make sure that these surfaces are not used as long-term storage. After a finished session, all materials should be stowed away and stored in the user's tool box. Unlabelled items lying around for any length of time will be removed by the lab staff and will eventually be disposed of. Only harmless materials may be stored in the personal tool boxes. *Materials with high probability of contamination or which may impose a safety risk, may under no circumstances be stored in the personal tool boxes!* Examples of banned items are chemicals, ordinary paper, and Styrofoam packaging material. These kinds of materials should be stored in a place advised by the lab personnel. Please note that the personal tool boxes are *personal*, i.e. you should not borrow items from a box that belongs to someone else.

6.6 Telephone and public address systems

Mobile (cellular) telephones are not permitted within the cleanroom area or media basement, as they may disturb sensitive electronic equipment. All usage of telephones must be done via the fixed telephone system, which is available throughout the laboratories. Outgoing calls are dialled in the same way as from other locations at Chalmers; internal numbers are dialled directly, "00" prefixes external calls.

Once you enter Process Labs 1 or 2 (areas *not* included in the above) you cannot be reached by telephone. This is on purpose - persons in these parts of the laboratories should not be disturbed unnecessarily, such as when the "wrong" person is answering the phone, or being forced to take off chemical protection gloves unnecessarily, etc. If you expect an important phone-call while inside this part of the lab, you have to inform someone in the lab group (or the secretary) outside the laboratory, prior to entering the lab.

This person can then use the internal public address (loudspeaker) system to inform you of an incoming call. You may then use the fixed telephone (3 extensions in the middle corridor in Process Lab 1, 1 extension in the centre of Process Lab 2) to make an outgoing call according to the instruction above.

The internal public address loudspeaker system in Process Lab 1 can be accessed outside the gowning room air lock, and outside the material air lock on the opposite side. The corresponding loudspeaker system for Process Lab 2 can be accessed from just outside of the entrance. Central access is also possible from the laboratory control room, which is located in close connection to the lab group office area, at level D2.

This public address system is an important part of the total safety function, as the users quickly can be informed about safety risks and other important matters. Each lab user must learn how to use the public address loudspeaker system!

6.7 Priorities

Projects, which have been undertaken by the lab, are normally handled in chronological order and the delivery should normally be done no later than at the date agreed on between the lab and the contractor. Delays caused by events beyond the control of Process Laboratory may result in a delivery later than the agreed date. Things like technical problems or illness may cause this. The level of bookings on specific equipment may also affect delivery date.

If the chronological order of priority for projects should be changed, it would be a subject of capacity or priority arguments and should be decided by the lab manger. In exceptional cases, the lab personnel may change or remove a users' booking, if time-critical projects require so. In such cases, the lab personnel should inform the user about the changes as soon as possible.

6.8 Charges

All users are charged for the usage of the facility. This user charge is handled differently for different categories of users and for different project categories.

Costs for ”standard” expendables (chemicals, gases, wipers, etc.) acquired by the process lab are included in the cost and need not be accounted for by the user. However, special items, such as special wafers or expensive materials will be charged based on the consumption. Which items are ”standard” in the lab can be found in the inventory list, always updated on the Web page.

Charging is performed through internal invoices within Chalmers, and through normal invoicing for other users. Payment conditions for the latter case is 30 days from the invoice date.

Note that lab staff does not guarantee the outcome of a project. Charging is performed regardless if the project was successful or not, or if the expected yield could be achieved or not. The lab staff does not take any responsibility for delays or unexpected cost increases related to the project.

7.0 Processes and equipment

7.1 Bookings

Equipment may be booked through the MC2 web site at: http://labbokning.mc2.chalmers.se/

Consider the following when you book equipment:

1. Plan your process steps. Do not book more time than you need.
2. Make sure that your process step is finished by 17:00, unless you have a lab buddy.
3. Cancel booked time that you do not intend to use.
4. Apply a professional attitude to your work, and keep strictly to your booked time. Delays will cause irritation among the subsequent users.
5. If you do not show up at the equipment within 30 min your booking is considered cancelled and another user could use your booked time.
6. Make sure that you have booked sufficient time for cleanup and resetting of the equipment to original state.

The lab group has in some special cases higher priority for bookings in order to ensure that ordered projects are progressing according to the process plan. Customers, both internal and external, are a very important source of income for the process lab. The ordered projects, especially the commercial ones often have a very tight schedule. The lab group should, of course, always attempt to plan the processes so that collisions are avoided, and only as an exception intrude on an already booked time.

