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Safety Manual

Electrum Laboratory

Table of Contents

1	Introduction	3
2	Contact information.....	4
3	Cleanroom	5
3.1	Layout.....	5
3.2	Cleanroom rules	6
4	5S in Electrum laboratory.....	8
4.1	What is 5S?.....	8
4.2	Improvement groups.....	9
5	Administrative guidelines.....	9
5.1	Cleanroom access	9
5.2	Tool license	10
5.3	Working hours.....	11
5.4	Charges.....	12
6	Work environment and safety	13
6.1	Safety organization.....	13
6.2	Alarms	14
7	Evacuation.....	16
7.1	Chemical waste handling.....	17
7.2	Safety gear and technical aids	17

1 Introduction

In 1987 the Institute of Microelectronics (IM) moved its cleanroom and laboratories for semiconductor research and development to an entirely new facility in the Electrum Building in Kista. A part of the laboratory was also dedicated for the Department of Solid State Electronics at KTH.

In 1993 IM was reorganized. Hence, the research oriented parts, together with the Semiconductor Laboratory, were transferred to KTH, while the projects oriented towards industry continued within a new institute – Industrial Microelectronics Center (IMC) – also including the Industrial Center for Materials and Microelectronics (IMM) in Linköping. In 1999 IMC and the Institute for Optical Research (IOF) merged and formed Acreo.

The Semiconductor Laboratory has been operated by KTH and IMC/Acreo in collaboration since 1993 and took the name of Electrum Laboratory in 2003. The Laboratory has continued to develop academic excellence as a resource for research and education for both Swedish and international universities, as well as the relevance for industrial customers as a resource for industrial development and small scale production, and also as an incubator for new companies.

Electrum Laboratory is presently organized as a Center at the KTH School of Information and Communication Technology (ICT). The Rector of KTH has appointed a board of Directors, representing the main user groups and with a few external representatives from academic, research and industrial organizations. The Board points out the strategy and long term goals for the Laboratory, sets the budget and investment plans on a yearly basis and establishes general principles for lab usage, charging, etc.

The Rector of KTH has also appointed a Director of the Center, who has the operational responsibility. The Director reports to the Board regarding the overall development of the Laboratory, and to the Dean of the ICT School regarding administrative issues, e.g., economy personnel, and work environment.

The Director leads a relatively small group of 6 people, with the task to coordinate the activities at the Laboratory. Included in the tasks of this Lab Group are:

- Management and economy
- Service and maintenance of the lab infrastructure:
 - Media supply
 - Climate and cleanroom air quality
 - Purchase of utensils, gases, chemicals, etc.
- User administration and coordination:
 - Maintenance of LIMS
 - User meetings and -information
 - Courses and education
 - Quality system
- Work environment and safety:
 - On-call duty
 - Organization of alarm group
 - Safety consultancy and inspections
 - Authority contacts and maintenance of necessary permits

The individual lab users and their respective lab user organizations have the responsibility for the operation of the tools, and the quality in processes and analysis results, as well as for user education on specific tools. The tool responsible person usually belongs to the organization with responsibility for the tool, and also the room responsible persons belong to the user organizations. The user organizations have agreed to maintain a certain level of service, safety, functionality and quality in the lab, and to give access to their tools to all lab users according to the agreed rules.

The Director is chair of the Laboratory Management Team, with representatives from the main user groups at Acreo and KTH, which have tool responsibility and contribute to the maintenance of the laboratory resources. The Laboratory Management Team is the forum for decisions on current matters, and prepares decisions in the Board on the overall lab operation.

At the weekly user meeting all lab users are welcome to discuss any lab related matter, and also suggest improvements. Representatives from the Lab Group and the user groups with tool responsibility are always present at these meetings, and standing items are:

- New users, tools and chemicals
- Safety issues and incident reports
- Status of tools and lab operation

The minutes from the weekly meetings are distributed as: “electrum Laboratory Newsletter” via e-mail, but can also be found in LIMS.

2 Contact information

Rescue services (fire brigade, ambulance):

SOS Alarm tel.nr. 112

Be prepared to answer the following questions:

1. What has happened? – Why do you need help?
2. Where are you? You are at ELECTRUMLABORATORIET, Isafjordsgatan 22. This is the address to the main entrance to Electrum from Isafjordsgatan.
3. Who are you? State your name and a telephone number where you can be reached. There is a telephone on the table below the stairs to the cafeteria, next to the alarm central; 08-7904276.

