# Laboratory Facilities

This document summarizes the facilities available in UiB's NanoStructures Lab. First of all, here is a list of the people and companies that were involved in setting up/maintain the laboratory:

- Bodil Holst (Tel: +47 55 58 29 67, Mob: +47 476 07 608, E-mail: Bodil.Holst@ift.uib.no)
- Martin Møller Greve (Tel: +47 55 58 83 26, Mob.: +47 900 79 974, E-Mail: Martin.Greve@ift.uib.no)
- Rachid Maad (Tel: +47 55 58 27 63, Mob:, E-Mail: Rachid.Maad@ift.uib.no)
- Xiaodong Guo (Tel: +47 55 58 83 27, Mob:, E-mail: Xiaodong.Guo@ift.uib.no)
- Thomas Reisinger (IFT, treisinger@gmail.com): PhD student. Scientific requirements and selection of tools
- Gjert Furhovden (IFT): IFT administrasjon. Helped with UiB communication/politics.
- Sverre Seth (EIA): Project leader appointed by the Eiendomsavdelingen (EIA). Left the project prematurely in July 2011.
- Lars Christensen (Abo-ARK/EIA, lars@abo-ark.no): Project leader who replaced Sverre, and was called in specifically for the project from Abo-ARK by EIA.
- Eivind Moe (COWI, eim@cowi.no, +47 950 83 688): External consultant for EIA
- Øivind Berg (YIT, oivind.b.berg@yit.no): Project manager overseeing installations supplied by YIT (Fumehoods/Ventilation)
- Stian Leikanger (YIT): Installation engineer at YIT. Most notably programming of ventilation regulation
- Karsten Gilde (YIT): worked with Stian
- Åge Sørensen (Handegård & Pedersen AS, a-sorens@handped.no): Electricity consultant (RIE)
- Ole Dankertsen (Martin Prestegård, ole@prestegard.no, Tel 55525320, Mob. 98221472) Saksbehandler electric installation
- Ørjan Fosså (Martin Prestegård,Telefon 98221483): Carried out most of the electric installation.
- Leif Kvamme (Martin Prestegård,Telefon 98221474): Montør. Mainly earth installation for Temescal and RIE.
- Tom Svendsen (GK, Tom.Svendsen@gk.no, +47 950 01 040): Planned cold-water system
- Truls Wie Perdersen (GK, Truls.Wie-Pedersen@gk.no): not sure what he did
- Petter Bjådal (GK, petter.bjaadal@gk.no): not sure what he did
- Tor Atle Myrmel (GK,41255867) Service engineer
- Kenneth (GK, 45237494) Service engineer
- Rune Hovland (Oras, Rune.Hovland@oras.no, 95297845): Rørlegger management
- Christian (Oras, 95297847): Rørlegger. Did most of the installation. Also tuning of pressures in Cold water system. Call him if there is a problem with the cold water system.
- Roger Hatlen (RHA Gass&Rørmontasje, 92039521) Nitrogen gas pipe installations
- B. Morstøl (Byggmester Morstøl AS). Subroom in 168 and removal of ceiling in 268 and perhaps some other building work (doors?)
- Frank Krogenæs (KL-Klima AS, frank@kl-klima.no, 47618157): Installation of humidifier
- Odd Olav Fosso (F-Tech AS, Mob: +4798298211, ofosso@f-tech.no) Consultant for Humidifier installation
- Dr. Michael Rüb (MCRT, michael.rueb@mcrt.de, +49-171-7903158) Service and Design Engineer

- Dr. Maximilian Dobler (MCRT, maximilian.dobler@mcrt.de, +49-151-21250429) Sales Manager
- Arnfinn Reines (Yara Praxair, arnfinn.reines@yarapraxair.com, (+47) 90966357) Engineering
- Ann-Kristin Lodgaard (Yara Praxair, Ann-Kristin.Lodgaard@yarapraxair.com, (+47) 976 81 143) Sales

## 1. Electricity (M.Prestegård)

The tools had various power requirements. The Plasmatherm and the Temescal in particular needed 400V 3-phase supply, so that transformers had to be installed in room 168. The fuse and power distribution box is also located there.


**Figure 1: Transformers for 400V 3-phase and power distribution panel in room 168, with documentation**

The e-Line is supplied with the standard 230 V directly to the UPS (located in 274b storage room).
The Temescal is also using the 230 V directly, except for the HV power supply.
The Plasmatherm also uses the transformers.

## 2. Closed-cycle cooling water = isvann (YIT/ORAS/HDK AS)

The cold water system is filled with a Dowcal 10 (not 100 % certain, ask rørlegger Christian). The temperature is supposed to be 18 °C, which is the only temperature that is compatible with all the systems. The following systems make use of the cold water:
Temescal, Temescal cryopump, Plasmatherm main system, Plasmatherm heat exchanger, Plasmatherm mechanical pump, e-Line temperature stabilised cleanroom cabin.


**Figure 2: Piping in room 168 of cold water installation, including buffer tank.**

**Figure 3: Water cooler outside of the nano-lab.**

This is serviced by GK so call them if there is a problem with it. But be aware that they have very little understanding of the rest of the cold water system. It can be very sensitive to bubbles in the system, so that it needs to be simply restarted, especially after power cuts.

