



uOttawa

**uOttawa NanoFab Facility
LAB PROTOCOLS and SAFETY MANUAL**

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<https://www.uottawa.ca/research-innovation/nanofab>

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NanoFab Core Facility LAB PROTOCOLS and SAFETY MANUAL

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APPENDIX 1 – GLOVE CHEMICAL RESISTANCE & BARRIER GUIDE

SECTION 1: LABORATORY RULES

In an emergency – contact University of Ottawa Protection at ext. 5411 and a NanoFab lab manager:

- Spyros Ntais (ext. 7221)
- Ewa Lisicka (ext. 7223)
- Jeremy Upham (ext.7139)

1.1 FACILITY ACCESS AND SECURITY

□ **Only authorized persons are allowed to work in the NanoFab Facility.** Please do not bring your friends or co-workers into the facilities to them your research projects.

- **Authorized Persons:** Those that have completed the access requirements (<https://www.uottawa.ca/research-innovation/nanofab/user-access>) and have been approved by a lab manager.
- **Visitors:** Visitors to the facilities must be pre-approved by a lab manager (<https://www.uottawa.ca/research-innovation/nanofab/user-access>) and escorted by a member of the NanoFab staff while in the laboratory.

If an authorized user would like to bring an unauthorized individual into the facilities to show them how a tool operates or to complete work on their behalf, this is allowed with some stipulations:

- Only the authorized user will operate the tool (never the visitor)
- The authorized user will send an email to a NanoFab staff member in advance to notify them of the visitor:
 - Spyros Ntais (sntais@uottawa.ca)
 - Ewa Lisicka (ewa.lisicka@uottawa.ca)
 - Jeremy Upham (jupham@gmail.com)
 - Betty Yakimenko (nanofabadmin@uottawa.ca)

The following information will need to be provided:

- Details of the visitor (name, position, company/supervisor)
- Date/Time
- Tool(s) being used
- Reason for bringing in a visitor

□ All NanoFab doors must be closed and locked at all times. The facilities are open from 8:30am to 5:00pm Monday to Friday. Students are not allowed to do work outside these times unless supervised.

After-hours access:

Although most authorized users have access to the NanoFab Facilities between 8:30am and 5:00pm, certain exceptions can be made providing that the user has:

- 2-3 years' experience working in a NanoFab/Clean Room environment (experience will be assessed by lab managers on a case by case basis)
- informed someone that they are going to be working in the lab outside of normal hours
- specified the tool they are going to use for booking purposes

Users with after-hours access are not allowed to let other users into the facilities after hours unless approval has been granted by at least one NanoFab lab manager. An email must be sent to a NanoFab staff member notifying them of the circumstances (*see Section 1.1 – Visitors*), and the after-hours user must remain in the lab at all times.

1.2 LAB SAFETY

For safety reasons working alone should be avoided. When working with hazardous materials or equipment at least one other person **must** be present in the lab.

Cleanroom gowns, boots, bouffants, and safety glasses must be worn at all times. Shorts, open-toes shoes, outdoor shoes, high-heeled shoes or being shoeless is **NOT** permitted.

Please do not wear perfume, cologne, aftershave or other fragrance. Use unscented personal care products. Wearing scented personal care products can mask any odours that may be unusual and becomes a safety issue. <https://maps.uottawa.ca/advanced-research-complex>

If you wear makeup please ensure that it is non-flaking as it could potentially contaminate and ruin wafers.

Backpacks, bags, purses, coats, etc. are **NOT** permitted in the Clean Room vestibule. Please use the vestibule in 329.

No food or drinks of any kind will be brought in or consumed in the laboratories.

Read **ALL** signage posted outside and inside of the laboratories.

Standard Operating Procedures (SOP):

- SOP's are continuously updated. Please refer to these and become familiar with them before starting a process.
- If an SOP does not exist. It is up to the user to create one. It must be approved by a lab manager before proceeding.

- Know the chemicals** you are going to be working with, and how they react to other materials in the area. **READ** the MSDS for each chemical you are using. Supervisors should be notified before users intend to work with hazardous chemicals.
- Labeling of chemicals** while in use and in storage is **REQUIRED**. Wet bench label tags are available. Bottles should be identified with your **name, date, contents, and any relevant cautions**. Proper WHMIS workplace labels should be firmly attached. Bottles should be stored in the appropriate chemical storage cabinet.
- All items coming into the lab must be cleanroom compatible and properly wiped down.
- Any new materials or processes must be approved by the lab manager.
- Tools, equipment, and consumables are supplied by the NanoFab depending on cost and usage, with the exception of certain metals (Au, Pt, Pd) and other expensive materials such as Cytop, Espacer, and Zep. Up to 1,000 nm of precious metal deposition is included under the NanoFab package. Additional use of precious metals exceeding 1,000 nm will be charged to the relevant supervisor at \$1.50/nm.
- Certain items in the NanoFab Facilities have been supplied by specific professors. Please do not assume that anything you find in the facilities is free for your use, but rather check with a lab manager or member of the research group for which the item belongs to see if you can use it.
- Most processing equipment have logbooks. Each user will sign in the log giving the date and time he or she uses the equipment and other requested information.
- DO NOT attempt equipment repairs.** In the event that equipment fails to perform correctly, immediately notify the lab staff and note the problem in the log book. Leave a note on the equipment, including date, time and failure symptoms.
- Personal Protective equipment (PPE):** The appropriate Personal Protective Equipment must be worn when dispensing or working with chemicals. Please use lab coats and goggles in 330.
- Some garments are disposable. Try to limit waste, i.e. bouffants and shoe covers are disposable but can still be used multiple times. They can be stored in your Clean Room gown for future use.
- Rushing causes accidents.** Work at a safe, deliberate pace. Pre-plan your experiments. Be aware that others around you may also be working with hazardous materials.
- Clean up after yourself:**
To limit the number of untrained personnel entering the NanoFab Facilities, we do not allow custodial staff into the Clean Rooms. Users are expected and encouraged to help keep the

facilities cleaned and organized. This includes the common areas as well. Users that consistently leave areas without cleaning up after themselves will be banned from the lab.

All users are responsible for maintaining cleanliness in the laboratory and properly disposing of consumed chemicals or other waste. Your work area must be cleaned up at the end of the day:

- Wetbench counters, basins, beakers, etc. must be thoroughly rinsed and washed after use. Test counters with pH paper.
- The general rule for beaker and bottle rinsing is to dump rinse 3 times, then rinse thoroughly with DI water. Hang on rack to dry, or dry with N₂ gun.
- Wet wipes should be thoroughly rinsed and left to dry overnight, they can then be disposed of as general waste.
- In addition, there are cleaning products in the Clean Room. All users are expected to help clean the floors, the countertops, wipe up around the general area and take out the garbage. Plan your work so that you have time to clean up properly.
- Users must not leave papers, documents or notebooks lying around, as there are bookshelves available for binders and notebooks in ARC 329 and ARC 333.
- Users are responsible for their gowns and shoe covers. Please use the hangars in the vestibule to hang the gown. Boots can be clipped together and placed on hangar.