Electrum laboratory on-call duty:

Electrum laboratory EMERGENCY / ON-CALL DUTY tel.nr. 070-648 60 32

This number reaches Electrum laboratory staff at all times. The purpose with this support, beside Electrum laboratory:s need to respond to automatic SMS alarms, is:

- Receive help. The help may be advisory over the phone or physical assistance.
- Report incidents. This should be done regardless of what consequences followed the incident.
- If the rescue services have been called upon, whatever the reason, this should be reported.
- Reporting technical faults or discrepancies concerning the operation of the cleanroom.

3 Cleanroom

3.1 Layout

Electrum laboratory is basically a secluded space within the main building served by a separate ventilation system. Evacuation of the cleanroom in this text refers to exiting the cleanroom by the nearest emergency exit and reassemble at a specified point.

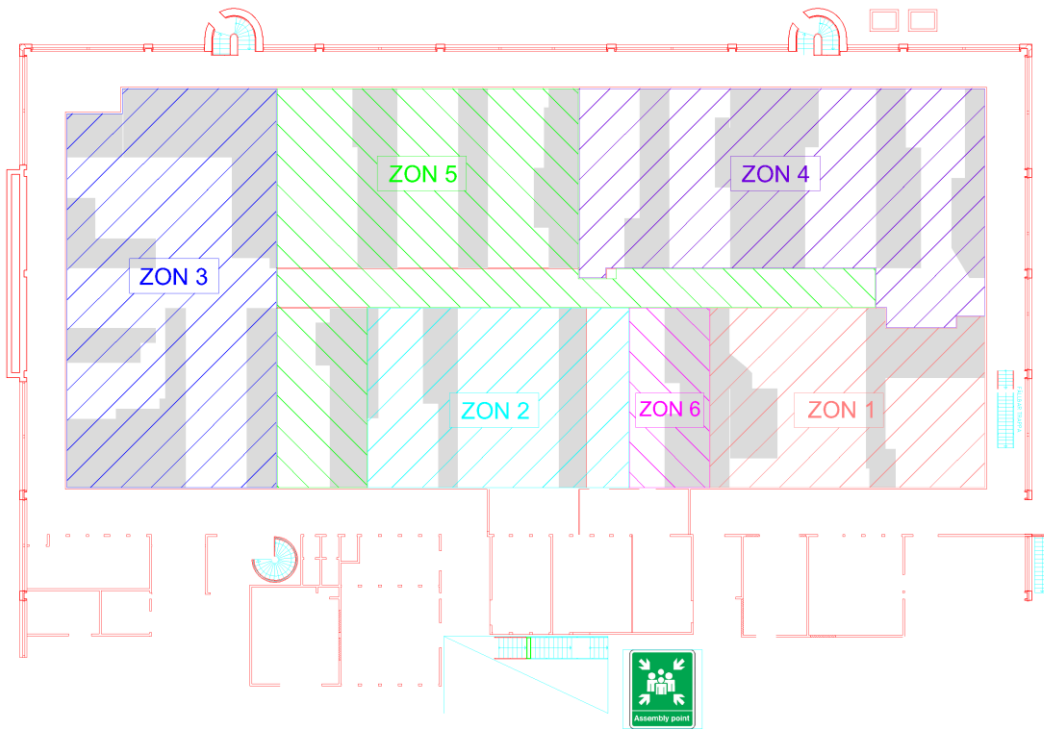


Figure 1 Electrum laboratory cleanroom

Figure 1 Electrum laboratory cleanroom depicts the cleanroom. White areas are clean zones and gray areas are service fingers, e.g. areas containing the back side of installed equipment and the supply of media to that equipment. The service fingers are not as clean as the clean zones, and normally only service work is performed there.

As shown by the map, the cleanroom is zone divided. In practice this cannot be seen. However, alarms, ventilation and the distribution of certain gases, can be manually and automatically controlled for each separate zone.

3.2 Cleanroom rules

Please obey the recommendations of proper cleanroom behavior as described in the Myfab general manual. We like to emphasize the following:

Procedure for entering and leaving the cleanroom:

Grey area

- Leave outdoor shoes in the shoe cabinet opposite to the cleanroom entrance and enter the grey area wearing socks only or barefoot.
- If you enter the grey area wearing indoor shoes, place them on the shelf.
- Leave any unnecessary items in the grey area. Warmer garment; cardigans, jumpers or sweaters, are not recommended to wear underneath the cleanroom coverall, and may be placed at the clothing stand.
- Hoods and coveralls are stored in cabinets in the grey area. If laundry have been shipped since the last time you visited the cleanroom, bring with you a new set of clothes from the cabinets. Do not open the plastic bags containing the clothes.
- Enter the shoes room.