Note that the pressures and flows of the systems is different for each so that if anything is changed the whole system needs to be recalibrated. The highest pressure is needed by the Temescal, which needs a large flow of cold water to keep the evaporation source from overheating.

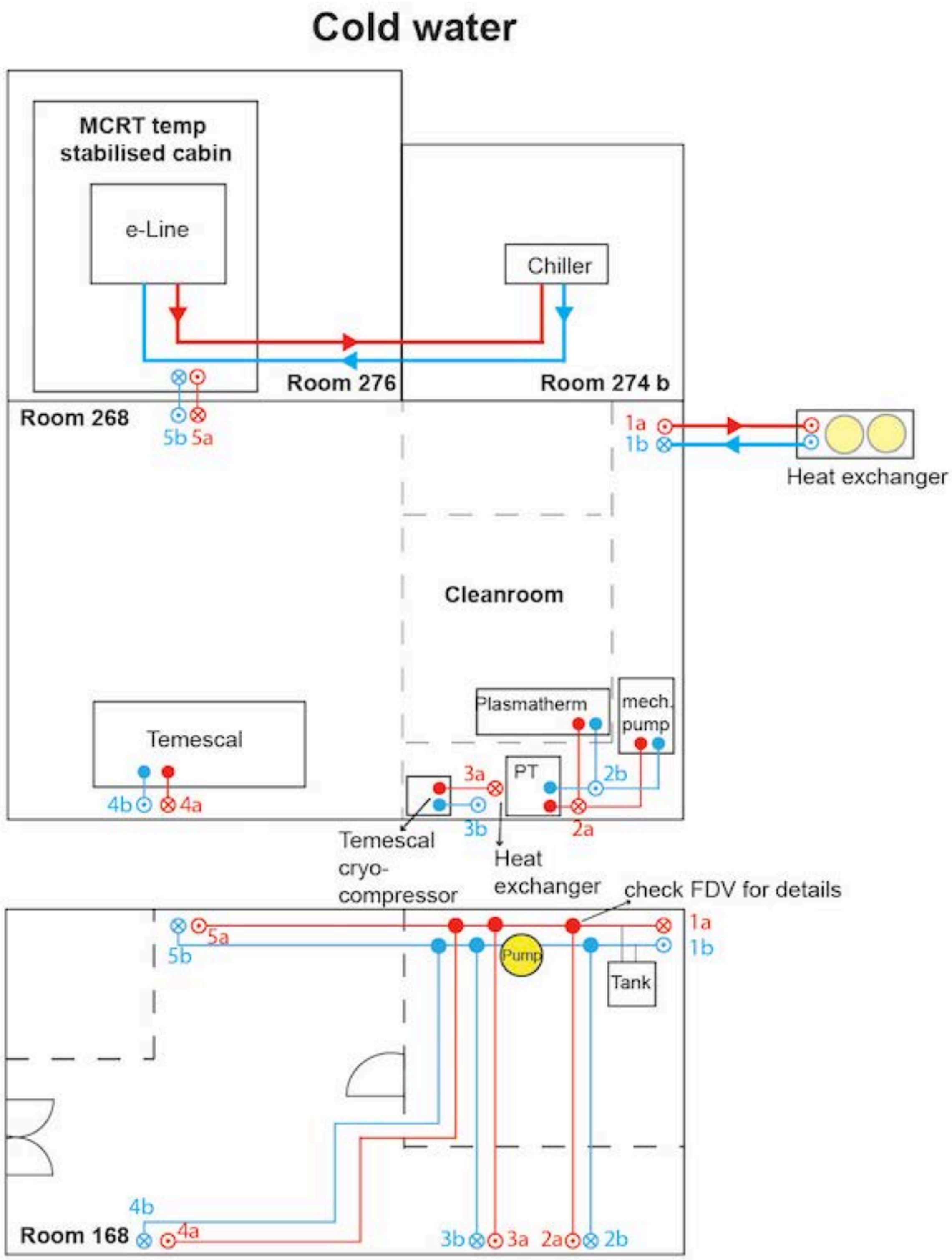


**Figure 4: Sketch of cooling water system.**

## 3. Ventilation and Air-conditioning (YIT/GK)

The ventilation system in room 268 ensures that there is enough fresh air from outside so that the required airflow into the fume hoods can be maintained. The air supply in 276, 274b and 168 is the standard building air supply.

