

Cleanroom Charter

Microfabrication Facility

Center for Microelectronics Materials
& Structures

Yale University

This document is an outline for the use and management of the Microfabrication Facility (MFF) at Yale University. You should familiarize yourself with this document before entering and working in the MFF. In order to make the MFF a safe, efficient and reliable place to work, the rules and guidelines written in this document will be followed. This document presents an overview for the newcomer, and it contains the general rules for working in the MFF. To learn more about the detailed operating procedures for each piece of equipment inside the MFF, please see the *Clean Room Procedures*, available from the Cleanroom Committee (CRC).

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General Information

Information contained in this section gives you a general idea about the function and use of the Microfabrication Facility (MFF). The contents of this charter may be changed by a majority vote of the cleanroom committee and approved by the MFF faculty. All modifications of this document will be reported in memos and the document will have the appropriate changes made on-line. A master copy will be available to the Chairman of the Cleanroom Committee. A new cover page indicating the revision and a new page with changes will be issued for any hard-copy versions that may exist. All users are expected to be familiar with and will be held responsible for all published policy changes.

1.1 Cleanroom Committee

The governing body of the MFF is the cleanroom committee (CRC) and it is responsible for the safety and operation of the MFF. The committee consists of a faculty adviser, the MFF manager, and at least one graduate student from each research group involved with the MFF. Each faculty member appoints at least one of his/her students to serve on this committee. Typically, there can be more than one student from any one group in order to promote continuity as students graduate or terminate their involvement with the cleanroom. One of the graduate students is appointed as Chairperson of the Committee. The Chairperson is responsible for calling all meetings and setting up subcommittees as necessary to manage the operation of the cleanroom.

To alleviate and lessen the workload of the Chairperson, the MFF manager is responsible for the facilities and utilities in the cleanroom and also serves as advisor to the Chairperson for the routine day to day operation.

1.2 Safety

Glasses and gloves **must** be worn in the MFF at all times. Failure to use glasses or gloves will result in disciplinary action by the CRC that may lead to a curtailment in privileges or disbarment.

Glasses are necessary due to the use of chemicals, vacuum systems, and high-pressure gases in the MFF. Contact lenses are also prohibited in the cleanroom area. Safety goggles will be worn when working with chemicals in the wet bench stations. Face shields will also be used when working with acids and caustics. Other safety equipment will be worn as dictated by the Material Safety Data Sheets (MSDS) that have accompanied the chemicals. If not available, check the MSDS listing in the cleanroom.

Vinyl gloves that are typically worn in the cleanroom are necessary to protect you from residual chemicals that may be present. They also keep oils from the hands from being transferred to working surfaces that contaminate electronic devices during processing. These gloves are NOT to be considered safety equipment when working with chemicals; they will only protect one from trace amounts of chemicals. The proper gloves **MUST** be obtained and worn prior to working with the chemicals. This information may be obtained from the MSDS.

1.3 Alarm System

All fire alarms in the cleanroom are equivalent to the fire alarms in the rest of the building. If the alarm is pulled in the cleanroom, the building alarm goes off and the fire department responds. If the building alarm is pulled, the cleanroom alarms sound. As a precaution, you should turn off your equipment and exit the building using the stairs whenever the alarm sounds as quickly as possible. Do NOT continue with your experiment and DO NOT USE THE ELEVATOR!

1.4 Gowning

All users of the MFF must be properly attired. In clean areas, this means gowning in a cleanroom suit (hood, jumpsuit, boots, safety glasses, and gloves). Failure to wear the proper attire will result in disciplinary action being taken against you. You may enter the service chases while gowning from the cleanroom if necessary. The service chases may also be entered from the back hall in street clothes provided paper booties are put on first.

1.5 Use of Equipment

Please do not touch or use equipment you are not authorized to use. This means that you are not authorized to operate equipment without the permission of the equipment master. Prior to authorization, you will be trained in the operation of that equipment. Once the master has determined your capability, you will be granted permission in writing. The master, whose name is listed on the equipment, has sole discretion as to whether or not you are qualified.

1.6 Hours of Operation

No one may work in the cleanroom during unauthorized hours. Unauthorized hours are normally Thanksgiving Day, Christmas Eve and Christmas Day as well as New Year's Day. We do this so that we are not trying to find personnel to respond to emergencies. On these holidays, it is difficult if not impossible to find those who would help us should an emergency arise.

1.7 Persons Allowed in The Microfabrication Facility

The above rules apply to everyone in the MFF. In order to delineate responsibility and privileges further, users are divided into categories based on their experience and needs.

General Users – A general user is someone who is issued the key card to the MFF and allowed to work in the MFF without supervision. The general user must meet all the criteria in section 2.1.

Special Users – The special users include all short-term working visitors and trainees. A special user is allowed to work in the MFF under the supervision of a general user who is responsible for training the special user. The “trainer” is responsible for the trainee's conduct and safety in the MFF. The special user must know the location, function and use of fire alarms, fire extinguishers, panic buttons, and spill control stations. The special users may use equipment they have been authorized to use by the appropriate master.