7.2 General media

Compressed air, tool vacuum, central vacuum cleaning, blowgun nitrogen, liquid nitrogen, and ultra-pure water should always be available in the Process Lab 1. Compressed air is used only for pneumatic valves and safety functions at the process benches. Tool vacuum is used for spinners, chucks, and vacuum tweezers, etc. Vacuum cleaning in the labs utilises a central vacuum cleaning (CVC) system. It is used for general house cleaning, (cautious) cleanup after broken wafers in equipment, as well as an integral part of some LCD processes. The CVC system starts when activating a microswitch inside the recessed connectors in the floor, as soon as the vacuum cleaning hose is connected. Please note that the CVC system may be used for chemical spills, but only in emergency situations, as the hardware is not designed for excessive chemical exposure.

De-ionised water is available at almost all process benches. We produce large amounts of DIW (>18 Mohm-cm) and we have a buffer tank of 5 m^3 in the media basement. In addition to processing, this water is also used in large amounts to humidify the air that is supplied to the Process Laboratorys during the colder parts of the year. Even though it is possible to get this ultra-pure water just by simply opening the tap, it does not mean that it is free or that the source is unlimited.

Even if some processes require extensive and careful rinsing, you are asked to ensure that no water taps are left open or that rinsing baths are left flowing unnecessarily.

Pure blowgun nitrogen (purity 4.6) is supplied from a separate liquid nitrogen tank and is distributed via a high purity piping system throughout the lab. The tank and the attached evaporator are placed at the north side of the MC2 building. This nitrogen gas with a purity better than 99.996%, is used for blowguns, for purging of WIP (Work In Progress) cabinets, and for several other equipment service functions in the lab.

Both blowgun nitrogen and liquid nitrogen (LN2) is available within the facility. Liquid nitrogen is a low temperature liquid, which is primarily used for cooling of vapour traps and substrate holders in vacuum equipment. Liquid nitrogen is *extremely* cold, 77K = -196°C, and may cause severe burns by freezing of the skin and underlying tissue. It is especially dangerous if LN2 is spilled into a closed volume, such as the inside of your shoes or gloves, or splashed into your eyes. LN2 is available via a direct line from the external cryogenic tank into the MBE equipment in the MBE Lab. If you would need LN2 for any other application, please contact someone in the lab group to help you fill your Dewar from the LN2 tap outside the MBE Lab. (There is also another LN2 tap in the corridor on the first floor right under the MBE Lab.)

Only Dewar vessels may be used due to the large evaporation rate from open containers. You must watch the filling process continuously to avoid overfilling. When handling large amounts of LN2 indoors, there is always a risk of suffocation as the evaporated nitrogen may replace the oxygen if the room is small or if the ventilation is insufficient. This risk may be regarded as negligible in the large corridor where the tap is placed. However, large spills must always be avoided, as 1 litre of LN2 will turn into more than 700 litres of gas when evaporated. Large spills will also cause severe damage to the floor. Please make sure that you close and lock the door after the filling is completed.

Our supplier of LN2 monitors the tank levels remotely, and delivers new LN2 when needed. This blowgun nitrogen is not free of charge. We use large quantities every year for venting, purging, etc. Don't waste nitrogen by using excessive flow rates or venting time!

7.3 Drains and exhaust

There are two drain systems installed in the labs, solvent drains and acid drains. It is extremely important that you use the correct drain system for your used chemicals, since mixing of these chemicals classes would cause risk of explosion in the waste handling facility. The solvent waste is collected in a tank at level 0 in the service building, to be transported away by a truck for destruction. The solvent drain should be used only for non-chlorinated solvents such as acetone or propanol.

The acid drain should be used for wastewater with acids and bases. This water is passing through a neutralisation tank that ensures that the water released to the public drain system is always neutral with a pH of 7.0.

All process benches with their etching and cleaning containers etc., are connected to the proper waste drain. If you have waste chemicals and you are unsure about what to do with them, please contact the lab personnel for advice. Never discharge any materials in the drains if you are not sure it belongs there. Put it in a closed bottle so you can decide later. Some chemicals should always be collected in waste bottles after use, to be disposed of by the lab personnel.

There is an additional drain system, the emergency drain, which should be used only, as the name indicates in cased emergencies. You will be instructed on how to use this drain in connection to the introductory training.

