



APPLIED MICRO & NANOSYSTEMS FACILITY

THE UNIVERSITY OF BRITISH COLUMBIA

Operation and Safety Protocols

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<https://osticket.ok.ubc.ca/apsc/>

Urgent contacts.

Emergencies:	Emergency / First Aid / Security	250-807-8111 (local 78111)
	Hazardous Materials Response	911
	Poison Control Centre	1-800-567-8911

Incident or near miss report: <https://www.cairs.ubc.ca/>

Training Inquiries, maintenance requests, user level changes submit ticket at:
<https://osticket.ok.ubc.ca/apsc/>

1.0 User Responsibilities and Policies.

1.1 User Responsibilities.

It is the responsibility of all Applied Micro and Nanosystems Facility (AMNF) users to familiarize themselves with facility equipment, chemicals, and hazards to ensure that everyone in the vicinity is safe at all times.

It is the responsibility of all AMNF users to not misuse equipment and to not tamper with, handle, or use items belonging to other facility users without explicit permission.

It is the responsibility of all AMNF users to adhere to the AMNF User Policies below. Adherence to these policies is mandatory, as the AMNF is a user-operated facility with many individuals and the potential for hazards. Failure to comply will result in disciplinary actions.

Before beginning AMNF training, individuals must review the UBC Emergency Response Procedures (red flip book next to the EME 1215 entrance) and UBC Emergency website

(<http://emergency.ok.ubc.ca/welcome.html>).

Access to the AMNF facility is granted after completion of the AMNF safety orientation and verification that the UBC Chemical Safety Course and practical have been completed. To schedule the AMNF safety orientation, fill out a ticket request at <https://osticket.ok.ubc.ca/apsc/>.

1.2 User Policies.

Access. Access to the AMNF is permitted for designated individuals:

i. Trainees. Trainees are permitted to enter the AMNF for equipment-specific training with Senior-user supervision. The trainee must at all times be directly supervised by a senior user.

ii. Users. Users are permitted to enter the facility to use the equipment for which they have been trained. In order to have status changed to user, individual must book a session with the technician in charge to show competency. The user must be able to properly use the piece of equipment in a safe manner to not cause harm to the instrument or to themselves. Please submit a ticket at <https://osticket.ok.ubc.ca/apsc/> for the request to become user.

iii. Senior-users. Senior-users are permitted to enter the facility to use the equipment for which they have been trained and to give equipment-specific training to Trainees. In order to have status changed to senior user, individual must book a session with the technician in charge to show competency. A senior user will have extensive knowledge of all aspects of the instrument and must be able to teach trainees how to properly use the equipment. Please submit a ticket at <https://osticket.ok.ubc.ca/apsc/> for the request to become user.

Access records for Trainees, Users, and Senior-users are kept by support staff. Additions, changes or deletions to these records should be reported to **David Zinz (david.zinz@ubc.ca)**.

Booking. An online booking system is used. <https://bookings.ok.ubc.ca/amnf/>. All equipment must be booked prior to entering the facility.

i. If the user knows they will be late for their booking time, they may update the booking system or leave a note indicating they were delayed and still intend to use the equipment. If the user is more than 30 minutes late with no indication they still intend to use the equipment, they will lose their spot and another user can use the equipment.

ii. Booking and not using the facility can lead to disciplinary action.

iii. If a user is using the facility and has not booked the equipment and someone else books the equipment, the user who books the equipment has the right to use the equipment.

iv. Be considerate of the time you book. If you wrap up early, adjust the booking schedule as someone else may be wanting to use the facility. If you are running late and there is a user waiting to use the facility be considerate and make arrangements with the next user.

Tracking. Individuals must login and logout for their specific equipment and provide all the requested details to facilitate tracking of usage and diagnoses. Report any equipment issues or other concerns to <https://osticket.ok.ubc.ca/apsc/>. All systems use a tracking sheet. Failure to completely fill out the sheet will result in disciplinary actions.