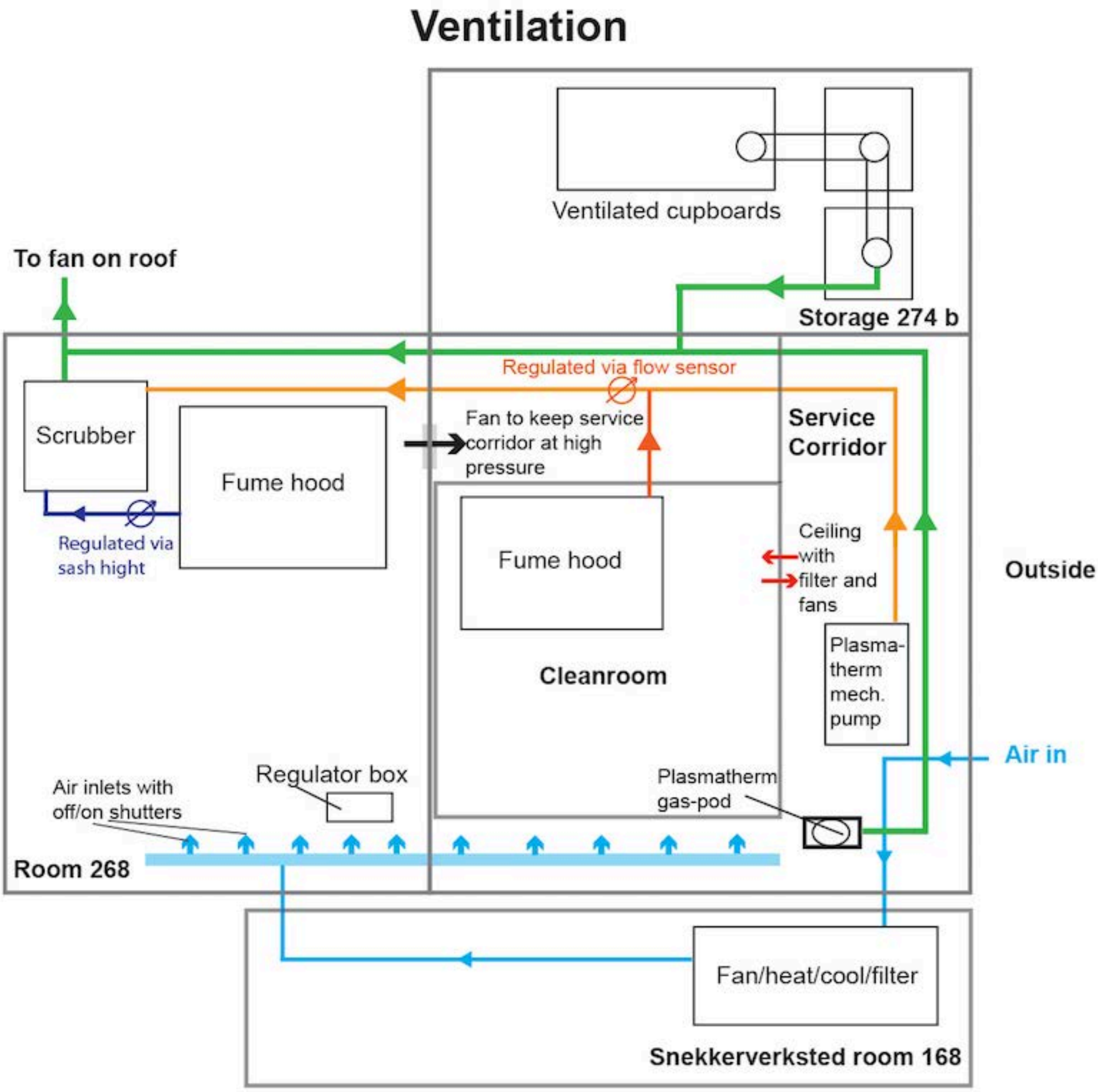


**Figure 5: Sketch of ventilation system.**


**Figure 6: Fresh air supply tunnel with heating, filtration, fan and air conditioning stored in room 168.**

**Figure 7: Air inlets with 5 on/off shutters in room 268.**

**Figure 8: Box with processor regulating the inlet air and what is extracted via fume hoods located in room 268.**

The roof-top ventilator is regulated using a pressure sensor located just above the scrubber and is set to keep a certain low pressure at that pressure sensor.

The flow through the fume hood is regulated with the two ventilation flaps (ceiling room 268). The outer fume hoods flow is based on the sash position sensor, and the cleanroom fume hood is based on a flow sensor.

**Figure 9: Control box for cold-water supply and ventilation system.**

Control Box installed by GK which both regulates cold-water supply and also ventilation system. So be aware that a service engineer might turn off the cold water when working on the ventilation system!
The Menu is more than cryptic but can be used to read-out status of ventilation and cold-water system.

Service contacts from GK are Tor Atle Myrmel (41255867) and Kenneth (45237494).

## 4. Pressurized Air (ORAS)

Pressurized air is supplied to the Raith, the Plasmatherm and the Temescal tool. The supplied pressure varied over the last few months (It was 7.5 bar and now it is about 6.5 bar). For the Plasmatherm the pressure is reduced to 6.0 bar (pressure reducer and gauge in service corridor of cleanroom). The pressurized air is also supplied to the nitrogen generator (see next section). There is an oil- and particle filter installed in room 268 left and above the emergency exit doors.