The process laboratories have 3 separate exhaust systems: solvent, acid, and poison exhaust. The exhaust fans for these systems are placed at level A9. (The poison exhaust is driven directly by a diesel-powered emergency system in the event of a general power failure. The other exhausts are driven by the same system, but at a lower priority.) The acid and poison exhaust systems are connected to water scrubbers, a waste handling system, that air have to pass through before it is released to the environment. The level of vapours in the solvent exhaust system has been regarded low enough so that waste handling is not needed before release to air.

The main consumers of exhaust are the process benches. Every bench is connected to one or more suitable exhaust systems. If all process benches were in operation simultaneously, their consumption would be more than the total capacity of the exhaust systems. Therefore, all benches are equipped with open/closed switches. Please refer to next section 7.4, Process benches, for further information.

Under which circumstances is it required to store chemicals in ventilated cabinets according to the authorities?
According to §13 of the Employee Protection Committee's regulations on laboratory work with chemicals (AFS 1997:10), chemicals that produce fumes which are hazardous to your health are required to be stored in mechanically ventilated cabinets or storage areas. There are no regulations concerning the storage of chemicals which do not give off dangerous fumes. It should be pointed out however that it may be appropriate to store certain chemicals in mechanically ventilated cabinets even if the regulations do not specifically require them to be.

When should one have a gas alarm in a ventilated chemical cabinet located in a school?
According to §7 of the Employee Protection Committee's regulations on laboratory work with chemicals (AFS 1997:10), "ventilated cabinets shall be equipped with a control system to reveal any problems in the ventilation system. This control is required to be in the form

of an alarm in certain situations. The alarm, which can be either auditory or visual, is required when working with the chemicals can cause life threatening or serious injuries of either the acute or chronic nature".

This requirement applies without exception, even in schools. The questions that need to be addressed first are: Which chemicals will be stored in this cabinet? What risks are involved for each chemical? The answers to these questions will lay the foundation for whether or not an alarm is required for the given cabinet.

It should also be noted that it is quite possible to have a combination of cabinets, some of which have alarms and some of which do not, as long as the dangerous chemicals are always stored in the cabinets which do have them.

7.4 Process benches

A large number of process benches are installed in Process Lab 1, Process Lab 2, CMP/ Dicing, and in the chemicals preparation room. The benches have built-in functions for etching, spincoating/developing, wafer cleaning, etc. When you are about to start working at a process bench, you will find (if the previous user have used it correctly) a status light signal, mounted on the bench, with a steady blue light. This indicates that the bench currently uses only 10% of its nominal exhaust capacity. To increase the bench exhaust flow to its nominal value, turn the "Exhaust" switch to "Open". If there is enough capacity in the total exhaust system at this moment, a valve is opened to enable nominal exhaust flow for this bench. At the same time, the status light signal changes from steady blue to steady green. If the green light does not turn on, too many benches are already in use, and you will have to wait until one of those benches is turned off.

For safety reasons, you are only permitted to use a process bench when the steady **green light is on**, i.e. when the exhaust flow is sufficient.

As soon as you have finished your work at the process bench, you should turn the "Exhaust" switch to the "Closed" position. This means that the exhaust flow for the bench returns to 10% of its nominal value, and that the electrical power to the installed equipment such as hotplates, heating baths, etc., is turned off. If you don't turn the bench off, you may block the availability of other benches to other users. When the bench has been "on" for a certain time (normally 4 hours), you will hear a warning signal. At this point, you will have to either turn the switch to "open" and continue working, or turn the switch to "closed". If not turned off manually, the bench will eventually automatically shut down and the status light signal will change to flashing blue. The bench is now disabled and must be reset. Please make sure that you avoid these unnecessary interruptions!

During your "driver's licence" training, you will receive further instructions on how to use the various equipment installed in the benches (such as spinners, ultrasonic baths, etc.), and how the bench fire extinguisher system works.

7.5 Special gases

The various gases, which are used for processing, are called "special gases" and are delivered throughout the facility under high pressure from steel bottles. Most of these bottles are installed in ventilated special gas cabinets, equipped with state-of-the-art high purity valves, pressure regulators, and flow controllers. Gas bottles must always be handled with the greatest respect, as an enormous energy is stored in the compressed gas. In addition, many of the gases are poisonous, corrosive, and/or flammable. Improper handling of gas bottles and installations may result in contaminated gas, and destroyed samples and equipment.

Service and maintenance of the special gases and the equipment in which they are used may only be done by the lab personnel. Gas bottles may only be exchanged by specially trained lab personnel.