Shoes room

- Bring your personal cleanroom shoes from the shelf (or a pair of guest shoes).
- Place the shoes on the sticky mat and put them on. NB: The yellow line in the floor marks the shoe boarder. On the sticky mat side of the shoe boarder, only cleanroom shoes should be worn, and touching the floor with socks or bare feet should be avoided. On the side adjacent to the shoe shelves, the cleanroom shoes should not touch the floor.
- If you are bringing items into the cleanroom, clean them with texwipes and Isopropanol (IPA) at the wipe station on the stainless steel cart.
- Enter the coverall room.

Coverall room

- Dress according to the top-down principle.
- Put the hood on first. Check that the hood is not turned inside out before you put it on.
- Users with longer hair are recommended to use a hairnet. In relevant cases add mouth cover.
- Put on the coverall. Prevent the sleeves of the coverall from touching the floor during dressing.
- Dispose of the plastic bags in the waste bin.
- Adjust your clothing and check in the mirror that the hood is tucked in underneath the coverall.
- In relevant cases, put on cover boots or boots.
- Put on cleanroom gloves. Wearing cotton gloves underneath the cleanroom gloves is recommended if you work longer sessions in the cleanroom. The cotton gloves are stored in the grey area. Cotton gloves should be reused and may be placed at the hanger with the aid of clips (available in the grey area).
- Enter the cleanroom.
- Clean your shoes by making a few steps on a sticky mat.

Procedure for leaving cleanroom

- Undress in reverse order.
- Dispose of gloves, take off the coverall and finally the hood.
- Attach cotton gloves to a clip and fit around the hanger. Place the coverall on the hanger. Leave the coverall unzipped. Place the hood over the hanger, with the wire part of the hanger extending through the face opening of the hood. Place the hanger in the rack.
- Exit the coverall room.
- Take off your shoes at the sticky mat in the shoes room, and place them in the shoe shelf.
- Do not forget to take away the things you bring into the grey area (e.g. extra clothes).

Rules for post-process room

- Cleanroom clothes should be used in this room. Follow the steps above.
- It is allowed to go from the cleanroom, through the coverall room to the post-process room and back without changing clothes.

4 5S in Electrum laboratory

4.1 What is 5S?

'5S' is the name of a workplace organization methodology that uses a list of five Japanese words which, transliterated and translated into English, start with the letter S.

The 5S Philosophy focuses on effective work place organization and standardized work procedures. 5S simplifies the work environment, reduces waste and non-value activity while improving quality, efficiency and safety.

The decision making process usually comes from a dialogue about standardization which builds a clear understanding among employees of how work should be done. It also instills ownership of the process in each employee.

The 5S methodology can be summarized to following activities:

1. Sort

Sort and remove all material, equipment, papers etc. that is not needed, never used, broken, out of date, too much of. Only material that's currently needed is allowed on the tables.

2. Stabilize

This means to make sure that every item has its dedicated place. This place should be a "smart spot", so that unnecessary time loss and ergonomically unsound movements are avoided. Equipment, tools documents, material etc. must be clearly labelled. One way to determine where different items should be placed is to categorize them depending on how often they are used. Items that are more frequently used should be placed as close as possible. Another way is to group items in accordance to their function.

3. Shine

Continuous cleaning and troubleshooting in the work area. This is done to find all root causes that's causing contamination, and take care of them for all time.

4. Standardize

To standardize is to appoint responsibility and to follow up the 5S- activities. It's important to have clear field of responsibilities where everyone has its own task. Make 5S your every day routine.

5. Sustain

Resolve identified root causes, improve the layout- rearrange equipment and material, continuous improvements, inform of activities in progress, educate and train your colleagues, inspire. Without a good effort here, one would do nothing else but clean the workplace in order to maintain the order.

4.2 Improvement groups

Every room in the Electrum laboratory has one “improvement group” made up of the room responsible and the most frequent users of that room. The improvement group is responsible for the 5S activities in their respective room. The improvement group has regular meetings where ideas are discussed, decided upon, documented and implemented. To their help there are standardized binders and documents for every 5S improvement group. The 5S activities are a natural part of the work performed in the Electrum laboratory.

In order to follow up the progress of 5S in the laboratory, regular revisions of the different improvement groups are performed. The revisions follow a standardized protocol that objectively measures and gives feedback of the current status and progress the improvement group has made.

5 Administrative guidelines

5.1 Cleanroom access

After attending the training course, the user’s key card (issued through the user’s own group/department) is activated for access to the cleanroom. Please note that an activated key card does not mean free indiscriminant access to the lab tools. In addition to the key card, a “*tool license*” is needed for each piece of tool before a user is allowed to use it. The license is issued by the person who is responsible for the specific tool, only after the user has been given proper training on how to use it.