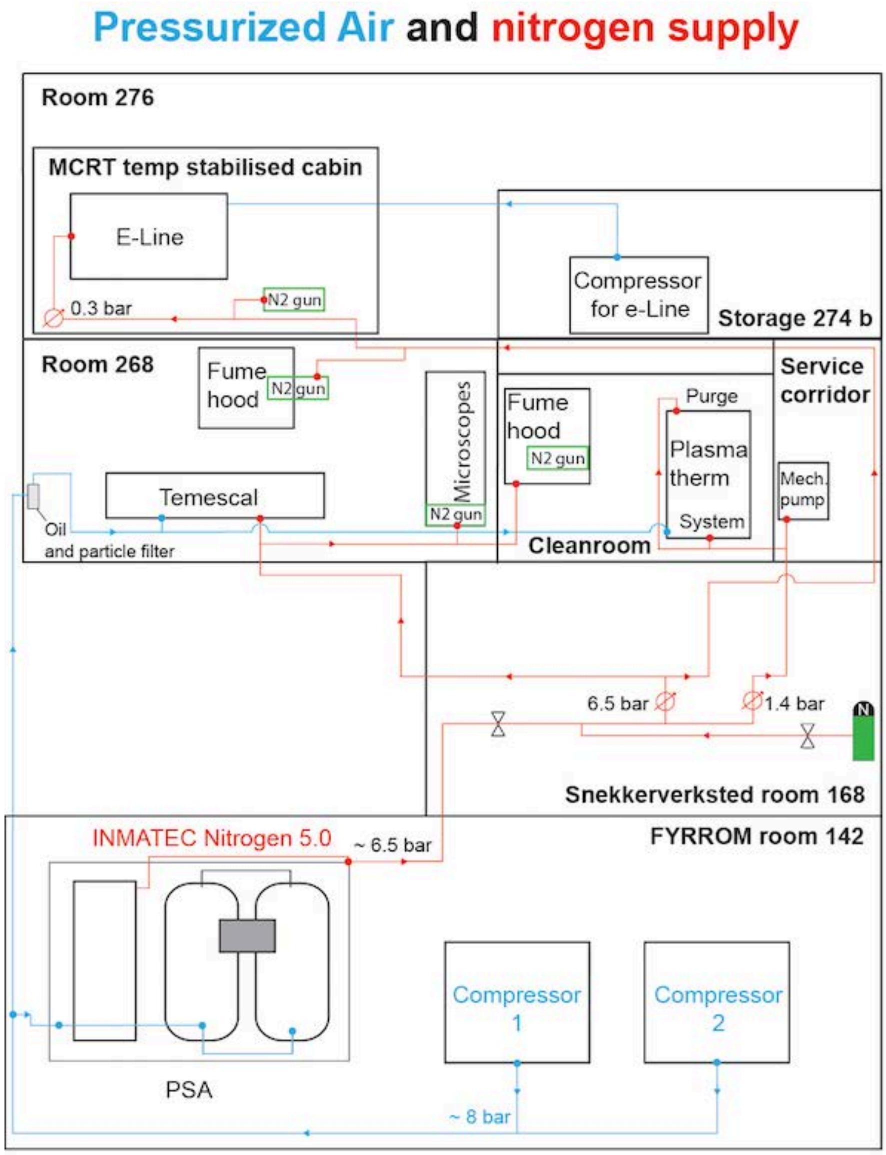


**Figure 10: Sketch of Pressurized air and nitrogen distribution.**

## 5. Nitrogen 5.0(INMATEC/ORAS)

The pressure-swing adsorption unit is located in the fyrrom (142) of Allégaten 55 (entrance next to main elevator in basement or see Figure 11.
In emergency call Svein Fosse (Driften, 555 89393) to get access.

It produces Nitrogen of purity 5.0 from pressurized air. The output maximum pressure is about 6.5 bar, just below the input pressurized air pressure. The mainr reason for installing it is the mechanical vacuum pump that came with the RIE. It requires a large continuous flow of nitrogen (about 20 l/min - a 50liter, 200 bar bottle only lasts a few hours).Now it also supplies the e-Line (vacuum vent-gas), FC-2000 (vacuum vent-gas) and the various spray guns for cleaning and drying around the lab.

**Figure 11: Door can be opend with Gjert Furhovden's yellow key.**

**Figure 12: Nitrogen Generator located in Fyrrom (142)**

The unit was supplied by Inmatec in Germany (Sales contact Harald Kerschensteiner: kerschensteiner@inmatec.de). It is supposed to be maintained by Granzow in Norway (Contact Arne Midtgård: arne@granzow.no, +47 48022922) - when the filter changes are due, call them to do it. The nitrogen tube installation was done by ORAS - contact Roger Hatlen: roger@rha-gass.no, +47 92039521. He also helped getting the system hooked up, so that we did not need to get Granzow involved - they have to fly over from Oslo and charge an arms length. So if there is any leakage problems better call Roger.

The system monitors the purity and some other parameters. You can log in on the touch screen: Password is 123


**Figure 13: Touchpanel log-on screnn and Parameters monitor. The purity should show 100% during normal operation.**

Note that if this system fails, the Plasmatherm will follow soon afterwards, as it requires the nitrogen flow for its prevacuum pump.

**Figure 14: Pressure regulator.**

Pressure regulators in the subroom of room 168 reducing the pressure of the nitrogen supply coming from the INMATEC generator in the Fyrrom.