Most of the gas bottles are stored in special cabinets in one of the four rooms in the Special Gas Building G. The four rooms are classified for:

Flammable gases
Poisonous gases
Corrosive gases
Inert gases

There are also a few ventilated special gas cabinets in the media basement (directly under Process Lab 1) and the media attic (above Process Lab 2), for gases which have physical properties that require them to be placed close to the equipment that they serve.
Gases which have many points of use are distributed via distribution boxes placed in the media basement. Finally, equipment that have a number of different special gases connected to them have a special ”Point of Use” box (PoU) from which the gases are delivered to the equipment. These PoU-boxes are placed below the raised floor in Process Lab 1, and in the service fingers in Process Lab 2. The gas pressure and flow can be regulated in these boxes.

Cabinets, distribution boxes, and PoU boxes that contain toxic, flammable, or corrosive gases, are connected to the poison exhaust. In addition, one or more gas detectors are installed in each unit. If a leak should occur, a signal will be distributed through four different wire loops to a gas monitoring system placed in the Process Laboratory control room. The information is acquired for detection and analysis and will trigger an alarm if needed. Even before an alarm is signaled, automatic pneumatic valves have shut off the entire gas distribution.

8.0 Cleanroom behaviour

8.1 What is proper cleanroom behaviour?

Every person generates particles. A person walking at normal pace will generate around 5 million particles per minute! In order to limit the number of particles spread to the cleanroom, special garments are used. These garments act as particle filters between the lab user and the cleanroom.

A correctly used outfit helps to drastically reduce the spreading of particles, but each user is responsible for further reduction of particle generation and spreading.

Please obey the following recommendations of proper cleanroom behaviour:

Plan your work in the cleanroom well. Book equipment and order chemicals to avoid reentering the cleanroom.

Persons suffering from cold or eczema should not enter the Process Laboratory.

A good personal hygiene is a condition to enter the Process Laboratory and especially the Process Lab 1 (”cleanroom”).

Smokers should wait at least 30 minutes after smoking before entering the cleanroom. Smokers and snuff users have to rinse their mouth before entering the cleanroom. Snuff is strictly forbidden in the Process Laboratory.

Cosmetics, rings and wristwatches have to be removed before entering the cleanroom.

Mobile phones are not allowed in the cleanroom areas and have to be switched off before entering the Process Laboratory.

No beverages or food, including chewing gum, are allowed in the Process Laboratory.

Do not bring paper protocols in to the cleanroom.

All movements should be slow and well planned.

Avoid touching any clean surfaces, such as loading stations.

Avoid creating crowds as contamination then will be concentrated.

Do not scratch yourself through the garment, as this will cause increased particle generation.

Avoid talking near your component/product.

Do not carry items close to your body. Carry them high and in front of you.

All components/products stored in the cleanroom have to be covered, preferably stored in closed boxes. Please note that long-term storage is not allowed in the cleanroom.

Garments that are wet or stained have substantially reduced filtering effect and have to be exchanged immediately.

It is up to each user to clean and reset the process equipment after use. Information about safety and cleaning of the equipment is included in the user driver's license training. All questions should be directed to the person responsible for the equipment. Please inform the responsible person immediately if you observe any damage or functionality problem of the equipment in use.

These rules may be difficult to follow, nevertheless they are a basic condition to enable the large group of lab users to successfully cooperate and produce unique research results. It is therefore the responsibility of the laboratory personnel to inform the users, in a kind but firm way, about any errors in their cleanroom behaviour. The users could also correct each other, if needed! A user can be banned from the cleanroom, or ordered further cleanroom training, if repeated or serious errors in the work procedure are found.

8.2 The cleanroom garments

The cleanroom garment is a particle filter worn to protect the clean room environment from the contaminations coming from the human body. The filtering function will only work properly if the garments are worn correctly and are free from moisture and stains. It is also important to choose garments of correct size. Gowning, garment handling and cleanroom entry is performed in the following manner:

Process Lab 1

1. All access to Process Lab 1 is via Level 3.
Enter the main entrance to the Process Laboratory at Level 3. Before you enter the shoe-changing area, take off any jacket or coat and place them in a locker. Sit down on the step-over bench, take off your street shoes as you swing your legs, one by one, to the cleanroom side of the bench. Place your street shoes in the shoe rack. Pick up your personal lab shoes and put them on at the second step over bench. Proceed through the door to the Process Laboratory, put on a hair cover just outside the door and walk down stairs to Level 2. The hair cover should cover all of your hair as well as the ears.