Entry. Upon entry, individuals will confirm that the facility they are **entering is in the class 100 operational state** being clean, orderly and safe. Chemicals, glassware, samples, etc. should be in their proper locations and all surfaces should have been wiped clean. Deviations from this state should be reported immediately to **David Zinz (david.zinz@ubc.ca)**. Unlabeled chemicals and spills are assumed toxic and proper disposal procedures will be initiated by staff. In such cases, login records will be checked and disciplinary actions (e.g., revoked access) may be taken. Proper use of gowning area is expected.

Exit. Upon exit, individuals must confirm that they are **leaving the facility in the class 100 operational state** being clean, orderly and safe. Chemicals, glassware, samples, etc. should be in their appropriate locations and all surfaces should be wiped clean. Deviations from this state may result in disciplinary action.

Samples, chemicals, consumables and glassware. Facility users are to have purchased samples, chemicals, consumables, glassware, etc. for their use alone. Plan your process to ensure that you have the necessary items. **Items can only be borrowed from others with owner permission.** All samples, chemicals, consumables and glassware must be labeled with the user group name and stored in the user group storage space.

MSDS records. Users must **provide up-to-date MSDS records** for all their chemicals to the “MSDS and Chemical Inventory Binder” near the cleanroom entrance. MSDS records must be no more than three years old. Canada is in a transition away from MSDS records to a new Globally Harmonized System, GHS, where current MSDS are replaced with Safety Data Sheets, or SDS. Every user should enrol in the WHMIS 2015 short course offered by UBC to familiarize themselves with the new system.

<http://riskmanagement.ok.ubc.ca/register/whmissafety.html>

Process labeling. Chemical processing of an extended duration (unattended) should be placed in a safe location of the fume hood or work bench and labeled with the following information: i. chemical name, ii. date, iii. user name and contact information, and iv. the statement “See MSDS”. Unlabeled samples will result in disciplinary action.

Buddy system. The AMNF has a buddy system. AMNF users must have another individual (buddy) in the cleanroom proximity be aware and familiar with their work. The buddy must understand the nature of the work, understand emergency procedures in case of spills/accidents and be willing to monitor all safety protocols. If a buddy is not available, please contact one of the technicians to regularly check on you.

Personal care and attention to chemical and cleanroom protocols. Personal listening devices (e.g., iPod) and dirty footwear/clothing are not permitted in the cleanroom. All users must adhere to proper class 100 cleanroom gowning procedures before entry (with NO exceptions). Users carrying out chemical processing must adhere to their chemical-specific training procedures with the appropriate safety accessories (e.g., face shields, gloves, aprons, etc.). Users not following safety procedures will have their access revoked. This action will be sent to the appropriate authority for further training or other actions as deemed necessary.

Hours of operation. Equipment within the AMNF is available for use only during the work week from 08:30-16:30.

Surveillance. The AMNF uses video surveillance. All users will be recorded while using the facility. Special arrangements can be made for a user who does not wish to be recorded while using the facility.

2.0 Cleanroom Operations.

2.1 Introduction.

(source: [www.coastwidelabs.com/Technical Articles/Cleaning the Cleanroom.htm](http://www.coastwidelabs.com/Technical%20Articles/Cleaning%20the%20Cleanroom.htm), reproduced in part)

A cleanroom is an environment in which the concentration of airborne particles is controlled to specified limits. Eliminating sub-micron airborne contamination is really a process of control. These contaminants are generated by people, process, facilities and equipment. They must be continually removed from the air.

The level to which these particles need to be removed depends upon the standards required. The most frequently used standard is the Federal Standard 209E. The 209E establishes classes of air cleanliness of airborne particulate levels in cleanrooms. Strict rules and procedures are followed to prevent contamination of the product.