Users are required to provide their own sample storage Tupperware containers when using the drawers and cabinets to store samples. Cardboard boxes are not acceptable. Our labs are not meant for long term sample storage. All samples need to be dated. Anything found that is older than 1 year will be disposed of.

It is your responsibility to clean up your work area when you are done your project in the NanoFab facility.

Please make arrangements in advance if you are going to require technical assistance for your work, as drop in requests may not be attended to.

The valves for equipment that uses CDA, N₂, or vacuum **MUST BE CLOSED** when you are finished with the tool.

1.3 REMOVING ITEMS FROM THE NANOFAB FACILITIES

PLEASE DO NOT remove any items from the labs:

- Most labware (including beakers, tweezers etc.) have been assigned for specific uses and areas. Do not remove labware from their designated areas. Use accordingly or ask if in doubt. If you need new labware please ask.
- The NanoFab provides most tools and consumables to maintain and support all user activities. Nothing is ever to be taken out of the labs unless it belongs specifically to that user or their group. Permission can be granted by a lab administrator. Such items include:

- Gel packs, sample/wafer storage, wafer pucks, glassware, dishes, chemicals, gloves, attire, clean room paper, documents, labels and signs, equipment manuals, CD's, USB keys, deposition materials, wafers, polishing films, tools, knife blades, pens/markers, stationary items, wipes, tape, pipettes and syringes, computer peripherals and cables.
- Removing anything from the NanoFab facilities without permission is considered theft and will be dealt with accordingly.
- **Sheets:** there are labware request spreadsheets posted inside each of the NanoFAB labs. Please use them.

1.4 SKEDDA ONLINE BOOKING SYSTEM

- Authorized users will be provided with a link to register themselves for the Skedda online booking system.
- Users must make a reservation through the online booking system in order to use the facilities and ONLY the instruments that are already trained and signed off. Equipment must be booked on the Skedda online booking system before use even if the tool appears to be available or if using the tools outside operational hours.
- Bookings can be cancelled up to 24 hours prior to the reservation time if the user no longer requires the facilities for the timeslot booked. Please cancel the reservation to provide other users with the available timeslot. After not doing so two times, the user's reservation privileges will be revoked. If you must cancel your booking less than 24 hours in advance, you must contact the NanoFab Administrative Assistant (nanofabadmin@uottawa.ca, ext. 7632) or Spyros Ntais (sntais@uottawa.ca, ext. 7221)
- Only book tools for the amount of time needed. Failure to show up one hour after the reserved timeslot can result in losing the timeslot.
- If there is a problem with the booking system, please inform a lab manager and contact nanofabadmin@uottawa.ca

1.5 MULTI-USER FACILITY MANNERS AND CULTURE

- Every tool is unique, and quite often things do not go as planned. Users have the right to adhere (to the minute) with the Skedda booking system. Allowing previous tool users to complete their work (if they are close to finishing) is common practice and good manners (both personal and professional). Communicating with other users and being willing to negotiate tool time and use is often necessary in a multi-user facility.

If you do have to handle someone else's sample, please treat their sample as though it were your own.

1.6 CONSEQUENCES FOR BREAKING LABORATORY RULES

We expect all facility users to respect the rules including limitations set for lab access for safety reasons. If you have not been provided with extended access to the facilities, it is unacceptable to utilize them after-hours, including the practice of propping open lab doors. If users are found to be breaking any of the rules outlined in this manual, the following escalation process will be implemented:

- **1st offense:** Verbal and email reminder of the user access policy and next steps for future offenses.
- **2nd offense:** Warning by email that access to facilities will be removed for 24 hours following another offense, with supervisor in copy
- **3rd offense:** Curtail access to facilities for 24 hours. Offender will receive an email notice with supervisor in copy.
- **4th offense:** Curtail access to facilities for 1 week. Offender will receive an email notice with supervisor in copy.
- **Final offense:** Curtail access to facilities permanently . Offender will receive an email notice with supervisor in copy.

IMPORTANT NOTE ON SAFETY

Some of the labs use dangerous chemicals, gases and products. While you may not be using them, you are still at risk. Pay attention to all smells and sounds. Please do not wear strong smelling body products or make-up in the labs.

SECTION 2: TOOL EQUIPMENT AND TRAINING

2.1 PRIOR TO TOOL TRAINING

Before user training occurs, new users are required to fill out the TYPEFORM online registration form document in full. Detailed information regarding new users' projects and the list of tools needed is required to customize tool training and reduce tool-training time.

Things new users need to know beforehand:

- Final structures, i.e. Nano-antenna, Waveguides, Electrical contact pads, etc.
- Dimensions of final structures. Lengths, widths, heights, depths, arrays, array sizes, etc.
- Substrates
- Materials needed, chemicals, metals, etc.

2.2 TOOL TRAINING AND USE

- The NanoFab is not a training facility. Users will be trained on tools they are expected to use. If a user has no use for a tool, they will not be trained on it.
- A NanoFab administrator or lab manager will train students on how to use equipment, after which the student is required to pass a test based on their training. Only when the student passes the test will they be granted access to the facilities and the online booking system (Skedda).
- Users will only use equipment for which they have received training by a qualified member of the NanoFab. There is no student-on-student training unless an exception has been granted by a lab manager or administrator.

The following administrators and lab managers are authorized to complete tool training or to grant exceptions for student-on-student training:

- Spyros Ntais: sntais@uottawa.ca, Room 316, ext 7221
- Ewa Lisicka-Skrek: ewa.lisicka@uottawa.ca, Room 318, ext 7223
- Howard Northfield: howard.northfield@uottawa.ca, Room
- Mathieu de Lafontaine: Mathieu.delafontaine@uottawa.ca, Room 360, Ext 3978
- Deepthi Sekhar: dsekhar@uottawa.ca, Room 367, ext 7366
- Hyung Choi: hchoi3@uottawa.ca, Room 321
- Jeremy Upham: jupham@gmail.com, Room 118, ext 7325
 - Primarily responsible for Samco RIE Etcher (333B)

□ **Equipment Training Procedure:**

In order to gain tool and Skedda access, a new user must demonstrate the ability to operate the tool (s) they have been trained on.