2. Enter the gowning area, close the door, and wash your hands up to your elbow. Dry your hands in the automatic dryer. Please note that make-up is not allowed in the cleanroom environment and must be removed before entering the gowning area.

3. Check if your overall and hood are on your personal coat hanger. If not, take an overall and a hood from the glass-door cabinet in the gowning area. The cleaning staff will periodically remove all garments on the garment racks.

4. Always begin gowning with putting on the hood (keep the hair cover on). Then put on the overall. Avoid touching the floor with your overall.

5. Carefully inspect (and correct) your garment in the mirror. Take a pair of booties from the wire shelves and continue to the step-over bench.

6. Put on the booties - one by one - as you swing your legs to the cleanroom side of the step-over bench. Never put the booties on the step-over bench with the sole down in order not to cross-contaminate other person's overalls.

7. Put on the gloves. The gloves must be worn over the cuffs of the overall.

8. Check that the airlock to the cleanroom is empty, open the airlock door and enter. Close the door behind you carefully and proceed to the cleanroom. Check that you have correctly closed the door behind you. Always take several steps on each sticky mat.

We recommend to use cleanroom undergarments under the overall. The undergarments work as a pre-filter. They are also cooler and more comfortable to wear under the overall than regular clothes. Undergarments are available from the person responsible for Service and Maintenance. Preferred storage places for the undergarments are the lockers on Level 3. The locker room is divided into a male and female section.

The overall is a particle filter and is not designed to withstand chemicals. The use of chemical resistant gloves and eye protection is compulsory when you work with chemicals. You can find more information about this in Section 9. Please note that the cleanroom garments are expensive and that it is important to be careful and avoid contaminating them.

The gowning procedure will be reversed when you leave, except that you keep the gloves on until you have left the gowning area:

1. Check that the airlock is empty, take several steps on the sticky mat before you open the door.

2. Enter the airlock, close the door carefully and proceed straight forward to the gowning area. Do not step outside of the black/yellow tape with booties and do not step inside of it without booties! Take off your booties and place them on the proper shelf. The booties must be sorted according to the size as marked on the shelves.

3. Keep your gloves on, take off the overall and hang it on the coat hanger. Then take off the hood (keep the hair cover on) and hang it together with your overall. Please take care that the outer surfaces of your garments do not touch the inner surfaces of other garments.

4. Normally you will hang your garments on the coat hanger. However, if your garments are dirty, put them in the laundry containers before leaving the gowning area. Please note that contaminated garments shall not be put in laundry containers. Contaminated or damaged garments shall be placed on the bench close to the door and you should inform one of the lab personnel.

5. Leave the gowning area and close the door carefully.

6. Take off the gloves, throw them away into the container near the entrance to the gowning area and proceed to Level 3. Continue to the step-over bench, take off the lab shoes as you swing the legs over the bench. Place the lab shoes on the shoe-shelf. Do not walk in your lab shoes in the sock area!

7. Change to your street shoes outside the step-over bench.

8. Take off and throw away the hair cover.

Process Lab 2 and other cleanroom classified areas (Dicing-room, MBE Lab, e-beam control-room, SEM&AFM metrology section):

The cleanroom garments in these areas are less advanced as the cleanroom class here is lower than in Process Lab 1. The garments consist of lab-shoes, coat, hair cover and gloves. The safety requirements regarding chemical gloves and eye protection are the same as in Process Lab 1. Please follow the gowning procedure as described below.

Entering Process Lab 2 and other classified areas from Level 3.

1. Enter the main entrance to the Process Laboratory at Level 3. Before you enter the shoe-changing area, take off any jacket or coat and lock those together with any luggage in the lockers. Sit down on the step-over bench, take off your street shoes as you swing your legs to the cleanroom side of the bench. Place your street shoes in the shoe rack. Pick up your personal lab shoes and put them on at the second step over bench. Proceed through the door to the Process Laboratory, put on a hair cover just outside the door and walk down stairs to Level 2. The hair cover should cover all of your hair as well as the ears.

2. Continue to the gowning area for visitors.

3. Take a coat from the rack. If you do not find a correct size, take a new one from the cabinet near the step-over bench. Put on a coat, check that it is properly sealed.

4. Put on gloves. The gloves must be worn over the cuffs of the coat.

5. Check if the air lock to visitors corridor if empty, enter the airlock and close the door behind you. When you leave the airlock close the door carefully. Take several steps on the sticky mat.