5.2 Tool license

Rules for tool booking:

1. Electrum Laboratory Information Management System (LIMS) is used for booking and logging usage of laboratory tools.
2. All tools marked “Booking: compulsory” on the tool label or “Booking type: Compulsory” in LIMS have to be booked before usage.
3. You have to create a log in LIMS every time you are using a tool marked “Logging: Compulsory” on the tool label or “Log level: Compulsory” in LIMS and for every booking you made.
4. To make it easier for all users to get access to laboratory you are not allowed booking neither more than 8 hours per day nor two following days in the same tool. Rule is not applicable for tools with very long process time (e.g. furnaces)
5. Any exception from rule No. 4 may occur only during these periods when the tool is not fully booked by other users. In this case you may book more time but not earlier than during the same day you want to use it.
6. Tool responsible can establish special rules for booking/logging, e.g. minimal or maximal time period allowed/recommended for booking/logging.
7. In case when you can not use the tool as planned because of big misjudgment of the time needed for the process or other problems you have to cancel the booking. Note that only future booking can be cancelled by user.
8. In case when it is too late to cancel the booking you should shorten booked time as much as possible and contact tool responsible to explain the situation and get help with logging.
9. It is allowed to take over the tool booked by other user if it is still free within half hour from the beginning of the booking period, but the “booking owner” should be contacted before you start to use the tool. In that case you should create the log without booking using Log status page.
10. The charging for the tool usage is based on the logged time.
11. The logged time of usage should not be shorter than the booked time. Only in case when rule No. 8 is applicable you are allowed to report shorter time than booked.
12. If rule No. 11 is not obeyed you can be charged for equipment usage according to your booking.
13. For runs shorter than the whole hour(s) the usage time is rounded up.

5.3 Working hours

Cleanroom work outside regular working hours.

Regular working hours are Monday to Friday 07.00 - 18.00.

Ventilation is in full operation Monday to Friday 06.00 - 22.00.

Safety

During regular working hours there are always enough people from the alarm group of the laboratory available in order to handle an incident. Outside regular working hours the Electrum Laboratory has a person on duty at home. This person always answers the telephone at the jour telephone number (as above) and will – if necessary – arrive to the Laboratory within 45 minutes (usually within 20-30 minutes) from an alarm or a telephone call.

Outside regular working hours the consequences of an accident may be much more severe than during regular working hours, primarily because only a few people are in place and also due to the time it takes for the person on duty at home to arrive at the laboratory.

Work should always be planned in a way that it only in exceptional cases is it performed outside regular working hours.

The person who works in the laboratory outside regular working hours should:

- Work with a partner prepared to help out at an accident.
- Register in **LIMS** under **Night Shift Booking** – if possible before 14.00 the same day – and also by making a phone call to someone in the service group in order to inform the person on duty that night work is going on in the lab.

Outside regular working hours is it only allowed to perform operations and processes which are well known and described in manuals and recipes. For potentially dangerous work always two people, both well familiar with the process, must be in place in the same room:

- Handling acids, bases and warm solvents.
- Processes using corrosive, toxic and/or ignitable gases.

It is under all circumstances forbidden to perform potentially dangerous service work:

- Service of equipment handling corrosive, toxic and/or ignitable chemicals or gases
- Changing gas bottles or corrosive, toxic and/or ignitable sources.

Ventilation night closure

By reducing the cleanroom ventilation when the lab is not in use, we save considerable amounts by reduced power consumption for the fans, central heating and cooling. In order to make it possible to reduce the ventilation without jeopardizing the cleanroom quality and safety, the cleanroom is closed when the fans are running at reduced speed.

The speeds of most fans – for circulation, inlet and exhaust air – are in a controlled way reduced to a minimum, and simultaneously a few motorized dampers are adjusted to optimize the airflow in the cleanroom.

Daytime the overpressure in the cleanroom, as compared to surrounding corridors, is about 20-22 Pascal. This makes the pressure fluctuations occurring when doors are opened and closed, barely observable. At reduced fan speed the overpressure is reduced to 6-8 Pascal. The cleanroom is hence much more sensitive to contamination, e.g., when someone opens a door to enter the cleanroom. In this case there is a large risk that the cleanroom will be contaminated if someone enters to “only” get something inside, to use a microscope, etc.

In the evening about 15 minutes before the ventilation is reduced, the blue lights in the ceiling (“technical fault”) are operational to warn those who still are in the lab that the night closure is near. These lights will be turned off again when the ventilation has stabilized at low level, and hence none is allowed to be inside the cleanroom.