For users subscribed to the Metrology Package:

- The user must be able to operate the Gemini SEM or the AFM (Bruker or Park) without assistance.
- If the SEM is the primary tool, the new user will be expected to demonstrate the ability to operate the tool and obtain high quality images in a timely fashion.

For users subscribed to the NanoFab Package:

- New users must demonstrate the ability to spin resists (Spin coater) and analyze the results of their resist (Dektak). Proper documentation of fabrication process and steps will be inspected. A verbal discussion will also be required to ensure the new user understands what has been done. Conventional fabrication processes and methods will be taught and stressed upon.
- If the new user plans to do Electron beam Lithography, they will be shown processes involving multiple layers of PMMA.
- If the new user plans to do UV Photolithography, they will be shown processes involving LOR/Photoresist Bi-layer processes

Although every tool is unique, the general training process is as follows:

- An administrator or lab manager will show the user how to operate the tool from start up to shut down.
 - Users in training may be asked to produce a summary Standard Operating Procedure (SOP) for specific tools before being allowed to use them.
 - Time permitting, the user being trained can use the tool while being supervised.
 - One week (or longer) after the final training session, the new user will be expected to fully operate the tool with supervision, but minimal guidance.
 - If the user demonstrates that they can operate the tool properly, they will be “signed off” as an official user.
- A list of tools available in the NanoFab Facilities as well as descriptions and brochures (if available) can be found on the NanoFab web site: <https://www.uottawa.ca/research-innovation/nanofab/facility-equipment>
- Generic processes are stored in the labeled binders in the Clean Room (333B). Users are expected to use these processes if possible and contribute to the process binders with working processes.
- If a tool in the lab starts making an unusual sound, whether related to your work or not, you should leave the area immediately and find a NanoFab administrator to notify them of the problem. You should not re-enter the lab until it is deemed safe to do so.

2.3 SPECIFIC TOOL MANNERS

If you see that a tool is booked for a long period of time, please talk to the person who has the tool reserved to see if you can hop on for an allotted period of time.

- **AFM Park and Zeiss Gemini SEM 500:**
- Due to the popularity of these two tools, booking is restricted 3 times per week, for a maximum of 4 hours per day (a total of 12 hours per week for each tool).
 - If you have used your allotted time for a given week but the tool is not reserved on Skedda, please contact the NanoFab Administrative Assistant (nanofabadmin@uottawa.ca, ext. 7632) or Spyros (sntais@uottawa.ca) to request an increased allotment for the week.
 - If there is no user after your run please turn off the equipment but NOT the PC.
- **Raith Pioneer EBL:**
- The Raith can only be booked at most for 2 days per week per user. If a longer booking is required please discuss with Spyros (sntais@uottawa.ca)
 - Do not use the PC while an exposure is running. Do not touch the chamber, column or plinth during an exposure.

- If it is your time slot to use the tool and another user's exposure is still running, try to contact that user before using the PC. If you cannot contact the user:
 - Stop the exposure, save the position list, record the time and U, V position as well as the position list position and approximate completion of that position.
- When unloading other samples, unload with care. If a storage box was not let out, there are boxes and dishes in the overhead cabinet beside the Samco RIE 10NR etcher. Label the sample box and leave it out for the user to collect.

□ **Angstrom Nexdep Evaporator**

- In order to achieve maximum efficiency from the tool, there are 2 time slots available for booking:
 - **Daytime slot:**
8:30 – 4:30pm. As the chamber accumulates material, pump down times increase. Always try to be ready to load early. Users are expected to be in the lab at 8:30am to start their deposition.
 - **Overnight pump down slot:**
When booking on Skedda, be sure to book the 4:30pm – 12:00am slots, as well as the 12:00am – 8:30am (next day) slots. Users are expected to have their samples removed by 8:30am to accommodate the daytime slot.
 - When booking please add the metals and thicknesses that you're planning to deposit.
- Contact Spyros (sntais@uottawa.ca) to update your booking if you change your plans.
- It's good practise to have the software and log book filled out when you load your samples. Having a labeled sample box and labeled witness sample box sitting by the tool is also helpful.
- In the event that the user is not able to show up to run the deposition, if everything mentioned above is done, then the user that wants to load can run the previous users deposition. Please inform Spyros, Ewa, or Betty (see Section 2.2) when you have to do another users deposition. If this becomes a common occurrence, we will take necessary actions. All users are encouraged to do their own work.
- **Reminder:** Users subscribed to the NanoFab package can use up to 1,000 nm of precious metals (Au, Pt, Pd) free-of-charge. Additional use exceeding 1,000 nm will be charged to the relevant supervisor at \$1.50/nm

□ **Fumehood:**

- Hotplates are sometimes needed for long periods of time. Proper etiquette and manners are expected when having to handle other user's samples.
- Each of the 3 hotplates that are available are unique. NanoFab administrators do try to keep each hotplate calibrated. A log sheet of calibrations and measured temperatures can be found pinned to the fumehood above the hotplates. Each user is expected to measure hotplate temperatures often and record their findings on the log sheet.
- Users often need to leave chemicals unattended in the fumehood. Please be sure everything is labeled properly using the "Work in Progress" forms. If you need to leave

your chemicals unattended, try to place them off to the side or the back of the fumehood so other users can work.

- Any chemicals or work left unattended and without proper labeling will be disposed by NanoFab administrative staff at the user's expense.

□ **AFM's/Dektak:**

- The AFM's and Dektak are sensitive to acoustics, and vibration. While scans are being done, do not open the lid or touch the enclosure. This will cause errors in the scan, as well as damage to the tip.
- If there is no one waiting to use the Park AFM please make sure to turn off the equipment and NOT the PC after your run.

□ **Optical Microscope:**

- Although the optical microscope is not bookable on Skedda, users are expected to communicate and share the tool in a fair and civilized manner. Try not to hog the tool.

□ **Orion NanoFab HIM/FIB:**

- This tool is extremely sensitive to vibration, acoustic noise, and magnetic fields. Please be quiet, and careful not to cause vibration when you are in 333C.

2.4 AUTHORITY OF NANOFAB ADMINISTRATIVE STAFF

□ NanoFab administrative staff have the authority to cancel bookings or stop a user from using a tool or performing certain tasks. Legitimate reasons for doing so may include:

- Industrial users require urgent use of a tool
- A tool appears to be unsafe or not functioning properly
- NanoFab administrators are authorized to prioritize certain projects
- If a NanoFab administrator believes a process is unsafe for the tool or the user. For example:
 - If a user is about to perform an AFM scan on a sample that appears to be very rough, or with unknown surface roughness
 - If a user appears to put non-compatible chemicals in vacuum chambers
- If a proposed process seems unlikely to work. For example:
 - If a user wants to evaporate XXX nm of gold on a patterned sample intended for lift-off, when the samples resist thickness is less than desired deposition.