6. Continue to your working place.

As an alternative, you can enter Process Lab 2 via the airlock at Level 2 in the A-building.

1. Enter the airlock. Take off your street shoes and put them on the shoe-shelf. Change into your personal lab shoes as you cross the step-over bench.

2. Put on the hair cover. The hair cover should cover all of your hair as well as the ears.

3. Take a coat from the rack. If you do not find a correct size, take a new one from the cabinet near the step-over bench. Put on a coat, check that it is properly sealed.

4. Leave the airlock, close the door carefully. Take several steps on the sticky mat outside the door.

5. Put on gloves. The gloves must be worn over the cuffs of the coat.

6. Continue to your work place.

The gowning procedure is reversed when you leave the Process Laboratory. You should leave the lab via the same airlock you entered. Please note that the hair cover should be worn in the whole Process Laboratory area and taken off just before leaving the entrance to the Process Laboratory.

Garment handling procedure for visitors:
All access to visit the Process Laboratory is via Level 3. As registered lab user are you allowed to show the Process Laboratory to your guests. Please instruct the visitors about the cleanroom environment before entering the Process Laboratory and follow the gowning procedure for lab users entering the Process Lab 2. All visitors should wear blue shoe covers. We recommend to limit the number of visitors per hosting lab user to max 3 persons.

9.0 Practical safety and work environment

9.1 General procedures at security risks and alarms

Considerable resources have been spent to make the Process Laboratory as safe as possible. Users who still find hazards are obliged to report these to the person responsible for the safety, or to the safety controller (see section 11.0). Use of the workstation that is under safety investigation may not continue until it has been approved by any of the persons mentioned above.

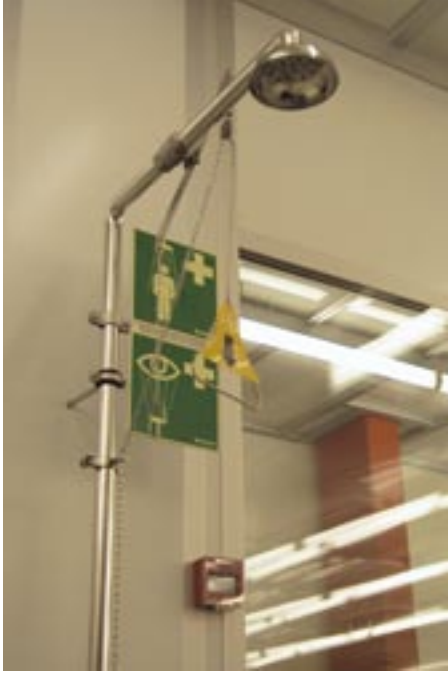
In the event of fire or gas alarm, the cleanroom should be evacuated immediately and all users should promptly move to the prescribed meeting place.
The meeting place is Kemigården, (the upper yard outside the chemistry building, see Appendix 1). Sprinklers are installed throughout the facility, and are activated automatically. An evacuation plan is displayed in the gowning area before entering the main air lock (outside Process Lab 1). Please take time to study it carefully! Activated sprinklers can only be shut off after control by the Emergency Services (Räddningstjänsten).

Emergency and eye rinsing stations are installed at the places in the laboratory where chemicals are used. You should familiarise yourself with them so that you are sure you can handle them in an emergency situation. When chemical spills are evident in emergency drains, emergency breakers should be activated and the event should be reported to the person responsible for service and maintenance.

Please note that all accidents should be reported to the lab manager.

In the event of a power failure, an emergency diesel power generator is started to ensure that all safety functions are maintained. Please note that the emergency power facility is intended only to maintain safety, not to enable continuous operation of the processes. The user must be aware that processes and equipment may be affected in the event of a power failure.

9.2 Practical chemical handling and safety



Manual handling of chemicals poses a potential risk for the users. These risks may be reduced to an acceptable level, provided that the users follow the instructions that are available.

A list of chemicals approved for usage in the Process Laboratory can be found at the Process Lab web site at: http://processlab.mc2.chalmers.se

On these pages, there is also a description here of how to perform first aid in the event of a chemical accident. First aid is often different for different chemicals, so please study carefully what applies to the chemicals you intend to use. Information is also given on how different chemicals should be disposed of.