The only way to control contamination is to control the total environment. Air flow rates and direction, pressurization, temperature, humidity and specialized filtration are all tightly controlled. Sources of particles need to be eliminated whenever possible. There is more to a cleanroom than air filters. Cleanrooms are planned and manufactured using strict protocol and methods. They are frequently found in electronics, pharmaceutical, biopharmaceutical, medical device industries and other critical manufacturing environments.

The AMNF is a class 100 cleanroom environment. Typical office building air contains from 500,000 to 1,000,000 particles (0.5 microns or larger) per cubic foot of air. A Class 100 cleanroom is designed to never allow more than 100 particles (0.5 microns or larger) per cubic foot of air. Class 1000 and Class 10,000 cleanrooms are designed to limit particles to 1000 and 10,000, respectively.

A human hair is about 75-100 microns in diameter. A particle 200 times smaller (0.5 micron) than the human hair can cause major disaster in a cleanroom. Contamination can lead to expensive downtime and increased costs. In fact, the billion dollar NASA Hubble Space Telescope was damaged and did not perform as designed because of a particle smaller than 0.5 microns. A cleanroom must be maintained and cleaned to the same high standards.

What is contamination? Contamination is a process or act that causes materials or surfaces to be soiled with contaminating substances. There are two broad categories of surface contaminants: film and particulates. These contaminants can produce a "killer defect" in a miniature circuit. Film contaminants of only 10 nm (nanometers) can drastically reduce coating adhesion on a wafer or chip. It is widely accepted that particles of 0.5 microns or larger are the main target. However, some industries are now targeting smaller particles.

A partial list of source contaminants is found below. Preventing these contaminants from entering the cleanroom is the objective. It requires a commitment by everyone entering the cleanroom. Strict procedures should be followed whenever entering a cleanroom. ***Compromise is not acceptable in a cleanroom.***

Sources of contamination. It is found that cleanroom contaminants are generated from five basic sources:

1. Facilities—such as walls, floors, ceilings, paint and coatings, construction material (sheet rock, saw dust etc.), air conditioning debris, vapors, spills and leaks;
2. People—skin flakes and oil, cosmetics and perfume, spittle, clothing debris (lint, fibers etc.), hair;
3. Tools—friction/wear particles, lubricants and emissions, vibrations, brooms, mops and dusters;
4. Fluids—Particulates floating in the air, bacteria, organics and moisture, floor finishes or coatings, cleaning chemicals, plasticizers (outgasses), deionized water;
5. Products—silicon chips, quartz flakes, cleanroom debris, aluminum particles.

Key elements of contamination control. We will look at several areas of concern to get a better idea of contamination control. These are the things to be considered when providing a contamination control program.

1. **HEPA (High Efficiency Particulate Air Filter)**—These filters are important for maintaining contamination control. They filter particles as small as 0.5 microns with a 99.97% minimum particle-collective efficiency.

2. **CLEANROOM ARCHITECTURE**—Cleanrooms are designed to achieve and maintain an airflow in which essentially the entire body of air within a confined area moves with uniform velocity along parallel lines. This is laminar flow. The more restriction of air flow, the more turbulence. Turbulence can cause particle movement.

3. **FILTRATION**—In addition to the HEPA filters commonly used in cleanrooms, there are a number of other filtration mechanisms used to remove particles from gases and liquids.

4. **CLEANING**—Cleaning is essential to contamination control. Decisions need to be made about the details of cleanroom maintenance and cleaning. Applications and procedures need to be written and agreed upon by cleanroom management and contractors. Managers need to answer the following questions before proceeding with any cleanroom cleaning program: What is clean? How is clean measured? What cleaning materials can be used in the cleanroom? When can the cleanroom be cleaned? How frequent does it need to be cleaned? Thorough cleaning will be conducted by the School of Engineering technicians. However, each user is responsible for cleaning after every use.

5. **CLEANROOM GARMENTS**—Know the garment requirements of the cleanroom. Gloves, face masks and head covers are standard in cleanrooms. Smocks are often used. Jump suits are required in very clean environments.