Red lights outside of the entrance locks are always on while the cleanroom is closed.

The card readers are operational, making it possible to open the doors, but you should always keep in mind the risk to contaminate the cleanroom when a door is opened.

Chemicals could remain in the acid- and solvent baths during night, but all bath lids and fume hood doors should be closed, as they should always be if the bench or hood is not in use.

Equipment which is allowed to run unattended during night, i.e., evaporators, diffusion furnaces, Camelia, ICP, AME etc. should be started before the fan speed is reduced.

In the morning after night closure the cleanroom doors may be opened already at 06.00, but the normal cleanliness level is obtained at about 06.05 - 06.10.

The night closure of the fans could be overridden manually. Anyone who wants to work after 22.00 has to inform the Electrum lab service group at latest 14.00 the same day. For weekend work the service group must be informed at latest Friday at 14.00. The service group should be informed by the compulsory “Night Shift” registration in LIMS and by a phone call to someone in the service group. **N.B. this registration must always be made for work outside regular working hours.**

5.4 Charges

At Electrum the costs are distributed between the different laboratory groups. All general costs for maintaining the infrastructure are at the Electrum Laboratory, including personnel, rent, electric power, cooling and heating, media including house gases, wet chemicals of general use, some depreciations, etc. All costs connected to the tools in the laboratory are at the tool responsible user group, including spare parts, service and maintenance, consumables, such as tool specific gases and chemicals, and, in some cases, depreciations related to the tool.

This also implies that the charges must be distributed between the different groups. Hence Electrum Laboratory will charge the users in three ways:

- Monthly fee for all registered users (applies during all time the access card is activated for cleanroom access.)
- Hourly fee for time spent in the cleanroom (according to card reader registration)
- Area fee for all tools in the cleanroom (the tool responsible group is charged).

The tool responsible groups will charge the lab users for their tool usage, according to registration in the logbooks in LIMS. The usage fees follow the Tool Rates established within Myfab, and are shown in LIMS.

It is the ambition of Electrum Laboratory that the invoicing should run smoothly for all users, even though many different groups provide lab resources and are involved in the invoicing procedure.

It is of utmost importance that all lab usage is logged and presented in a proper way, to obtain a fair distribution of the costs.

6 Work environment and safety

6.1 Safety organization

Electrum laboratory is responsible for the general safety in the laboratory, and coordinates safety work and measures amongst the laboratory users. This is done by the safety group, consisting of members from the user groups and Electrum laboratory. Specifically this means managing issues like:

- Safety infrastructure. Eye showers, hydrogen and toxic gas monitoring as well as other parts of the alarm system, exhaust air, etc.
- Safety organization. Organizing an alarm group, on-call-duty outside normal work hours.
- Authority contacts. Managing necessary permits for the possession and use of certain chemicals and gases. Keep track of legislative news concerning the laboratory activity, and implement them when necessary.
- Revision of the laboratory environment from a safety perspective every 6 months.

Faults and discrepancies concerning the laboratory operation should always be reported to Electrum laboratory.

Electrum laboratory organizes an alarm group, consisting of Electrum laboratory staff and experienced laboratory users. In all 10 persons with a fair knowledge and understanding of the cleanroom. The alarm group tasks are:

- Assemble at the alarm central in case of an alarm.
- Investigate the reason for the alarm.
- Prepare equipment and protective gear on the basis of this reason.
- Search for possibly injured personnel inside the cleanroom when the alarm reason has been established, if necessary using protective gear.
- Find, evacuate and attend to any injured personnel.
- Notify rescue services if necessary.
- Attend to the alarm reason.
- Support the rescue services if and when they arrive.

Electrum laboratory does not expect all 10 members of the alarm group to be present in, or just outside, the cleanroom at any given time. The idea is that with 10 members, at least 4-5 should be present at normal work hours, and be able to carry out the alarm group tasks when needed.

However, all relevant alarms are forwarded automatically by SMS to staff that has on-call duty. In case of an alarm outside office hours, staff arrives no later than 45 minutes after the initial alarm. The response of the person with on call duty cannot be compared with the capacity and efficiency of the alarm group present at working hours. Thus, working late, or at other odd hours, increases the risks in the cleanroom, meaning that an accident may lead to greater consequences than otherwise.

The alarm group has equipment and protective gear for dealing with fire, wet chemicals and gases. On a regular basis the routines and equipment of the alarm group are used and trained in drills. Incidents, that is, events that could have resulted in an accident, should be reported to the Electrum laboratory staff. An incident of more serious nature should be reported and then documented in written form.