Acids, bases, and solvents are, for safety reasons, stored in separate cabinets and trolleys in the Process Laboratorys. **This storage code may under no circumstances be changed!**

Leaking chemical containers should be regarded as ticking bombs and may cause severe personal and/or material damage, particularly if any of the chemical groups are mixed.
Refilling of chemicals in the Process Laboratory should exclusively be handled by the lab personnel, ensuring that the stock of chemicals is always maintained. The user handling (regardless of previous experience) of chemicals is limited to transporting the container from the cabinet/trolley to the process bench. Users that intend to use large quantities of chemicals are requested to contact the lab personnel, which will see to that the amount of this chemical in the lab is sufficient. If the supply of a chemical is used up, primarily someone in the Service and Maintenance group should be contacted. Some special chemicals should be prepared in the chemicals preparation room. Please contact the person responsible for Service and Maintenance for advice!

The following routines applies to all handling of chemicals in the Process Laboratory:

Put chemical protective gloves over the Nitrile gloves before you start working with chemicals at the process benches.

Put on a face protective visor when required.

Inspect your gloves carefully. If the gloves are discoloured or damaged, they should be disposed of and replaced immediately. Rinse the gloves carefully before placing them into the trash bins. New gloves are acquired from the person responsible for Service and Maintenance.

Every process bench has two status lights, green and blue, indicating the current exhaust flow. All work at a process bench requires a green status light!

Chemicals may only be handled at a process bench.

Apply the Acid-Into-Water rule.

Never mix chemicals without prior knowledge of the consequences.

Some containers/beakers are dedicated for certain chemicals, and may not be used for anything else.

Hydrofluoric acid (HF) and Potassium Hydroxide (KOH) solutions may only be used in plastic containers.

Open containers containing Ammonia (NH3) and Hydrochloric acid (HCl) may not be placed next to each other, as the chemical reaction between the vapours will generate solid particles in the cleanroom.

Chemicals in containers that are not clearly labelled should be disposed of immediately. Mark the container ”unknown content” and call the lab personnel.

Some chemicals are being re-used. Pour this back into the bottle and carefully rinse the container with pure water.

After the work in the process bench has been completed, the chemical protection gloves should be rinsed and put back to their designated place, without touching any surface besides the process bench.

Pay special attention while you are working with Hydrofluoric acid (HF). This acid may cause severe burns into the bone marrow, and the symptoms may sometimes not be noticed until 24 hours after the exposure. Any exposed skin should be covered with ”HF Antidote Gel”. Spread the gel and contact a physician as soon as possible. The paste is available near the process benches that contain HF. Please note that HF is a component of BOE (Buffered Oxide Etch).

Ensure that flammable chemicals (e.g. acetone or propanol) are not used near hot surfaces. Even small amounts may cause fire incidents.
You may not introduce previously unknown chemicals without prior approval from the lab manager. Purchase of chemicals should be done through the lab staff.

Do not disturb persons working with chemicals.

The user is responsible for cleanup of minor chemical spills. Please contact the lab group if a major spill has occurred.

Do not dispose of used chemicals if you are not sure how to do this. Store in closed bottles/containers until further notice. This applies especially to concentrated, unmixed chemicals. Contact the lab personnel for advice.

In addition to process bench work, there are some other processes that require special attention:

Diamond saw and polishing:	Use apron and safety goggles.
Lithography:	Use safety goggles during spin-coating and development.

10.0 Information updates

Information regarding changes, additions, and other Process Laboratory-related information updates, are published on a continuous basis on the web site at:: http://processlab.mc2.chalmers.se/

Furthermore, information regarding the facility is sent by e-mail to the address specified by the user at the time of registration. It is every user's responsibility to access this information regularly. These messages are not only intended to make life simpler for the user (e.g. opening hours during vacation time), but also to inform about subjects directly connected to the safety of the lab users.

11.0 Persons to contact

All equipment has a "Contact person". If you have questions or problem with a specific equipment contact primarily this contact, a list wich can can be found on the web site at: http://processlab.mc2.chalmers.se

MC2 uses a specially trained cleaning staff from the Chalmers cleaning organisation to clean the cleanroom area.