6. **HUMAN ACTIVITY**—There are physical and psychological concerns in cleanrooms. Physical behavior like fast motion and horseplay increase contamination. Psychological concerns like room temperature, humidity, claustrophobia, odors and attitude are important. People are a major source of contamination in the cleanroom. In the activities listed below, notice the number of particles produced per minute during these activities:

ACTIVITY	PARTICLES/MINUTE (0.5 microns and larger)
Motionless (standing or seated)	100,000
Walking about 2 mph	5,000,000
Walking about 3.5 mph	7,000,000
Walking about 5 mph	10,000,000
Horseplay	100,000,000

7. **COMMODITIES**—Care is taken when selecting and using commodity items in cleanrooms. Wipers, cleanroom paper and pens and other supplies that service the cleanroom should be carefully screened and selected. Review of the local cleanroom requirements for approving and taking these items into the cleanroom are essential. In fact, many cleanroom managers will have approval lists of these types of items.

8. **COSMETICS**—Many cosmetics contain sodium, magnesium, silicon, calcium, potassium or iron. These chemicals can create damaging particles. Cleanroom managers may ban or restrict cosmetics in the cleanroom. This is usually dependent upon the threat to the product being made in the cleanroom. A recent mirror on a space telescope was fogged up from the cologne that was present in the cleanroom.

9. **MEASUREMENT AND INSTRUMENTATION**—Some important measurements for contamination control are particle count, air flow, humidity, temperature and cleanliness. It is necessary to monitor/control these factors.

10. **ELECTROSTATIC DISCHARGE (ESD)**—When two surfaces rub together an electrical charge can be created. Moving air creates a charge. People touching surfaces or walking across the floor can create an electric charge. Special care is taken to use ESD protective materials to prevent damage from ESD. Managers should work with their personnel to understand where these conditions may be present and how to prevent them.

2.2 General Cleanroom Regulations.

General cleanroom regulations:

1. Personal items (Cell phones, laptops, keys, watches, rings, matches, lighters and cigarettes) should be stored outside the cleanroom.
2. Valuable personal items such as wallets may be permitted in the cleanroom provided they are NEVER removed from beneath the cleanroom garments.
3. NO eating, smoking, gum chewing, or personal earphones are allowed inside the cleanroom.
4. Only garments approved for the cleanroom should be worn when entering.
5. NO cosmetics shall be worn in the cleanroom, including but not limited to: rouge, lipstick, eye shadow, eyebrow pencil, mascara, eye liner, false eye lashes, fingernail polish, hair spray, mousse, or strong aerosols, after-shaves and perfumes.
6. Only approved cleanroom paper shall be allowed in the cleanroom.
7. Pens are the only writing tool to be used.
8. Use of paper or fabric towels is prohibited. Cleanroom wipes must be used.
9. Gloves should not be allowed to touch any item/surface that is not clean. Use only approved gloves, finger cots (powder-free), pliers, tweezers to handle products. Fingerprints are a major source of contamination.
10. Solvent contact with the bare skin should be avoided. They can remove skin oils and increase skin flaking. Approved skin lotions or lanolin based soaps are sometimes allowed. These can reduce skin flaking.
11. All tools, containers and fixtures used in the cleaning process should be cleaned to the same degree as the cleanroom surfaces. All of these items are a source of contamination.
14. NO tool should be allowed to rest on the surface of a bench or table. It should be placed on a cleanroom wiper.
15. Only cleanroom approved wipes are allowed. The wipes must be approved for the cleanroom.
16. ALL equipment, materials and containers brought into the facility are subject to cleaning prior to entrance.
17. NO ONE who is physically ill, especially respiratory or stomach disorders, may enter the cleanroom.

Personal actions prohibited in cleanrooms:

1. Fast motions such as running, walking fast or horseplay.
2. Sitting or leaning on equipment or work surfaces.
3. Writing on equipment or garments.
4. Wearing the cleanroom garment outside the cleanroom (beyond that of the gowning procedure).
5. Wearing torn or soiled garments.