□ NanoFab administrators have the authority to ask for and review any user's process flow:

- A user may be asked to provide full fabrication details, measurements, and images proving the legitimacy of their process. If NanoFab administrators are not convinced, they can stop the user from proceeding.
- Users may be told to change a process or steps if a NanoFab administrator feels the user's process is inefficient and is excessively consuming NanoFab goods and/or tool time.
- A discussion with the user, and admin users can be arranged afterwards.

- Doing fabrication without regular inspections of each process step can be costly (both financially and time-wise) to all users. Therefore, as examples, you may need to:
 - Prove your bi-layer resist is of the expected thickness before occupying E-beam time
 - Prove your bi-layer resist can support your desired gold thickness and survive lift-off before doing a deposition.

- If an administrator loses confidence in a user's ability to safely and properly operate a tool they can revoke user access. A test will have to be redone, or the user may be asked to revert back to a prerequisite tool to gain more experience.

- Although we try our best to keep users informed and updated via e-mail or notes placed on or near tools, NanoFab administrators may recalibrate tools without notice. This includes:
 - Recalibrating alignments on beam tools
 - Recalibrating mask aligner intensity
 - Recalibration hotplate temperatures
 - Changing spin processor programs
 - Recalibrating oven temperatures
 - Adjusting pneumatic pressures

- Every user is expected to check and measure tools before and during use. Hotplate temperatures slowly drift away from calibration values over time and with use.

- If chemical levels are running low please contact NanoFab Admin (nanofabadmin@uottawa.ca) or Spyros (sntais@uottawa.ca)

- Administrative users may reorganize, and relocate tools, equipment, chemicals, and user/group property stored in the facilities.

2.5 NEW USER PREPARATIONS/TYPEFORM INFORMATION

Users must be prepared before requesting tool training. This means the Typeform online registration form must be completed. Users must know what they plan to fabricate and have a proposed process flow. Better prepared users will receive priority over unprepared users for scheduling training. Users can provide a detailed sketch, CAD layout, PPT process flow, etc. of their proposed final design.

SECTION 3: RESTRICTIONS

3.1 GOWNING

- All laboratory users MUST wear protective eyewear at all times in all the labs.
- The wearing of contact lenses in the lab is discouraged due to the hazard of trapping chemicals in or under your lenses. If you choose to wear contact lenses in the lab, you do so at your own risk and we strongly suggest you wear “chemical splash goggles” at all times when in the laboratory.
- For reasons of safety, radios, headphones, or earplugs are not allowed in the labs.
- Safety goggles and face shields must be worn while handling hazardous chemicals. Acid resistant smocks must be worn when handling acids. Under certain circumstances, such as in the presence of UV sources, further specialized eyewear may be required. Contact the lab supervisor if you anticipate this need.
- If your suit/boots or gloves become torn, let the lab supervisors know so that they may be replaced.
- Cleanroom “regulars” (users who use the cleanroom once a week or more) are permitted to claim a launderable coverall and booties set. Each coverall and booties set are numbered. There is a sign out sheet posted on the wall to sign out and claim a set. By claiming a set, you will be the sole user of this set. You will be responsible for maintaining the set, i.e. wash it regularly, at least once a month or as needed. A user’s lack of hygiene can affect the quality of other’s work.

3.2 CELL PHONE USAGE

- Cell phones or earplugs should not be used when operating equipment.

3.3 WORKING ALONE

- As mentioned above, for safety reasons, working alone should be avoided. Someone should always be within call when a laboratory procedure is being performed. For work with hazardous materials or procedures the supervisor has the right to require that at least one other person be present.

3.4 USE OF EQUIPMENT

- Lab users will **ONLY** use equipment on which they have received training. The individuals authorized to provide training are listed in Section 2.2.
- Each tool has a posted list of users who are authorized to use the tool. Training is given by a qualified member of the NanoFab staff. Proof of training must be demonstrated to the lab supervisor and lab managers. The appropriate paperwork must be completed and submitted to the NanoFab Administrative Assistant before access to the equipment is granted (<https://www.uottawa.ca/research-innovation/nanofab/user-access>).

□ In order to use the equipment all authorized users must reserve their timeslot through the Skedda online booking system. Access to the booking system will be granted once all aforementioned requirements have been completed

3.5 SAMPLE STORAGE

□ There are several desiccators sample storage cabinets throughout the facilities. Users can be assigned trays upon request. Drawers and wall mounted cabinets can also be requested for storing larger items. Users are expected to keep their storage spaces organized and well kept. Archive samples and materials when possible.

□ As mentioned, users are required to provide their own sample storage Tupperware containers when using drawers and cabinets to store samples. Cardboard boxes are not acceptable. Our labs are not meant for long term sample storage. All samples need to be dated. Anything found that is older than 1 year will be disposed of.

□ NanoFab administrative staff may need to reorganize without notice, user chemicals may also be reorganized or removed and disposed of if the user has not been in the facilities for an extended duration.

□ NanoFab administrative staff will remove and dispose of samples when the student finishes their projects. If any remaining samples are useful to your research group, please make the necessary arrangements before your access to the facilities.

3.6 CLEANROOM PRACTICES

□ Wood, cardboard, pencils, and regular paper are some of the items restricted from the cleanroom. Only pens and special cleanroom paper and cleanroom notebooks are allowed. Cleanroom approved paper is available in limited quantities in room 333B or from the NanoFab Administrative Assistant (ARC 350).

□ Any items coming into the lab must be wiped down in the gowning area.

□ Avoid touching your face with the vinyl or nitrile gloves on – replace your gloves if you do.

□ Please do not wear perfume, cologne, aftershave or other fragrance. Use unscented personal care products. Wearing scented personal care products can mask any odours that may be unusual and becomes a safety issue. <https://maps.uottawa.ca/advanced-research-complex>

□ Please do not wear makeup in the labs as particles can flake off and ruin someone's work.

3.7 “HAZARDOUS ACIDS IN USE” SIGN

Always check the sign posted on the door to room 333A (yellow room) before entering. If the “Hazardous acids in use “ sign is up you are not to enter the room unless the person using the hazardous acids gives you permission to do so. Always knock first and ensure you have their attention.