## 6. Oxygen Deficiency Monitors (Prestegård/PureAire)

Oxygen deficiency monitors were installed in the subroom of 168 and also next to the nitrogen generator in the fyrrom. These two rooms have too little or no ventilation so that there is a risk of asphyxiation due to leaks in the nitrogen 5.0 lines (The nitrogen generator can supply a large flow of oxygen deficient air). Red lights and sirens will be installed outside the doors. Shutdown nitrogen generator before entering the room if alarm signal is present! Installation was done by Prestegård. Monitors directly ordered from PureAire.


**Figure 15: Oxygen deficiency monitor. Check operation by spraying for example helium or nitrogen from a bottle at the sensor located underneath the box.**

**Figure 16: Oxygen deficiency monitor in Fyrrom next to Nitrogen Generator. The output pressure regulator of the Nitrogen generator can be seen in the front**

## 7. Process gas installation (YARAPRAXAIR)

The RIE uses 5 different process gases, which are stored in the gas cupboard in room 274 b (storage room). The gas-tube installation was done by YARAPRAXAIR. The engineer who did the installation was Tor (mob: 40490466). Best to call him directly if there is a leak.


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**Figure 17: Storage cabinet for the Process gases used by the RIE (Oxygen, Helium, Argon, $CHF_3$, $CF_4$)**

Note: $CHF_3$ and $CF_4$ are climate active gases and thus extremely expensive. So be careful not to waste them when changing bottles! Still the process lines should be flushed pressurizing and releasing the pressure via the valves attached to the regulators a number of times, to make sure that the process gases have the required purity.

## 8. De-ionized water (YIT/Millipore)

The Millipore unit located in the subroom in 168 supplies the fume hood sinks with ultra-clean de-ionized water, which is essential for clean processing.