Cleanroom entry items to note:

1. Cleanroom entry and exit protocols noting the differential pressures between areas.
2. Fire extinguishers.
3. Eyewashes and safety showers.
4. Emergency phone.

5. Process benches.

2.3 Cleanroom Procedures.

Entry. Before entering the cleanroom, ensure that you have eye protection and are suitably attired (long pants, full-coverage shoes, no sandals/flip-flops, no high heels). Remove personal listening devices/earphones.

All gowning is to be carried out in the gowning room. Enter through the curtain to the “dirty” side. Move to the “clean” side after donning boot covers. Then enter into the clean room stepping on tacky mat to remove dust from the bottom of the boot covers.

Don gloves for the gowning procedure. We gown up in “top-down” fashion.

First, put on the hair cover, tucking your hair underneath if appropriate, and beard cover (for men with two or more days of growth). Put on the hood. Fasten the hood closure, and adjust the fit snaps as needed.

Don a coverall of appropriate size that has been assigned to your group, while preventing the coverall from contacting the floor as much as possible. Fasten the coverall with the front zipper, ensuring the hood tails are completely tucked in to the neck of the coverall. Use the mirror to verify that you are “tucked in” completely.

Finally, put on the boots over your shoe covers. Use the adjustable strap to secure the lower part of the boot against your foot and shoe. Tuck the coverall into the top part of the boot, fasten the top of the boot to the bottom of the coverall with the snaps provided, and secure the top strap snugly with its snap.

Now you are ready to step onto the next tacky mat and walk into the cleanroom (using your Salto Access Card).

Exit. The degowning procedure is the reverse of the gowning procedure. While still gloved, remove your garments in “bottom-up” fashion – remove the boots then the coveralls (being careful to not let it contact the floor). Finally, remove the hood, and snap it to the coverall as well. Remove the shoe covers, gloves, and hair/beard cover.

2.4 Chemical Safety and Handling Procedures.

The following document provides chemical handling instructions from storage through disposal. The procedures ensure the safety of everyone. Individuals admitted to the facility should be familiar with the procedures. Reading these procedures in no way qualifies you to enter or do any work in the cleanroom, although it is a pre-requisite.

Chemical storage. Bottles of acid or caustic chemicals should be transported between storage locations using a single nitrile glove to allow the user to have one ungloved free hand to open doors. Chemicals are to be stored in chemical cabinets. Chemical bottles should be rinsed/wiped prior to being placed back in the cabinet. Bottles should be returned to the storage location immediately after use. We have four chemical storage locations:

- i. Acids. These are stored in the acid storage cabinet below the fume hood outside the cleanroom.
- ii. Cleanroom flammables/solvents. These are stored in the yellow cleanroom flammables cabinet.
- iii. Exterior flammable/solvents. These are stored in the yellow exterior flammables cabinet.
- iv. Photoresists and sensitive polymers. These should be stored in the cleanroom refrigerator to preserve their life.

Chemical labeling. All chemicals in and around the benches must be properly labeled and covered whenever you are not using them. **This is not optional.** Label your glassware with the following information:

- i. chemical name(s),
- ii. date,
- iii. your name and contact info,
- iv. the statement “see MSDS”.

When you empty a bottle of chemical, it is your responsibility to dispose of the empty bottle. You must rinse the bottle with water at least 3 times. The rinsate can be poured down the drain. After rinsing you must deface or remove the bottle's label and place the bottle in the designated empty bottle storage area. When you are beginning a chemical process, be sure that you have a proper waste bottle ready and available.

Personal protective equipment. Chemical tasks have special requirements for personal protective equipment. Proper personal protective equipment reduces the risk of injury in the event of a chemical accident. Eye protection is mandatory at all times and in all locations in the ANMF.