SECTION 4: CHEMICAL SAFETY

4.1 FIRST AID

- The First Aid Kit is located on the bookshelf in the entrance of the Metrology lab (ARC 329)
- Injuries, such as minor burns and cuts can be treated with the first aid kit. If you use any items, please let the lab supervisor or NanoFab Administrative Assistant know as soon as possible.
- The following people hold Emergency Level Safety Oriented First Aid:
 - Ewa Lisicka: ext 7223, Room 318

4.2 CHEMICAL INFORMATION AND REFERENCE MATERIALS RISK ASSESSMENT

- A large number of chemicals are used in the NanoFab Facilities. Materials Safety Data Sheets (MSDS) are required for every chemical in the labs. MSDS are in binders located in the White Clean Room (ARC 333B) and can be found online (<http://orm.uottawa.ca/whmis/lab/msds>)
- A Chemical and Materials Inventory list is posted on the door to ARC 333A. Users are expected to keep this up to date. Any new chemicals coming in or emptied out must be updated on this list. Lab users should familiarize themselves with the chemicals that they plan to use in their research. Do not use any chemical without first reading the MSDS. If a chemical you need is not listed in the Chemicals and Materials Inventory, you must:
 - Contact the lab supervisor to get approval to bring the chemical into the lab.
 - Make sure an MSDS is ordered at the time the chemical is ordered.
- There is also an “Items Needed” list posted in the Clean Room vestibule. If a chemical is getting low, please update this list. Users may also add in any other items they feel are needed.
- Chemicals cannot be brought into the lab until you receive approval from the lab supervisor and an MSDS sheet is on file in the MSDS binders. MSDS sheets should be given to the lab supervisor when received. **NO EXCEPTIONS**
- Chemicals must be properly transported into the appropriate room and storage locations (see section 4.4 for additional information).
- All chemicals stored in containers must have proper WHMIS labels (either Manufacturer’s or Workplace) stating its contents and dated.

- Chemicals for a dedicated user are designated as “special chemicals” and are inventoried separately from standard chemicals. Special chemicals should be ordered in minimum volumes, reducing high disposal costs. Your account will be charged for disposal costs of any special chemicals you bring into the NanoFab Facilities.
- Lab member “formulations” must also bear a “Special Chemical Formula” label detailing contents and percentages.

4.3 PROTECTING YOURSELF/PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Prior to working with chemicals, make sure you are properly protected. You **MUST** wear chemically related gloves, goggles, a full chemical resistant smock, and a face shield.
- Only authorized persons can work with dangerous chemicals (a list of those persons can be found on the acids fume hood in room 333A).
- If gloves, smocks, or face shields aren’t readily available near your location, contact the lab managers and the necessary items will be provided.
- Gloves:**
 - The vinyl/nitrile gloves are not of sufficient strength to protect against chemical burns or solvents.
 - **Caution:** A common problem with all gloves is dermatitis from the moisture held against skin while wearing gloves. If you have problems with dermatitis please report the problem to the lab supervisor.
- Lab Coats and goggles must be worn in the wet chemistry lab (ARC330).

4.4 TRANSPORTING CHEMICALS THROUGH THE LAB

- Chemicals for the lab are stored in special cabinets. ALL FLAMMABLE chemicals are to be stored in the solvent fume hood cabinets
- After removing any item from the cabinets, make sure the doors are closed. Wet Bench sliding doors must always remain closed for safety reasons.
- If you cannot locate a chemical listed on the inventory sheets, contact the lab supervisor.
- Be sure to check that there are no bottles of the chemical you need in your area before bringing and opening new ones.

□ Never draw from the main bottles, always be sure to pour into smaller bottles or vials. Never put anything back into the main bottles which it was taken from.

- **4.4.1 WORKING WITH CHEMICALS**

- Always work at an exhausted wet process station! Wet process stations are exhausted, with face velocities greater than 80 feet/minute. DO NOT adjust the back sashes. They are set by the Facilities Department. This assures proper exhaust velocity.

- **4.4.2 DRY CHEMICALS**

- When measuring out chemicals never pour a chemical back into its reagent bottle. This can contaminate the remaining chemical in the bottle. When removing dry chemicals, pour them out when possible. Scoop only when necessary and use freshly cleaned spatulas. If you pour too much, instead of throwing the excess away, you might want to store it in a clean, labeled container for your use later.

- **4.4.3 SOLUTIONS**

- Forbidden chemicals – ONLY lab administrators (or special users) can use these:
 - Hydrofluoric acid (HF)
 - Potassium Hydroxide (KOH)
 - Tetramethylammonium hydroxide (TMAH)
 - Piranha Solution (H_2SO_4 or NH_4OH)
 - Aqua Regia ($\text{HNO}_3 + 3\text{HCl}$)
 - RCA Processing Station
- Always place fuming containers toward the back of the fume hoods where there is maximum exhaust.
- If you must leave an area with a process in progress, make absolutely sure that you fill in the work sheet: **WORK IN PROGRESS**
 - These sheets are available in the NanoFab Facility (on the vacuum oven in 333A)
 - Please indicate what is in beakers when in active use. Simply put a labelled wipe under the beaker with chemical name and user name.
 - Make sure you leave your process clearly labeled with your name, the date, time, your expected time of return, where you can be reached (if you will be gone more than 10 minutes) and the chemical involved.
 - Do not leave chemical processes unattended unless absolutely necessary.

4.5 CHEMICAL DISPOSAL

When you are through with your process, clean up completely. Chemicals are **NOT** to be dumped down the drain (including photoresists).

Proper disposal procedures:

- Dispose of special mixtures when you anticipate that they will no longer be required.
- Non-organic chemicals, organic chemicals, and acids each have their own disposal containers
- Organic solvents, such as acetone, Isopropanol and Methanol may be stored together for hazardous waste disposal.
- Chlorinated organic solvents must be stored separately for hazardous waste disposal. Make sure it is a solvent and that waste bottles are not overfilled. Obtain a WHMIS workplace label and enter the summary of contents to the peel-off label and place it on the bottle.

4.6 CHEMICAL EXPOSURE

If you are exposed to chemicals:

- Immediately remove all affected clothing
- Flush the affected areas with water for 15 minutes, not less. Use the emergency shower and/or eye washes as necessary.
- The location of the safety showers and eyewashes are clearly marked with signs. Memorize the locations of the safety showers and eyewashes.

Exposure of the eyes requires flushing with water for at least 15 minutes. As a precaution, all exposures to the eye will require a visit to an emergency room for a check-up. Contact a staff member as soon as possible for assistance or call **ext. 5411**

4.7 CHEMICAL SPILLS

Chemical spills will be cleaned up by a NanoFab lab administrator.

A spill kit is located in 333A in a yellow bag beside the acid fume hood, under the oven bench. There is also a spill kit located in ARC 330 next to the dicing saw. These kits contain the needed materials to safely cleanup a spill. Instruction are included in each spill kit.