It is possible that a short-term working visitor may need to work independently in the MFF without supervision. In such a case it must be explained to the CRC why this is necessary and inform them about the processes that will be performed in the MFF. The CRC will review the request and determine if it is reasonable. If the request is granted the special user must pass all the qualification procedures in section 2.1 and observe all the regulations required of the general users. In addition, all special users must obtain permission from the CRC before a process is modified or a new process is introduced. On the completion of the work in the facility, the special user must withdraw all personal belongings and unnecessary experimental setups from the lab and inform the CRC of their departure.

Visitors – A visitor is someone who is just visiting the facility. This may include prospective graduate students, visitors from industry, curious faculty, etc. A general user, the MFF manager, or any MFF faculty **must** accompany the visitor. **A visitor may not touch or operate any equipment unless he/she is a maintenance visitor.**

Maintenance Visitor – A maintenance visitor is someone who is allowed into the MFF for the specific purpose of fixing or maintaining equipment. They may only touch or operate the equipment for which they are responsible. A maintenance visitor will be supervised by the appropriate equipment master or by the MFF manager, or another duly qualified individual appointed by them. The maintenance visitor should notify the CRC of any new parts, tools, or equipment going into the cleanroom.

1.8 How to Gain Access

If you wish to use the MFF, this document will guide you through the necessary procedures to accomplish your goal. If you need more information, contact a member of the CRC. All persons wishing to use the MFF as a general user must meet the qualification procedures outlined in section 2.1.

Should you want to use any chemicals not provided for, you must bring this to the attention of the CRC committee. The CRC committee also has information about the equipment and chemicals available in the MFF.

2 General User Qualifications

The following qualifications must be met before lone entry into the cleanroom will be allowed. Lone entry to the cleanroom does not imply qualification to operate any equipment located inside. To become qualified to use the equipment, the general users must meet the equipment masters' expectations for a particular machine. The operational procedures for the equipment are documented in the *Cleanroom Procedure*, which can be obtained from the CRC or found on-line.

2.1 Criteria

Since the general user is the only type of user allowed in the MFF without supervision, the standards for this type of user are tough and stringent. Before becoming a general user, one must meet the following criteria:

- Safety
 1. Glasses and Gloves – The general user, as well as special users, guests and visitors, must always wear glasses and gloves in the MFF. Contact lenses are not allowed in the cleanroom.
 2. Safety Features – The general user must know the location and function of all fire extinguishers, fire alarms, panic buttons, eye washes, safety showers, first aid kit and spill control stations in the MFF.
 3. Chemicals – All general users must know all the characteristics of standard chemicals found in the cleanroom. (e.g. flammability, toxicity, special handling needs).
 4. Spill Control – The general user must know the spill control procedure for all chemicals commonly in the MFF. The user must know the spill procedure for the chemicals used in their process; especially those not commonly found in the cleanroom. Procedures for spill control can be found in Section 5.
 5. Processing – The general user must notify the CRC of his/her processing procedure. Any changes in this procedure (new chemicals, equipment, etc.) must be brought to the attention of the CRC for prior approval. This is necessary since the CRC must oversee the use of the entire MFF in order to insure that no process or use is detrimental to the safe operation of the lab.

- Operation
 1. Basics – The general user must understand and strictly follow the procedures of entering and leaving the MFF (sections 3&4). General users must not work in the MFF during unauthorized hours as specified in Section 1.6.

2. Equipment – The general user may not operate, without supervision of an equipment master, a piece of equipment until he/she has been certified in its use by the master of the equipment. The qualification of the general user to use the equipment is at the discretion of the master. This applies to all the process and test equipment in the MFF, such as wet benches, mask aligners, furnaces, evaporators, etc. The qualification procedures for all the equipment can be found in *Cleanroom Procedures*, which can be obtained from the CRC.
3. Supervision – If a general user wished to supervise a visitor, the general user is responsible for the conduct and safety of the person being supervised. The general user may only train one special user at a time at the wet benches and two at a time elsewhere in the cleanroom.

- Maintenance

1. Responsibility – The proper operation of the cleanroom is the responsibility of all users. It is the responsibility of all users to make sure that things are done properly. In some cases, responsibility, such as changing the sheets on the tack mats, is shared among several users. All general users take turns as person of the week (POW) during which time they are responsible for performing general maintenance and cleaning. Instructions for this procedure can be found in the cleanroom procedures and the POW checklist. In case the designated person cannot perform the duties of POW for the designated week, that person is responsible for finding a replacement. Failure to perform POW duties will result in a warning and an extra week of duty. A second failure will result in further disciplinary action with possible loss of cleanroom privileges.

It is expected that all users will clean up after themselves and restore the working area to the condition it was found. If equipment is inadvertently broken, make plans to fix it. If you cannot fix it, you will be required to be available to assist in the repairs. If it was your equipment that was broken by someone else, think of how you would feel. It is the responsibility of all users to be mature and admit their mistakes. This is an educational institution; we learn by our mistakes as well as by studying.

DO NOT COVER UP MISTAKES! This can result in disciplinary action including loss of cleanroom privileges.

If any user recognizes any potential problems, please bring them to the CRC's attention so that they may be resolved.