6.2 Alarms

The Electrum laboratory alarm system is a collection of monitoring subsystems in the building, together with a PLC for alarm inputs and outputs (counter actions), and a PC fitted with a modem for forwarding alarms by SMS. An alarm chart displays the alarms at the alarm central.

The subsystems are:

Fire alarm. Smoke- and heat detectors together with fire alarm buttons are installed in the cleanroom, cellar corridor, on top of the cleanroom (area for ventilation pipes), the second floor above the cleanroom (fans for supply air, circulation and exhausts). The fire alarm is automatically forwarded to the fire brigade. The cleanroom and the surrounding parts of the main building are also fitted with a sprinkler system. Each individual sprinkler head breaks at a certain elevated temperature, thus releasing vast amounts of water. This is an automatic and very effective way of fire fighting, although destructive to the cleanroom.

Hydrogen detection. Electrum laboratory distributes hydrogen in electro polished tubing from central supplies into the cleanroom. Given the flammable and explosive nature of hydrogen, concentration monitoring is necessary. The lowest alarm level is at 1 % (mole percent) in the cleanroom air. The hydrogen/air mixture becomes explosive at 4 %. The individual sensors are installed in the ceiling of the clean zones and service fingers.

Toxic gas monitoring. There are some 80-90 gas bottles installed in the Electrum laboratory, connected to varying equipment. Many of them containing gases that are harmless. But a fair amount is toxic, corrosive, flammable or a combination thereof. Where assessed necessary, at the site of the specific machine and gas bottle installation, sensors are mounted. Altogether there are approximately 100 sensors mounted in the cleanroom. Most of them on exhaust pipes serving machine- and gas cabinets, giving an early warning of a leak. At some locations there are also sensors mounted in the actual clean zone. All alarm levels are set so that the alarm will be triggered before any immediately dangerous concentrations are reached. As a principle, Electrum laboratory does not tolerate any measureable concentration of dangerous gas where there normally should not be.

The cleanroom is fitted with a network of fire alarm, yellow and red buttons to manually trigger certain alarms.

Yellow buttons. In the cleanroom corridor and in most clean zones there are yellow buttons mounted. They trigger the yellow alarm in the zone where the specific button pushed is located. Intended use is either when there is an urgent need to evacuate a particular zone, or when assistance from the alarm group is needed urgently. The idea is that rather than fumbling with the telephone, finding the right telephone number, there is a simple and fast way to get attention. This is certainly true when there is an injured person demanding attention. When the yellow alert is triggered manually, the alarm chart at the alarm central display which zone it concerns. Hence, the area in which the alarm group needs to search for personnel is narrowed down.

Red buttons. Triggers the red alert. Is only meant for situations in which there is a need to evacuate the whole cleanroom. Examples are gas leaks or fires that are spotted before monitoring systems have detected them. This action gives no information on where there is a problem.

Relayed fault signals from equipment necessary for the cleanroom function (production of DI water, ventilation fans, production of pressurized air, and so on). Referred to here as operational alarms. Relayed output signals to equipment (ventilation- and gas control).

Alarm lights and sirens both in and outside the cleanroom to notify and warn personnel. To make alarms visible and heard, there are 3 types of warning lights and 2 types of sirens. Mixing them constitutes the different alarms, or alerts, according to the Figure 2 Alarm scheme below:






<p>RÖTT LARM joddlande siren</p> <p>Total utrymning gå till samlingsplats</p>		<p>RED ALERT oscillating siren</p> <p>Total evacuation go to meeting point</p>
<p>GUL-BLÅTT gift gas LARM</p> <p>fast tjtutande siren</p> <p>Zonvis utrymning gå till samlingsplats</p>	 	<p>YELLOW-BLUE toxic gas ALERT</p> <p>continuous siren</p> <p>Zone evacuation go to meeting point</p>
<p>GUL LARM fast tjtutande siren</p> <p>Zonvis utrymning gå till samlingsplats</p>		<p>YELLOW ALERT</p> <p>continuous siren</p> <p>Zone evacuation go to meeting point</p>
<p>BLÅTT LARM</p> <p>Driftstörning kontakta Driftpersonal</p>		<p>BLUE ALERT</p> <p>technical fault contact service personal</p>

Figure 2 Alarm scheme

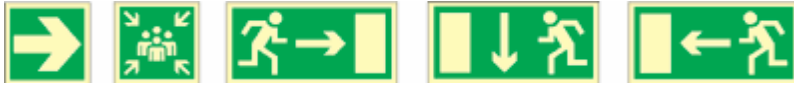
Red alert means total evacuation of the cleanroom. This alarm is triggered by the fire alarm, *high* concentration of hydrogen or one of the other gases monitored by the toxic gas monitoring system, or manually by pushing one of the red buttons in the central cleanroom corridor. Apart from turning on the red lights and the sirens, the alarm system will stop the air supply and circulation, leaving the exhaust on, which creates an underpressure in the cleanroom. This prevents any toxic gases to escape out into the main building, and also limit the supply of air to any fire. The supply of hydrogen and silane to the cleanroom shuts down. If the alarm is not reset to normal conditions within 10 minutes, these gas lines will automatically be flushed with nitrogen.