The following people have been trained on chemical spill cleanup. In case of a chemical spill, you **MUST** seek help from one or more of the following people:

Ewa Lisicka: ext. 7223, Room 318

Spyros Ntais: ext. 7221, Room 316

REPORT ALL SPILLS TO THE LAB SUPERVISOR.

4.8 DECANTING

All resists stored in the fridge must be decanted before use.

- The bottles must be taken out of the fridge and let to sit until the bottle and contents are at room temperature before the lid is opened. This can take between 2-4 hours.
- Once at room temperature, open the bottle and pour the contents into a smaller draw bottle.
- Failure to do this will contaminate the entire source bottle. This can drastically change fabrication process for everyone that uses the facility. Some of the resists are very expensive, some can cost upwards of \$5,000 per 250ml. Once these bottles become contaminated, they must be disposed of.
- Please ensure any chemical requiring refrigeration is put back into the fridge.

SECTION 5: DISPOSAL OF HAZARDOUS OBJECTS

There are specific containers for the disposal of all types of waste. Please use them appropriately.

Broken Glassware:

Broken glassware should first be rinsed thoroughly if necessary, then disposed of by depositing in the glass pail. Contact a staff member if you need help disposing of broken glass

Wafers:

- Check with the lab supervisor before throwing away whole wafers. They might be recycled or used as dummies for other operations.
- Wafers and broken wafers are disposed of in the same pails as broken glassware.
- Pieces of wafer containing arsenic are to be disposed of in their own container.

Needles and Razor Blades:

Needles and razor blades should be disposed of in the containers labeled “sharps” provided throughout the NanoFab facilities. If these plastic containers are full, contact a NanoFab lab administrator and they will be emptied. Do not dispose of needles or razor blades in the waste cans!

Broken Thermometers

Because of the danger of metallic mercury, broken thermometers should be disposed of properly. Contact a NanoFab lab administrator for assistance if you break a thermometer.

SECTION 6: COMPRESSED GASES

6.1 HANDLING GAS CYLINDERS

- Cylinders of both toxic and non-toxic compressed gases are in use throughout the lab. Lab users are not allowed to install or disconnect these cylinders. All compressed gas cylinders are to be handled by trained staff. There are several reasons for this policy:

- Some gases are toxic
- Some gases in these cylinders are at high pressures, some as high as 3000 psi
- Regulators are designed to handle specific gases and can explode if not properly chosen
- Improper installation or purging will contaminate a full bottle of gas. Some of our etching gases cost hundreds of dollars and their loss or contamination is very costly.

Gas cylinders must be chained and strapped down at all times.

6.2 TOXIC GASES

All toxic, flammable or corrosive gases are kept in exhausted steel gas cabinets.

List of toxic gases:

- Oxygen
- Argon
- Tetrafluoromethane
- Helium
- Sulfur hexafluoride
- Hydrogen
- Methane
- Nitrogen
- Chlorine
- Boron Trichloride
- Liquid Nitrogen
- Ammonia
- Hexamethyldisilazane vapour

Most of these gases have a characteristic odor. If a gas leak is suspected, the lab MUST be evacuated. If you notice an unusual odor, leave the lab and immediately report it to the NanoFab staff so an evacuation announcement can be made. If no staff is available, call ext. 5411.

SECTION 7: FIRE HAZARDS

7.1 FIRE PREVENTION

Fires in the lab can result from many causes including ignition of flammable gases or solvents, and combustion of materials. Use care when using heat lamps or heating flammable solvents on hot plates.

Always use a water bath to transfer heat to flammable solvents when using a hot plate.

- Avoid water around electricity and use common sense when working in the lab.

7.2 LABORATORY FIRES

- Before using any chemicals, you should make yourself familiar with all the potential fire hazards associated with the chemical. This information will be found on the MSDS in the fire, explosion and reactivity sections. The information will
- If a **small fire** does start in a lab and is contained in a beaker, flask, or other small container, you may attempt to extinguish the fire with the proper fire extinguisher or by smothering it. Call for help from others in the area while doing this so they are aware of the fire and ready to take action if your attempt is not successful.
- After the fire is out, immediately report the fire and actions taken to Protection Services at ext. 5411.
- **Major Fire Emergencies:** (Pg 7 of University of Ottawa Laboratory Safety Manual)
In the event of a major fire beyond your control:
 - SHOUT “FIRE, FIRE, FIRE”** and pull the nearest fire alarm.
 - Attempt to rescue persons in immediate danger. Do not endanger yourself.
 - Evacuate personnel from the area
 - Leave fume hoods on.
 - Close, but **DO NOT** lock the door.
 - Do not attempt to fight a major fire on your own.
 - Fire extinguishers are to be used to assist you in getting out safely.
 - CALL PROTECTION AT EXT. 5411.** Give location and details. Remain available in case further information is required.
- Classes of Fire:
 - A Class – ordinary combustibles such as wood, paper, cloth, plastic, etc.
 - B Class – flammable and combustible liquids.
 - C Class – charged electrical fires
 - D Class – combustible “metals”
- Fire extinguishers are located in the ARC 329 vestibule, in ARC 330, just outside the lab door for ARC 333, as well as at the ARC Emergency Exits. These are Type 5-BC(Carbon Dioxide) extinguishers capable of extinguishing fires of flammable liquids or electrical equipment (not paper) without damaging equipment. Use water to extinguish paper fires.
- The uOttawa Health, Safety and Risk Management Office regularly checks fire extinguishers. Report any use of a fire extinguisher to that office immediately.

- NanoFab facility users are not expected to be fire fighters and should evacuate the building when a fire threatens safety.
- For fires, call Protection Services emergency number, **ext. 5411**, and evacuate the lab.
- In all cases fill out a University of Ottawa Injury/Incident report.

SECTION 8: ELECTRICAL SAFETY

- All electrical power wiring is to be done by the University of Ottawa maintenance staff.
- Learn the locations of the circuit breakers required by the equipment you use.
- In the case of an electric shock of someone in the lab, do not touch or grab them. Do not attempt to shut off power on the system, but rather use the circuit breakers or unplug the equipment in the service chases.
- Report all electrical problems to NanoFab staff.