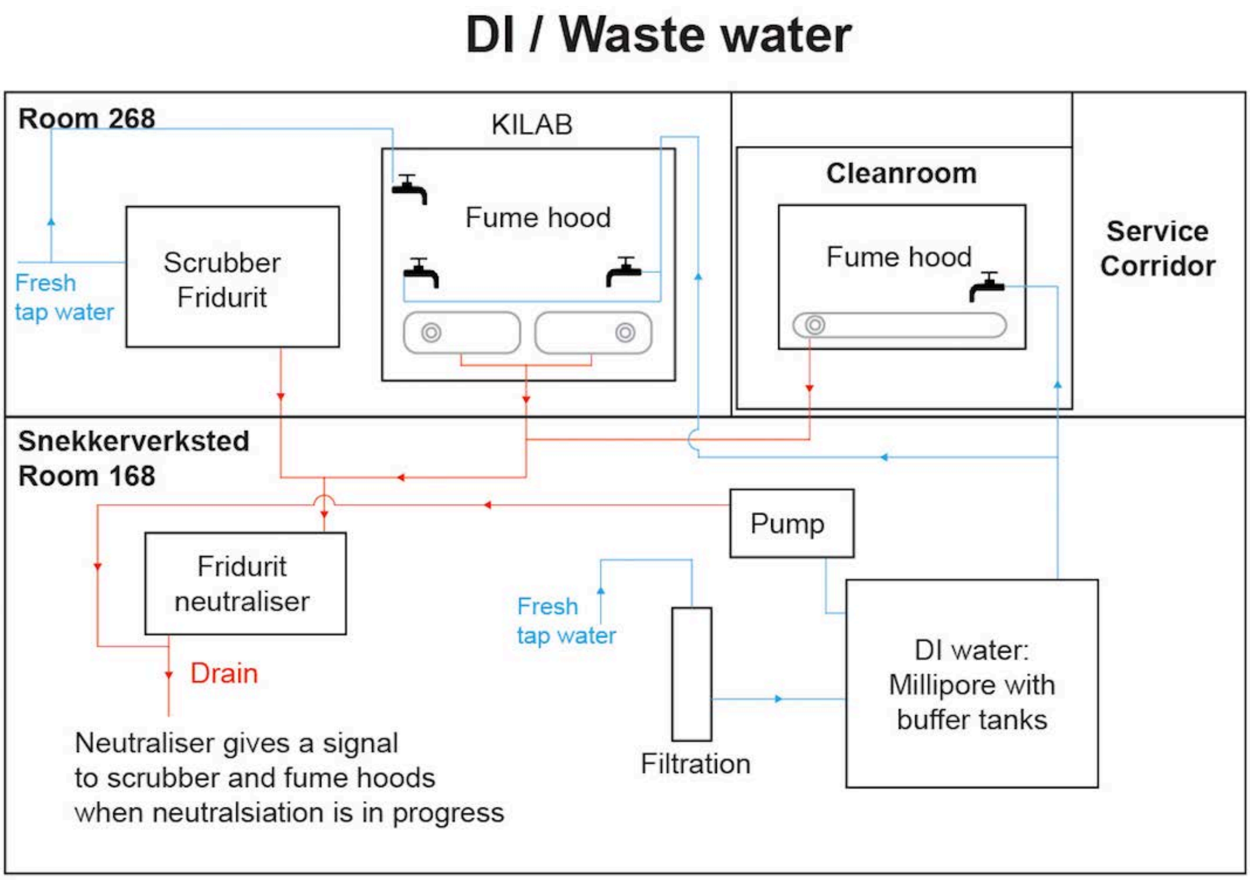


**Figure 18: Sketch of the lab's water and drainage system.**


**Figure 19: Millipore Di-water unit with storage tanks. Check display for maintenance messages!**

**Figure 20: Pump removing overspill from DI water unit to drain.**

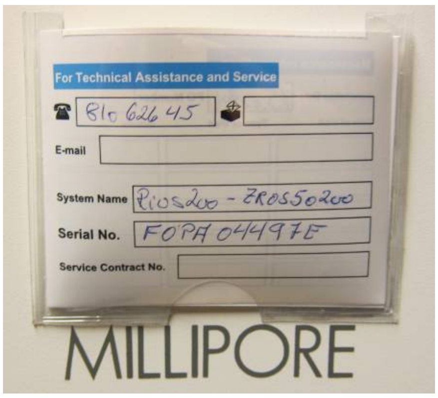


**Figure 21: Technical assistance for Millipore unit.**

## 9. Waste-water neutralization (YIT/FRIATEC)

The neutralizer unit in room 168 receives the wastewater from the fume hood sinks as well as the scrubber. It accumulates the wastewater and when the tank is filled adds the correct amount of hydrochloric acid or sodium hydroxide to neutralize the wastewater in the tank. After neutralization the tank is emptied to the drain.

Call Friatec directly for service.


**Figure 22: Fridurit Neutralizer unit located in room 168.**

## 10. Exhaust air Scrubber (YIT/FRIATEC)

The fume scrubber processes the air extracted from the fume hoods and the Plasmatherm mechanical-pump. It removes any contaminations (mainly acid or base fumes) from it. It does so by spraying tap water through the airflow. The thus produced wastewater is delivered to the Neutralizer unit (see previous section).


**Figure 23: Fridurit Fume Scrubber located in room 268. Call Firatec directly for service.**

## 11. E-Line Temperature-stabilized Cleanroom cabin (MCRT)

The temperature-stabilized cabin installed in room 276 serves the purpose of controlling the temperature environment of the e-Line. The e-Line experiences large drifts if exposed to too large temperature variations. Especially during long exposures the precision of the exposed patterns can be improved by keeping the lithography system in a temperature-controlled environment. The cabin is equipped with ISO class 7 filters and keeps the room at +/- 0.2°C. The temperature set via the front panel should be slightly lower than the temperature outside the cabin, since the cabin can only cool the air. This it achieves using a cold water supply of 18°C and a regulated heat exchanger. The temperature-controlled air is distributed via laminarization units installed of the ceiling of the cabin.

**Figure 24: MCRT-cabin with sliding door entrance to e-Line. Squared air-inlets with filter fabric can be seen on the right. Cooling water supply can be seen on the top.**

**Figure 25: View into cabin from operator terminal.**

Control panel for the cabin can be seen on the left as well as the on/off switch. Electronics and filters can be accessed when the panel wall is removed (use black handles).

## 12. ISO-5 cleanroom cabin (MCRT)

The ISO-5 cleanroom located in room 268 was installed by MCRT. It is accessible via an air lock. The air is cleaned via fan&filter units (FFU) located in the ceiling. The air recirculates via the service corridor (also accessible via airlock) and leaves the cleanroom through open slit close to floor.

The lighting is yellow to allow work with photo-resists and with the UV exposure contact-lithography unit.

**Figure 26: MCRT ISO-5 cleanroom cabin.**

The entrance is via air lock on the left. The fan at the top left keeps the service corridor pressurized (not really ideal, as this should be achieved with the fresh air inlet, but was difficult to coordinate between YIT and MCRT).

The doors are inter-locked so that only one can be opened at a time. The red emergency buttons undo this interlocking.

Differential pressures and FFU operation percentage can be read-out via the panel located behind the entrance door to the service corridor.

## 13. Cleanroom fume hood (MCRT)

The cleanroom fume hood located in room 268 is equipped with a wet-bench type-working surface. Any spillage is collected and drained to the neutralizer unit.
There is a DI-water spray gun.
A collector box can be used as drain sink to avoid unnecessary spillage when rinsing equipment with DI water and also when diluting waste acids with DI-water. Two holes at the bottom of the box with the whole array of the wet-bench, so that any collected water there in is directly sent down the drain.
The fume-hood is equipped with an additional chemical filter located at top of fume hood.