Yellow-Blue means zone evacuation. The yellow and blue lights will only be visible in the affected zone. This alert is triggered by the toxic gas monitoring system at a detected *low* concentration in one of the clean zones, or a higher concentration in an exhaust pipe. If the concentration increases, the yellow-blue alert will turn red for some of the installed sensors (gas and equipment specific). Only personnel working in the affected zone must evacuate. In a manner similar to red alert, the air circulation and the distribution of hydrogen and silane will be stopped, but only in this zone.

Yellow alert is the same as yellow-blue, a zone alarm, only the reason for the alarm is different. Yellow alert means that either a low concentration of hydrogen has been detected, or that the alarm has been manually triggered by pushing one of the yellow buttons inside the cleanroom.

Blue alert is an operational alarm, and mean no danger.

7 Evacuation



An evacuation alarm should result in an immediate response from the laboratory user:

- Without hesitation, go to the nearest emergency exit and leave the cleanroom. Emergency exits are marked with green and white signs according to international standards. All clean zones have emergency exits in the very room where work is performed. Almost all of the service fingers have emergency exits. At all locations in the cleanroom there are at least two alternative ways out.
- Go to the reassembly point and await further instructions. Do not leave the reassembly point unless the alarm group authorizes this action.
- When evacuating, do not waste time removing your cleanroom clothing, leave them on. Do not delay evacuation by trying to end work that otherwise might be spoiled.
- During evacuation, be sure that your colleagues follow your example. Help them if necessary and possible. Account, if possible, for the whereabouts of presumed missing colleagues.
-

Some equipment and processes in Electrum laboratory calls for certain actions from the operator if there is an evacuation alarm. Those actions are machine and process specific and will not be described here. The Emergency exits and the assembly point are shown in Figure 3 Emergency Exits and assembly point.