SECTION 9: LAB EVACUATION PROCEDURES

- When the building fire alarm sounds, you **MUST** evacuate the NanoFab Facilities and the ARC building.
- The Evacuation Procedure is as follows:
 - Secure your process and leave the lab quickly
 - Exit out of the labs by the Main Entrance
 - Once you are out of the NanoFab Facility and in the hallway, turn left (note the illuminated EXIT sign) and leave the area via the stairway
 - Proceed down the stairway until you reach the outside door and exit the building
 - Once outside meet in front of the ARC building
- If there is an emergency in the lab (volatile or toxic materials fire or toxic gas leak):
 - Call **ext. 5411** and inform the Safety Officer of the situation
 - Evacuate the lab (evacuate the other lab users as you leave)
 - Find the nearest exit

SECTION 10: REFERENCES

- 1) User Access to NanoFab Facilities: <https://www.uottawa.ca/research-innovation/nanofab/user-access>
- 2) Typeform Registration Form: <https://crpuo.typeform.com/to/anMKRF>
- 3) WHMIS for Lab Workers, Material Safety Data Sheets (MSDS): <https://www.uottawa.ca/about-us/administration-services/office-risk-management>
- 4) University of Ottawa Laboratory Safety Manual: <https://www.uottawa.ca/about-us/administration-services/office-risk-management/training/lab-safety>

SECTION 11: MANDATORY READINGS

“Microfluidics Techniques Reviews and Protocols”, humana Press 2006, ISBN 978-1-58829-517-0. Chapter 2: Introduction to Microfabrication Techniques, R. Zaouk, B.Y. Park & M.J. Madou
You can access an on-line version of this book through the University of Ottawa Library.

“NanoFabrication Handbook;”, CRC Press 2012, ISBN 978-1-4200-9052-9, S. Cabrini & S. Kawata.

Chapter 1: Introduction to NanoFabrication

Chapter 2: for Electron Beam Lithography (Raith Pioneer System)

Chapters 3 & 4: for HIM/FIB (Orion NanoFab)

Chapter 5: for RIE (Samco 110ip, Samco 10NR)

Chapter 6: for PhotoLithography (Mask Aligner)

You can access an on-line version of this book through the University of Ottawa Library.

SEM Scanning Electron Microscope A to Z, Basic Knowledge for Using the SEM. JEOL

Spin Coating Theory, Oct 2013. University of Louisville.

SECTION 12: NANOFAB USER GUIDE AND MANUAL QUIZ

Name: _____

Date: _____

PART 1: TRUE OR FALSE

1) You are allowed to bring food and drinks into the labs.

True False

2) You are allowed to bring in your own notebooks and paper into the clean room.

True False

3) You are allowed to take tools, chemicals, glassware, etc. from the Core Labs and bring them into your own lab for use.

True False

4) Users are expected to fix broken tools.

True False

5) Headphones/earplugs are allowed in the labs.

True False

6) You are allowed to bring friends and co-workers into the core labs to show them what you are doing.

True False

7) Chemical wastes such as Acetone, IPA and photoresists are disposed of in the sink.

True False

8) There are coat hangers in the clean room vestibule; this is where we store our backpacks, jackets and outside boots/shoes.

True False

9) A tool you need to use is available, therefore you can just use it without booking on

False

10) Anything found in the Core Labs is free for anyone and everyone to use.

True False

11) Signs and posters in the labs are there for decorations, and you don't have to read them.

True False

PART 2: POINT FORM / SHORT ANSWER

12) Who is allowed to provide tool training?

1) _____

2) _____

3) _____

4) _____

5) _____

6) _____

13) Operational hours are from _____ am to _____ pm.

14) Explain how to properly decant refrigerated resists.

15) Regular clean room users are allowed to claim a coverall set. How often should you clean them?

- Everyday
- Weekly
- Monthly
- Annually

16) A tool completely unrelated to you and your work starts making an unusual sound, what do you do?

17) Where is the chemical spill kit located?

18) Before requesting tool training, you are required to know some details about the devices you plan to fabricate or work with. List 4 of these characteristics:

1) _____

2) _____

3) _____

4) _____

19) Your fabrication process requires certain chemicals and materials. What steps should you do before working with and/or bringing these chemicals into the Core Labs?

1) _____

2) _____

3) _____

4) _____

20) List 5 different types of waste containers (in 333 and 330):

1) _____

2) _____

3) _____

4) _____

5) _____

* Please return your quiz answers within one week of receiving the NanoFab LAB PROTOCOLS and SAFETY MANUAL. No access to the labs will be granted prior to reception of this document.

SECTION 13: STATEMENT OF UNDERSTANDING

NanoFab Core Facility of the University of Ottawa LAB PROTOCOLS and SAFETY MANUAL

I, _____ hereby acknowledge and declare that:
(Print Name)

- (i) I have received, read and understood the rules and procedures outlined in the LAB PROTOCOLS and SAFETY MANUAL of the NanoFab Core Facility of the University of Ottawa.
- (ii) I agree to conduct my activities in accordance with the NanoFab's rules and procedures and understand that breaching these standards may result in disciplinary action such as suspension or revocation of access to laboratories.

Signature: _____

Date: _____

* Please return the signed Statement of Understanding within one week of receiving the NanoFab Lab Protocols and Safety Manual. No access to the labs will be granted prior to reception of this document.

APPENDIX 1 – GLOVE CHEMICAL RESISTANCE & BARRIER GUIDE

Chemical Name	Hazard Rating	Nitrile	Latex	PVC
Acetaldehyde	3	P	G	P
Acetic Acid (Glacial)	3	F	G	F
Acetic Anhydride	3	F	G	P
Acetone	1	F	G	P
Acetonitrile	2	F	F	P
Acrylic Acid	3	G	G	P
Ammonium Acetate		E	E	G
Ammonium Carbonate		E	E	E
Ammonium Fluoride, 30-70%	3	E	E	G
Ammonium Hydroxide, 30-70%		E	E	E
Ammonium Hydroxide, <30%		E	E	E
Amyl Alcohol	1	E	G	G
Aniline	3	F	G	G
Aqua Regia		P	P	F
AZT			G	
Benzaldehyde	2	P	F	P
Benzene	2	F	P	P
Boric Acid		E	G	E
Bromopropionic Acid		F	G	G
Butyl Acrylate	2	P	P	P
Butyl Cellusolve		G	G	P
Calcium Hydroxide		E	E	
Carbon Disulfide	3	G	P	P
Carbon Tetrachloride	3	P	P	F
Chlorobenzene	2	P	P	P
Chlorodibromomethane		P	P	F
Chloroform	2	P	P	P
Chloronaphthalenes	1	P	P	P
Chromic Acid	3	F	P	G
Cisplatin		G	G	P
Citric Acid, 30-70%		E	E	E
Cyclohexane	1	E	P	P
Cyclohexanol	1	E	G	E
Cyclohexanone	1	P	P	P
Cyclohexylamine	3	P	P	P
Di-N-Amylamine	3	E	P	P
Di-N-Butylamine	3	E	P	P
Di-N-Butylphthalate	0	E	F	P
Di-N-Octylphthalate	0	E	F	P
Diacetone Alcohol	1	G	F	P
Diallylamine		P	P	P
Dichoroacetyl Chloride	3	P	P	P
Diesel Fuel	0	E	P	
Diethanolamine	1	E	E	E
Diethylamine	3	G	F	P
Diethylene Glycol	1	E	E	
Diethylenetriamine	3	P	P	P
Diisobutyl Ketone	1	G	P	P
Diisobutylamine	3	E	P	P
Dimethyl Ether		G	P	P