All users working or observing at the fume hood are required to wear safety glasses, a face shield, a chemical apron, and the heavy green nitrile gloves. If you are using "less-dangerous" chemicals you must still use the full personal protective equipment if there are "more dangerous" chemicals in the vicinity.

Personal protective equipment should be put on in the following order: goggles, apron, face shield, green nitrile gloves. Upon completing your work, rinse and dry contaminated green nitrile gloves and remove them before taking off the face shield and apron to avoid touching the apron and shield with contaminated green nitrile gloves.

Emergency Eye Wash Procedures. All chemical eye contaminations can be treated with the eyewash station **except** the following: a foreign shard such as a metal/glass (for which you must cover both eyes and contact first aid at 250-807-8111 or 78111 local); any chemicals that are reactive with water (this information can be found on your MSDS records). For all other chemical eye contaminations, carry out the following eyewash procedures:

1. Bring the person to the eyewash station and turn it on. There are two eye wash stations in EME 1215. One is in the alley on the entrance side and the other is located through a burst door on the south end of the room near the fume hood. The burst door is the best option if a chemical enters the eyes at the fume hood.
2. Have the person hold their eyes open and place their eyes in the stream of water.
3. Continue flushing for 15-20 minutes. As the natural tendency is to stop treatment prematurely, ensure that they are supervised during the process. You may have to help hold the person's head in the eyewash station.
4. Send a bystander to get the MSDS for the chemical that was splashed and call for first aid, 250-807-8111 or 78111 (local). If the individual is sent for medical aid, send the MSDS with them.
5. If water has pooled on the floor, contact Facilities Management after the incident to ensure it is contained.

Emergency Drench Shower Procedures. If a chemical has splashed onto clothing it can damage or penetrate the skin and cause serious injury. All chemical splashes can be treated with the Emergency Drench Shower **except** the following: any chemicals that are reactive with water (this information can be found on your MSDS records). For all other chemical splashes, carry out the following emergency drench shower procedures:

1. Bring the person to the Emergency Drench Shower and turn it on. There are two shower stations in EME 1215. One is in the alley on the entrance side and the other is located through a burst door on the south end of the room near the fume hood. The burst door is the best option if a chemical is splashed onto clothing at the fume hood.
2. Put the person in the shower and have them take off all of their clothing.
3. Send a bystander to call for first aid (250-807-8111 or local 78111).
4. Have the individual scrub to remove as much chemical as possible.
5. The shower is cold; you will likely have to hold the individual in the shower.
6. Send a bystander to get the chemical's MSDS. If the individual is sent for first aid, send the MSDS with them.
7. Continue showering for 15-20 minutes (there is a natural tendency to stop treatment prematurely).
8. If possible have a bystander gather clothing, towels or blankets to cover the showering area and to cover them.
9. If water has pooled on the floor, contact Facilities Management **after** the incident to ensure water is contained.

Chemical MSDS information repository. All chemicals brought into (or around) the cleanroom must have Material Safety Data Sheet (MSDS) records. The information cannot be more than three years old. Users are responsible for acquiring and supplying their own MSDS information. The hardcopy is to be added to the **MSDS and Chemical Inventory Binder** near the entrance to the cleanroom.

Minor spills. In the event of a minor (non-hazardous) spill that can be safely cleaned, carry out the following:

1. Ensure your own personal safety.
2. Evacuate the area and post warnings if necessary.
3. Isolate spill from surrounding personnel and equipment to minimize damage.
4. Perform a risk assessment: What chemical was spilled? How much was spilled? What are the hazards?
5. Determine appropriate cleanup procedure to contain and control the specific spill type:

i. Solvents

- Get the Spill-X S Kit (Solvent Spill Kit). Create a dam to control the spread and to absorb the liquid.
- Control fire hazards in the surroundings.
- Do not allow solvents to contact metals.

ii. Acids (for hydrofluoric acid, isolate the spill and contact Campus Security at (250)-807-8111.