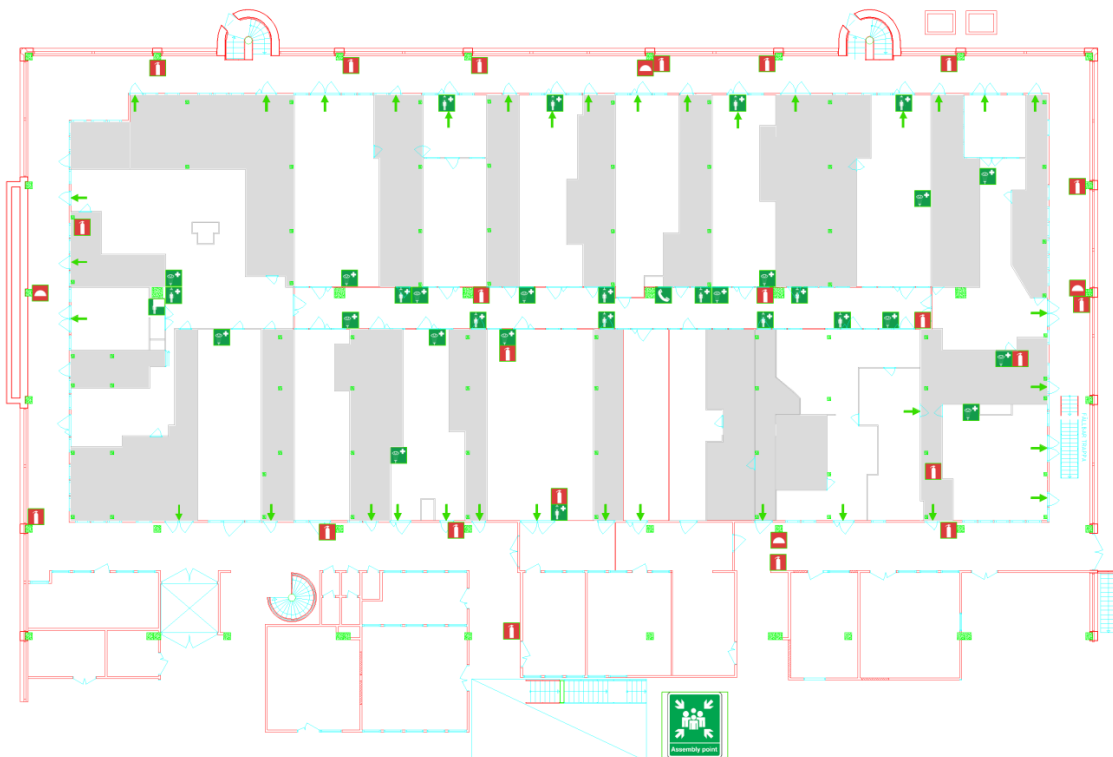


Figure 3 Emergency Exits and assembly point

7.1 Chemical waste handling

GENERAL RULES

- After use all chemicals shall be regarded as hazardous waste.
- In case of uncertainty seek advice from experienced personnel and contact Electrum laboratory personnel before processing.
- “Standard” acids and bases can be emptied in the acid drain (HCl, H₂SO₄, HNO₃, HF, KOH, H₂O₂, H₃PO₃, NH₃, Acetic acid, and TMAH- and NaOH based developers etc.)
- “Standard” organic solvents can be emptied in the solvent drain. Avoid, if possible, discharging N-methyl-2-pyrrolidon (aka NMP or Remover 1165) in the solvent drain. Collect this waste in plastic bottles and dispose of as a common waste product (see below).
- No chemicals can be emptied in to the communal/external drain or disposed of with the paper waste. Empty bottles shall be rinsed thoroughly (control if necessary with pH/litmus paper) and disposed of in the container for hard plastic *without* the cork/cap. ***Failure to follow this procedure can lead to damage to the waste disposal equipment and even personal injury.***

ALL OTHER WASTE PRODUCTS SHALL BE SENT TO SAKAB FOR DISPOSAL

- Use plastic bottles for collecting waste, avoid glass bottles if at all possible.
- Ensure that the packaging is clean from spills and enclosed in a plastic bag. Clearly mark the packaging with contents plus your own name and department.
- Common waste products that are familiar to both users and Electrum laboratory shall be placed on the bottom shelf of the pass-through. Indicate on the whiteboard in the outer room that the waste should be collected. Common waste products are those that accumulate and are disposed of on a regular basis (every few weeks) such as photoresist, gold etch, NMP, GaAs contaminated waste and polishing slurry.
- All other waste shall be packaged and labeled as above and contact made with Electrum laboratory staff for direct removal from the lab. Unusual or high-risk waste shall be transported direct to the SAKAB storage area and shall not accumulate in the lab. ***This type of waste shall under no circumstances be left on the floor or in cupboards to be collected in the general disposal process.***

7.2 Safety gear and technical aids

The location of the emergency exits, assembly point, eye showers, emergency showers and fire extinguishers is shown in Figure 3 Emergency Exits and assembly point.

First aid gear is located in the cabinet facing the alarm central. Boards with simpler first aid gear, band aids and such, are posted on several places (not in the cleanroom though).

Fire-extinguishers. There are fire-extinguishers mounted on several locations in the cleanroom. Several in the cleanroom corridor, but also in some of the clean zones and service fingers. The locations are marked with an additional sign. The extinguishers are of carbon dioxide type due to the nondestructive properties of that fire extinguishing media. A drawback with that media is that one has to come fairly close to the base of the fire to put it out, and the efficiency is poor compared to powder or foam based extinguishers. Cleanroom users are not expected to use fire-extinguishers in any but a few cases. If an incident with a fire can be controlled and put out by a laboratory user early on in the course of events, and *without any form of risk taking*, then this action is tolerable. However, any form of risk taking, calculated or not, is absolutely forbidden. Any incidents of that nature should be attended to by the alarm group. A basic demonstration of a fire-extinguisher is part of the introduction to the cleanroom.

Antidote gel for HF induced burns. Available at the changing rooms to the cleanroom, the alarm central, the wet chemistry room, and some other places where hydrofluoric acid is used. The antidote gel is used to treat burns on the skin from hydrofluoric acid. If the skin is exposed to hydrofluoric acid, rinse with plenty of water for 4-5 minutes. Check with pH-indicator that no acid is left on the skin. Apply the antidote gel on the area exposed. Repeat treatment every 10 minutes during the first hour. Report the incident to Electrum laboratory staff.

Warning lights. Rooms (outside the cleanroom) with laser applications have yellow/orange warning lights mounted above the entrance door. When the lights are on, the laser is in use. Do not enter! When changing gas on the MOVPE, a yellow light is turned on in the corridor outside the cleanroom. Don't pass this area until this yellow light is turned off.