Chemical Name	Hazard Rating	Nitrile	Latex	PVC
Dimethyl Sulfoxide (DMSO)	1	G	E	G
Dimethylacetamide	2	F	G	P
Dimethylformamide (DMF)	1	P	P	P
Dioxane	2	P	P	P
Epichlorohydrin	3	P	F	P
Ethanol	0	G	G	G
Ethyl Acetate	1	P	F	P
Ethyl Ether	1	G	P	P
Ethylene Glycol Dimethyl	2	F	F	P
Ethylene Dichloride	2	P	P	P
Ethylene Glycol	1	E	E	G
Formaldehyde, 30-70%	3	E	G	E
Formic Acid	3	G	E	E
Freon 113 OR TF		E	P	F
Freon TMC		F	F	P
Furfural	3	P	P	P
Gasoline, 40-50% Aromatics	1	E	P	P
Gasoline, unleaded	1	G	P	P
Glutaraldehyde, <5%		G	G	F
Glycerol		E	E	
Heptanes	1	E	P	P
Hexane	1	E	P	P
Hydrazine	3	E	F	E
Hydrochloric Acid, <30%	3	G	E	E
Hydrofluoric Acid, <10%	4	G	G	F
I Sobytyl Alcohol	1	E	P	F
I Sooctane	0	E	P	P
I Sopropyl Alcohol	1	E	E	G
I Sopropylamine	3	P	P	P
Jet Fuel, <30% Aromatics 73-248C	1	G	P	P
Kerosene		E	P	F
Lactic Acid		E	E	E
Lauric Acid		E	E	F
Malathion, 30-70%		G		
Maleic Acid		G	G	E
Methanol	1	F	F	F
Methyl Acetate	1	P	P	P
Methyl Ethyl Ketone	1	P	P	P
Methyl Isobutyl Ketone	2	P	P	P
Methyl Methacrylate	2	P	P	P
Methylene Chloride	2	P	P	P
Amyl Acetate	1	F	P	P
Butyl Acetate	1	F	P	P
Butyl Alcohol	1	E	E	F
N-Methyl-2 Pyrrolidone (NMP)	2	P	E	P
N-Nitrosodiethylamine		P		
Propyl Alcohol	1	E	E	F
Naphtha, <3% Aromatics	1	E	P	F
Nitric Acid, <30%	3	G	G	G
Nitric Acid, 30-70%	3	P	P	F

TOLL FREE 1.800.434.2633 x39
LOCAL 905.625.6021 x39
WEBSITE www.diamed.ca

FAX 1.800.293.2987
FAX 905.625.6280
EMAIL diamed@diamed.ca



Chemical Name	Hazard Rating	Nitrile	Latex	PVC
Nitrobenzene	3	F	F	P
Nitroethane	1	P	G	P
1-Nitropropane	1	P	F	P
2-Nitropropane	1	P	P	P
Octane	0	G	P	P
Octyl Alcohol	1	E	E	F
Oleic Acid	0	E	G	G
Oxalic Acid	3	E	E	E
Palmitic Acid		G	F	G
PCB (Polychlorinated Biphenyls)	2	G	P	
Pentachlorophenol	3	G	F	P
Pentane	1	E	P	P
Perchloric Acid, 30-70%	3	F	F	F
Perchloroethylene	2	G	P	P
Peroxyacetic Acid		P	P	P
Petroleum Ethers, 80-110C	1	G	P	P
Phenol	4	F	F	F
Phosphoric Acid	3	G	F	G
Picric Acid	3	E	G	E
Potassium Hydroxide	3	E	G	E
Potassium Iodide		G	G	G
Propyl Acetate	1	F	P	P
Pyridine	3	P	P	P
Sodium Carbonate		E	E	E
Sodium Chloride		E	E	E
Sodium Fluoride	3	G	G	G
Sodium Hydroxide, 30-70%	3	G	E	E
Sodium Hypochlorite		E	E	F
Sodium Thiosulfate		G	G	G
Styrene	2	P	P	P
Sulfuric Acid, <70%	3	F	G	G
Sulfuric Acid, >70%	3	P	P	P
Tannic Acid	0	G	G	G
1,1,1,2-Tetrachloroethane		F	P	P
Tetrahydrofuran	2	F	P	P
Toluene	2	F	P	P
Toluene-2,4-Diisocyanate (TDI)	3	P	P	P
1,2,4 - Trichlorobenzene	2	F	P	P
1,1,1-Trichloroethane	2	P	P	P
1,1,2,-Trichloroethane	2	P	P	P
Trichloroethylene	2	P	P	P
Tricresyl Phosphate	2	G	G	F
Triethanolamine	2	E	E	E
Turpentine	1	E	P	F
Xylenes	2	F	P	P

The National Fire Protection Association (NFPA), Chemical Health Hazard Rating System

- 4** - Danger, may be fatal on short exposure. Specialized Protective Equipment Required
- 3** - Warning, corrosive or toxic
- 2** - Warning, may be harmful if inhaled or absorbed
- 1** - Caution, may be irritating
- 0** - No Unusual hazard
- No Information Available, Avoid skin contact or inhalation

Chemical Resistance

- P** - Poor Chemical Resistance
- F** - Fair Chemical Resistance
- G** - Good Chemical Resistance
- E** - Excellent Chemical Resistance

Diamed's thin gauge and disposable Nitrile, Latex, and Polyvinyl Chloride (PVC) gloves are designed to provide barrier protection and tactile sensitivity for users. Please note that our gloves are not designed for prolonged, direct exposure to chemicals. This chart was designed to provide a guideline for the chemical compatibility of our Nitrile, Latex, and PVC gloves to the commonly used chemicals listed.

Please note:

Variability in material thickness, chemical concentration, temperature, and length of exposure to chemicals will affect specific performance. Diamed recommends that you use caution at all times.

TOLL FREE 1.800.434.2633 x39 **FAX** 1.800.293.2987
LOCAL 905.625.6021 x39 **FAX** 905.625.6280
WEBSITE www.diamed.ca **EMAIL** diamed@diamed.ca

DiaSILK

DiaSOFT

DiaSTRETCH

Diamed.ca