- Get the Spill-X A Kit (Acid Spill Kit). Use the pH test to confirm that the pH is less than 7.
- Use the acid neutralizer to neutralize the spill.
- Retest the pH and repeat neutralization until the pH is between 5 and 8.
- Absorb and scoop into appropriate waste container.
- Ensure that the site, your personal protective equipment and the spill equipment are clean.

iii. Caustics

- Get the Spill-X C Kit (Caustic Spill Kit). Use the pH test to confirm that the pH is greater than 7.
- Use the caustic neutralizer to neutralize the spill.
- Retest the pH and repeat neutralization until the pH is between 6 and 8.
- Absorb and scoop into appropriate and labeled waste container.
- Ensure that the site, your personal protective equipment and the spill equipment are clean.

6. Arrange material disposal with the Risk Management Hazardous Waste Inventory System.

7. Report the spill using the UBC Spill Reporting, www.ubc.ca/okanagan/hse/environment/spills.html.

If the appropriate spill cleanup equipment and/or personnel is not available, the spill cleanup should not proceed. Contact the AMNF technician, David Zinz, 250-807-8047, and isolate the area. Do not attempt a spill cleanup.

Major Spills. In the event of a spill that releases chemicals that pose an immediate risk to health or involves an uncontrolled fire or explosion, proceed with the following:

1. Call Campus Security at (250)-807-8111 and give details of the accident including location, types of hazardous materials involved, and whether there is a personal injury.
2. Evacuate the area.

3. Care for the injured:

- Move the victim from the area of fire, explosion, or spill (if this can be done without further injury to all people).
- Locate the nearest emergency eyewash or safety shower.
- Remove victim's contaminated clothing and flush all contaminated body areas with copious water (according to Emergency Shower Drench Procedures above).

Hazardous Waste Disposal. Consider the following instructions for day-to-day disposal of hazardous waste.

- i. For liquids, neutralize acids/caustics until non-hazardous and dispose in the drain. All other liquids must be placed in disposal containers and labeled with components, percentages, and your name/contact information.
- ii. For solids, place items in the appropriately labeled 20L pail with powders in secondary containers. Advise Risk Management when the pail is full.
- iii. For sharps, carefully place the sharps in the chemically-contaminated sharps container.

Hazardous Waste Pickup. Hazardous waste is any product, substance or organism that is dangerous to the environment or humans and that is no longer useful. Hazardous waste can be dangerous because of its quantity, concentration, physical, chemical, or infectious characteristics. Hazardous waste is dealt with by Risk Management at UBC's Okanagan campus. Hazardous waste that is not accepted by Risk Management is unknown solids or liquids, explosives and potentially explosive materials, and compressed gas cylinders/bottles.

Consult Risk Management before pouring anything down the drain that is against the law to throw away or otherwise harmful in our water supply. Corrosives must be neutralized to have a pH of 6-8 before it can be discharged in the drain with plenty of water. Consult Risk Management with your neutralization plan prior to implementation. Also collect hazardous solutions in containers and send them to Risk Management for proper disposal.

If you have excess chemicals or by-products that need disposing, follow these steps:

1. Request a pickup online from Risk Management.

<http://riskmanagement.ok.ubc.ca/environment/hazardousmaterials.html>

2. Login and follow the four steps (Click New User if you are new or login under Existing User):

- i. Read the hazardous waste inventory guidelines BEFORE proceeding;
- ii. Confirm your information is correct and then proceed to the "Pickup Option" by clicking on "Next";
- iii. Enter detailed and complete chemical waste information;
- iv. Check, confirm and submit your request.

3. Input COMPLETE chemical information.

4. An approval email will be send back to you from Risk Management.

5. Use the approval form to segregate chemicals by hazard class.

6. Ensure the package is less than 10 kg.

7. Affix the approval form to the waste.

8. Risk Management will, in most cases, come by your lab to pick up the waste within one week of request.

For liquid chemicals, segregate halogenated and non-halogenated chemicals.