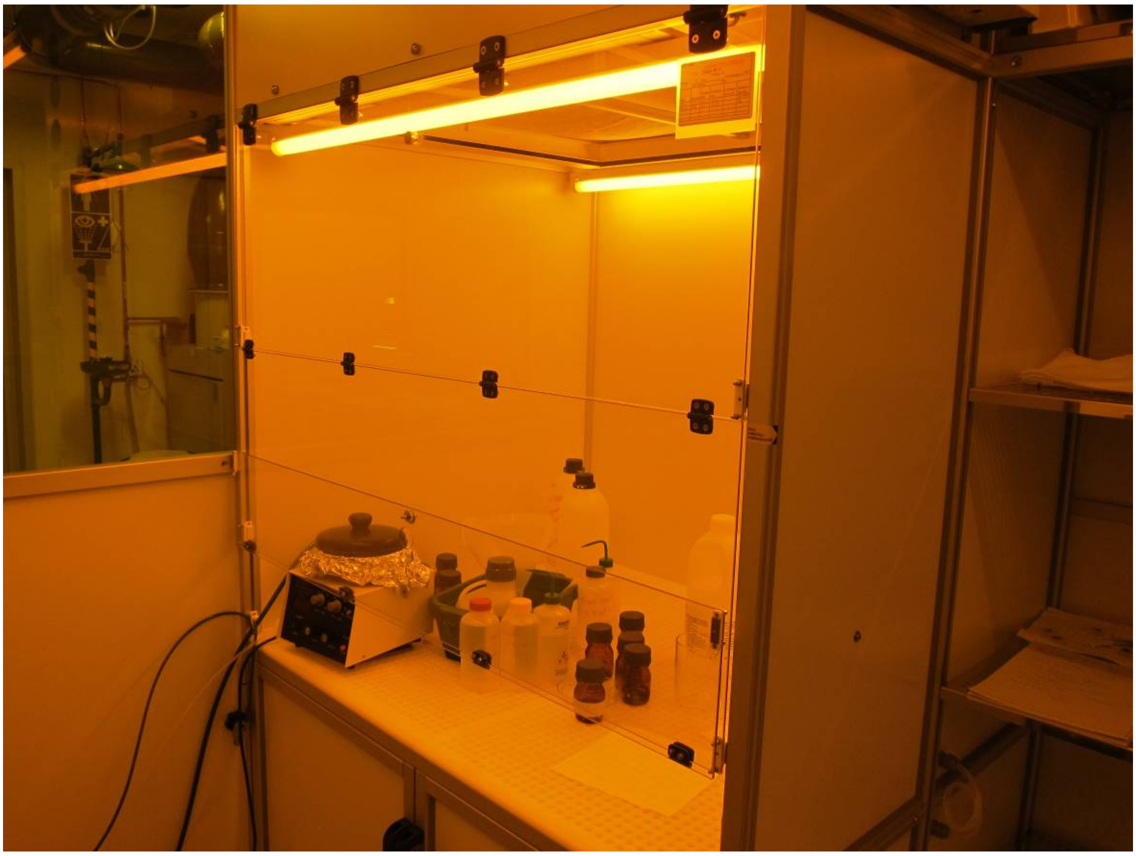

**Figure 27: Cleanroom fume hood.**

Typical uses: Spin-coating, solvent cleaning, resist development, wet-etch with hot-plate, lift-off, cleaning steps (e.g. RCA clean)


**Figure 28: Fume hood controls.**

Black-box: Neturalizer drainage alarm (on/off and indicator light and buzzer)

Grey box: Light switch for fume hood.

Vertical bar: Contains regulator for airflow.

If there is a problem with the air flow, a beeping alarm sounds and the green light on the upper right changes to orange.

If the neutralizer is in the neutralizing process stage no more wastewater should be sent through the drains of the sinks! - This is indicated by an audible alarm (can be turned off with switch at front panel) and also by a light.

The cupboard underneath can be used for general storage, but should not be used for storage of chemicals, as the cupboard is NOT ventilated.