12.0 References

From ”Arbetarskyddstyrelsens författningssamling”:

Anestesigaser AFS 1983.11
Bildskärmar AFS 1992:14
Biologisk ämnen AFS 1992:8, 1993:18 och 1994:34
Buller AFS 1992:10
Canserframkallande ämnen AFS 1993:37
Ensamarbete AFS 1982:3
Farliga ämnen AFS 1994:2
Gaser AFS 1997:7
Gasflaskor AFS 1996:9, 1996:10, 1996:11 och 1996:12
Hygieniska gränsvärden 1996:2
Härdplaster 1996:4
Internkontroll av arbetsmiljön AFS 1996:6
Kemiskt laboratoriearbete AFS 198714 och AFS 1997:10
Klor AFS 1997:7 Gaser
Laboratoriearbete med kemikalier AFS 1997:10
Laser AFS 1994:8
Luftföroreningar AFS 1980:11 och 1993:7
Nattarbete AFS 1997:8
Organiska lösningsmedel AFS 1990:14
Riskavfall AFS 1989:2
Slutet utrymme AFS 1993:3
Ögonspolning AFS 1986:25

See also:
http://www.kemi.se/ and http://www.kemi.se/default.cfm?page=kemdatbas.htm)

Sprängämnesinspektionens PM dnr 31/406/92 Rev 2000-02-08;
Brandfarliga varor på laboratorium

Books;
AGA AB, Red K. Ahlberg - ”Gashandbok”
Air Liquide Gas AB - ”Säker och effektiv användning av högrena gaser och gasblandningar”
Matheson - ”Guide to safe Handling of Compressed Gases”
Matheson - ”Effects of Exposure to Toxic gases”
N. Irving Sax - ”Dangerous properties of Industrial Materials”
Larry Fluer, Inc. - ”Chemical Handler´s Guide”
Merck and Co - ”The merck Index”
National Research Council - ”Prudent Practice for Handling Hazardous Chemicals in Laboratories”
L. Bretherick - ”Handbook of Reactive Chemical Hazards”
R. Scott Tricoff and D.B. Walters - ”Laboratory Health and Safety Handbook”
CRC Press - ”Handbook of Laboratory Safety”
Ed. by Jay Young - ”Improving Safety in Chemical Laboratory”
Whyte - ”CleanRoom Design”
L. Månson - ”Högteknologins osynliga fiende”

Appendix 1

Alarm indications

EVACUATION ALARM

Alarm:	Red flashing light and acoustic signal (acoustic signal: 0.8 sec audible signal followed by 0.8 sec silence and so on, until it is reset)
Cause:	Fire alarm or toxic/flammable/corrosive gas detected.
Response:	All persons should evacuate the facility through the closest emergency exit in a controlled manner. Go to the point of assembly. Public emergency service arrives. Prohibited to reenter before the red lights are swthched off by the Rescue Brigade

PROCESS ALARM

Alarm:	Blue flashing light and short acoustic signal (acoustic signal: a very short audible signal followed by a relatively long silence, 60 sec, and so on, until it is reset)
Cause:	Process/service alarm.
Response:	Service personnel, Process or equipment specialist. Evacuation is not necessary. Call Service personnel and/or Process/Equipment specialist as well as the lab manager. Wait until the personnel have corrected the problem. You will be informed if the problem can be corrected within reasonable time.

POINT OF ASSEMBLY

Kemigården (the upper yard outside the chemistry buildning)

Notes

In case of an

EMERGENCY call 00-112

Ask for:	Rescue brigade (Räddningstjänst) Ambulance or Doctor
Give address:	Chalmers University of Technology MC2-building, D-section, Level 2 Entrance: Kemivägen 9
Always state extention:	Your name, location and telephone Number of wounded The kind and extent of the injury Particular hazard
Set up meeting place:	State clearly the entrance you will be at.
In case of fire or accident:	Inform also Chalmers telephone exchange - ext. 99

Other important telephone numbers:

In case of illness or accident:	Doctor on duty: Tel (00) 703 1500
In case of poisoning:	Emergency: Tel (00) 112 , ask for poisoning info In other cases (Giftinformation): Tel (00) 08 -33 12 31

Since being founded in 1829, about 28,000 university level Swedish engineers and architects have been educated at Chalmers University of Technology. At the Chalmers campus in central Göteborg, undergraduate education and research in technical subjects, scientific subjects and architecture are conducted. There are presently around 5,000 undergraduate students. There are also approximately 2,500 school employees, the majority of which perform teaching or research assignments.

MC2 occupies a new building that is adjacent to the School of Physics & Engineering Physics. Expressly constructed for research in microtechnology and nano-science, MC2 houses, among other facilities, a clean room that has one thousand square metres of workspace. Research conditions are without parallel in the world. Some two hundred researchers that are currently active at MC2 have access to the world's most advanced devices, installations and techniques. With the Chalmers campus situated amid the modern and multifaceted civic centre of Göteborg.

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