For glass waste, dispose of chemically contaminated glassware in 20 L white plastic pails provided by Risk Management.

Fire. The AMNF is equipped with a clean agent fire extinguisher. No residue will be left after using this extinguisher and this type should be the only type used inside the clean room. Use the fire extinguisher only if it is safe to do so. The clean agent fire extinguisher has a low level of toxicity; it can however displace oxygen. Do not use on a person. The airflow of the cleanroom is sufficient to supply ample oxygen to the user. If the fans are turned off, do not use the fire extinguisher inside the clean room as oxygen can be displaced. Exit the clean room immediately after using the extinguisher. If the fire is outside the clean room, and if it is safe to do so, use the extinguisher on the wall of 1215.

2.5 Cleanroom Layout.

The AMNF in the Engineering Management Education (EME) room 1215 is comprised of an alley and cleanroom.

The alley contains all consumables, garments and most of the external equipment for the operation of the cleanroom.

The cleanroom facility shown in the figure below contains four stations:

- i. Station 1, Deposition, Sputter System, Angstrom Engineering NEXDEP – for thin film deposition,
- ii. Station 2, Photolithography, Mask Aligner, OAI Model 204 – patterning micro-features via UV photolithography,
- iii. Station 3, Chemical processing – fume hood for chemical etching and processing with caustic chemicals,
- iv. Station 4, Wire Bonder – used to make electrical connections,
- v. Station 5, Microscope – Zeiss stereo microscope,
- vi. Station 6, Profilometer – surface measurements,
- vii. Station 7, Laser Micromill – Oxford Lasers micro machining station.

Stations must be booked prior to usage. Booking is carried out with AMNF online calendars.

Stations must be signed-in/out. Use the AMNF website to track your equipment usage and status. You must sign-in and out at the start and completion of your processing and record any requested tools status details. Note that certain tools may also have a logbook in their proximity to record details.

3.0 Disciplinary Procedure.

3.1 Introduction.

The clean room, AMNF, is used by many groups for different purposes. Safety is the main concern when working in the clean room. All safety protocols are expected to be followed. With many users utilizing the space, it is expected that the clean room remains tidy and ready for the next person to use. Failure to follow common courtesies, safety protocols, proper use of equipment and UBC's policies and procedures will lead to disciplinary actions. A user may be expelled from the facility even if the facility is needed for the user to graduate.

3.2 Process.

To enforce the protocols outlined in the AMNF Operations and Safety Protocols handout, a strike policy will be in effect. A strike will be issued, in writing, outlining the concern and what corrective actions are required. The user will have three warnings, or strikes, that their use of the clean room is not up to protocols. On the second and third infraction, the user's supervisor will be informed that infractions have occurred and if another infraction happens the user's privilege of using the clean room will be revoked. On the fourth infraction, clean room access will be

revoked for a period of time. A meeting will be held with the user, user's supervisor along with managers of the clean room. The length of the suspension will be determined at this meeting, usually less than 1 month. After the suspension, access will be reinstated. If a further three strikes are issued, permanent ban from the facility will be instated (on the third strike), regardless of why the user needs to use the facility. At each strike following the first suspension from the clean room the user's supervisor will be informed of the misuse of the facility. The managers have the right to revoke access at their discretion, without strictly adhering to the procedure above.

All disciplinary actions will be documented. The user will sign to acknowledging the errors and what corrective actions are needed to ensure proper use of the clean room. A letter will also be sent to the user's supervisor outlining the situation. There will be no tolerance for those who fabricate scenarios to get someone else in trouble. All reported incidences will be kept anonymous so backlash will not occur. It is not our goal to punish people, it is simply so that everyone can have a positive experience in a safe work environment. The rules and regulations are outlined in the Operation and Safety Protocols handout, which is available both inside and outside the clean room. All UBC policies and procedures apply when using the clean room and the disciplinary procedure outlined above will be used to enforce them.