## 14. Outer lab fume hood (YIT/KILAB)

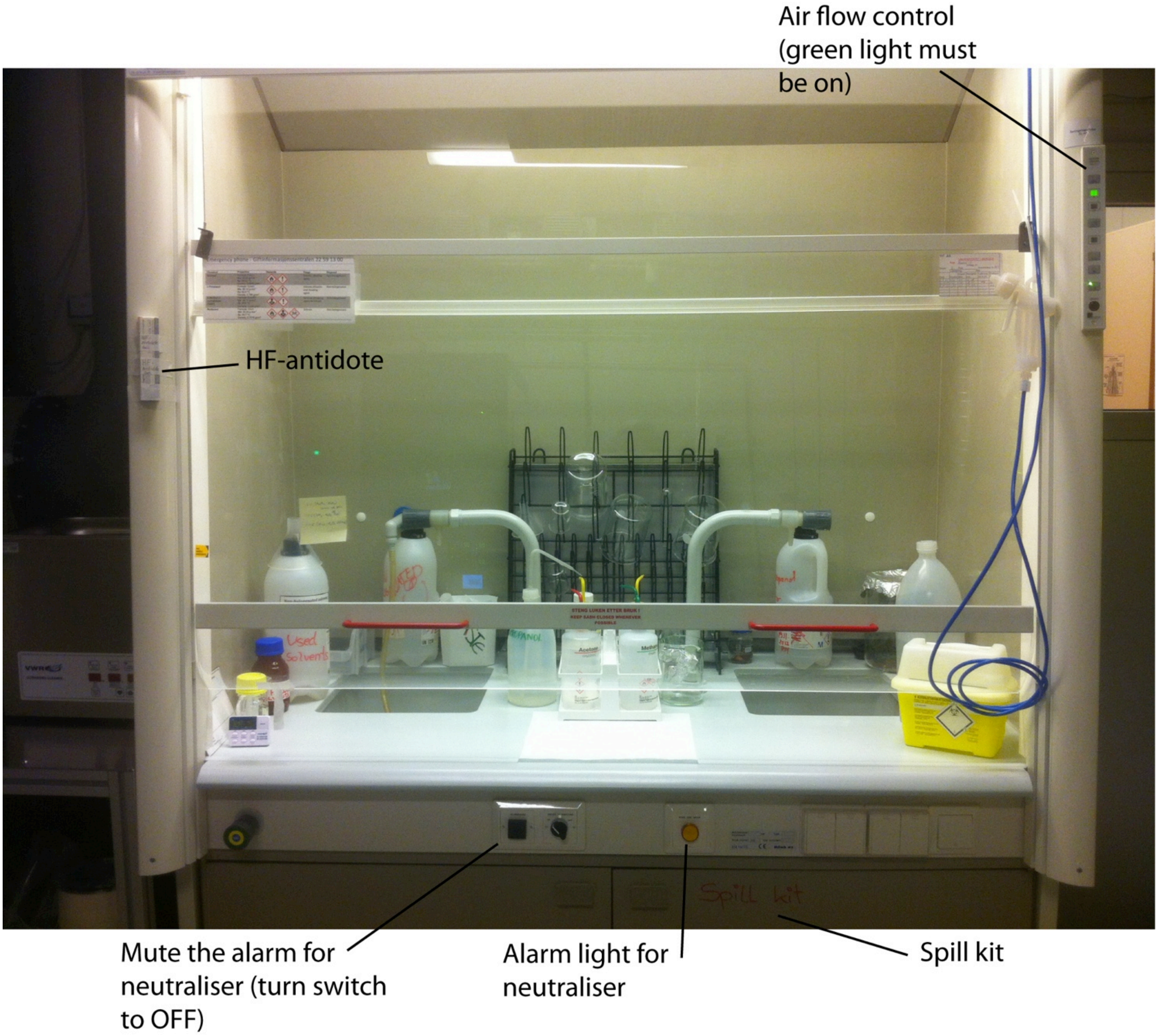


**Figure 29: Outerlab fume hood with two sinks. Each has a DI-water tap. The left sink also has a building water tap.**

If there is a problem with the air flow, a beeping alarm sounds and the green light on the panel to the upper right changes to orange.

If the neutralizer is in the neutralizing process stage no more wastewater should be sent through the drains of the sinks! - This is indicated by an audible alarm (can be turned off with switch at front panel) and also by a light.

The sash can be opened beyond the recommended working height by removing a stopper located at the upper left of the tracks of the sash.

The cupboard underneath can be used for general storage, but should not be used for storage of chemicals, as the cupboard is NOT ventilated.

The fume hood has a light which can be switched on and off via the front panel.

## 15. <u>Humidifier = befukter (YIT/KL-Klima AS/F-Tech AS)</u>

Mainly for consistent spin results it is important to keep room humidity in the range 40-50%. This is achieved inside the cleanroom using the humidifier located in the service corridor of the cleanroom. The regulating sensor is also located in the service corridor, as mounting it inside the cleanroom led to condensation on the ceiling.


**Figure 30: Hygromatik steam humidifier. Outlet is on the left and control box on the right. The black box in the middle is the Power distribution box for the Plasmatherm.**

Hygromatik steam humidifier. Outlet is on the left and control box on the right. The black box in the middle is the Power distribution box for the Plasmatherm.

The solenoid valve had to be exchanged once already to to build-up of steam inside the control unit. For this reason the complicated drainage and steam-stoppage installation has been added after wards.

## 16. Alarms

There are four parameters relating to the lab facilities that are monitored and will cause an alarm that is forwarded to the drift centre. The four alarms are:
1) Cooling water temperature
2) Cooling water flow
3) Pressurized air pressure
4) Power-cuts (Measures current into laboratory)
An sms should be sent to three different people (Gjert, Bodil and one more)

## 17. Anti-static laboratory floor

The floors in rooms 268, 276 and 274 are coated with graphite and connected to earth with a large-cross section copper cable. With appropriate clothing (especially shoes!) the lab can thus be used to handle ESD sensitive samples and equipment.

## 18. Storage for chemicals

In the storage room (274b) there are 4 cupboards located that are ventilated and can thus be used to store chemicals. Ensure that only compatible chemicals are stored in the same cupboard. For example do not store acids and solvents in the same cupboard.

## 19. Emergency shower and eye-wash

An emergency shower and eye wash is located in room 268 next to the scrubber. It is connected to both hot and cold water (which was necessary to achieve the required water flow)

**Figure 31: Emergency shower and eye wash.**

## Document History

Version 0.1, MAR-2012, Author: Thomas Reisinger, Changes: First version

Version 0.2, Aug-2014, Author: Melanie Ostermann, Changes: Update primary stuff content, insert captures for all pictures, page numbers, new sketches of pressurized air; cooling water; DI-water; and ventilation (instead of hand draw sketches), new picture of outer lab fume hood (see Figure 29).