2. Supplies – The general user must know the location of the supply sheet and make note whenever there is a shortage of cleanroom supplies. General users may be assigned to make sure one or more

items are stocked properly. Should that item run low, it is the assigned general user's (Supply Master) responsibility to re-order.

3. Equipment Failure – The general user shall notify the master of the malfunctioning equipment in case of failure. The general user will also notify the building manager in the event of loss of gas, water, or electrical. The MFF manager will be notified in the event of loss of DI, house vacuum or chilled water. If the nitrogen is low, it is YOUR responsibility to make the switch-over. Generally, if the liquid nitrogen is low in both tanks it is the responsibility of the POW to alleviate the condition. However, if there has been power outage and several people are regenerating cryo-pumps, the high usage may not have been noticed by the POW. Don't allow the cleanroom to run out of nitrogen. If you can't find the POW, please obtain a dewar and start the transfer. It's your cleanroom too. And remember, you don't have to be the POW to perform a switch-over.
4. Tool Box – A general toolbox for the use of all users is kept in the cleanroom. These tools are not to leave the cleanroom. Since the tools are for everyone, tools will be returned to the box immediately after use and care should be taken to keep the box in an orderly fashion. If you find the box in disarray, it is your responsibility to take a couple of minutes to clean it up and arrange it. Likewise, if tools are found laying around in the cleanroom, you should put them away. Sometimes it is obvious that they are being used and the user has left to take a break. In this case, leaving them would be justified. But don't let this become a ready excuse for leaving the tools, otherwise we can expect to find a sloppy cleanroom, as this habit will be hard to break.

If you break a tool, report it to the cleanroom committee, they will order a new one. Don't leave it for someone else to discover. Remember, you may need that tool again, and not replacing it may slow down your own research. Also, if you discover that we don't have a tool, enter it on the supply sheet so we can order it.

2.2 Qualification Procedures

To be qualified as a general user, the prospective user must follow these procedures:

1. Appear at a regular CRC meeting to inform them that you are beginning the training process. You have to fill out a new user request form. On the form, you must also outline the process you would like to perform and what equipment you will need to accomplish that process. That way, we will know how to structure your training.
2. Choose a general user to be your primary trainer. It is possible you will have several before you are through. You may take the cleanroom exam when the primary trainer feels you are ready to work in the cleanroom alone.
3. Read all the materials in this document.

4. In the event that you want to be qualified as a wet bench user as well, most people do, you need to read operation procedures for the wet benches and chemical handling procedures. These and other related procedures can be found in the *Cleanroom Procedures*, available from the CRC. Under the supervision of a general user, you must work in the MFF at least three times. Be sure to know all the criterion and rules listed in section 2.1.
5. When, according to the guidelines of this charter, you are ready to take the cleanroom exam, and when you have the need to use the cleanroom on a reasonably consistent basis, ask the CRC to arrange a written as well as a practical test. Inform the CRC if you require wet bench testing for your individual process. These tests are used to evaluate prospective general user's knowledge on all procedures regarding safety, maintenance and operation of the MFF. Those requiring qualification on the use of the wet benches will be tested for their knowledge on chemical handling procedures, chemical safety and operational procedures of the wet bench. Two Senior General Users of the CRC will administer the test. If two General Users are not available, then one General User along with one Principal Investigator or the MFF Manager may be used to administer the test. A unanimous vote from both the examiners is required for the student to become a general user.
6. Any person who fails this test is advised to start over from step 1. People who pass the tests are qualified as general users and are issued a key to the facility.
7. Upon passing the test, the new general user will be appointed a task for which he/she will take responsibility until she/he is no longer a user of the facility. Some users will be responsible for more than one item, depending upon the number of users of the MFF.

Note: The qualification procedures for using the wet benches are the same as the qualification procedures for becoming a general user. Therefore, people who will use the wet benches are strongly advised to take the wet bench qualification test as part of the tests for the general users so they do not have to arrange to take two separate tests.

2.3 Disqualification Procedures

It may become necessary to revoke the privileges of the general user. In order to avoid confrontations later, the general user should be aware of the following:

1. Any violation of the rules listed in section 2.1 must be brought before the CRC. The user will be given a chance to explain his/her actions before the committee. In cases of rules violations, the faculty advisor and/or the MFF manager must be present at the meeting.
2. At the discretion of the CRC, the following actions may be taken:
 - a. The user may be reprimanded. A second violation of the same offense after a reprimand will be cause for suspension.
 - b. The user may have his/her privileges curtailed. In this instance, the general user becomes a special user, and his/her key to the MFF is deactivated until the issue has been resolved as determined by the CRC. In this instance, a majority vote of the CRC is required before privileges have been curbed.
 - c. The user may have all cleanroom privileges suspended. In this instance, a majority vote of the CRC is required for suspensions of up to 14 days. For longer suspensions or expulsion, a vote of the faculty is also required.

3. Reinstatement – The special or former general user may be reinstated. In the case of privilege curtailment, the user may be reinstated after a period determined by the CRC and after passing the written and oral general user exam as per section 2.2. In the case of a full suspension, the former user may not enter the MFF for a period determined by the CRC. In order to become a general user once again the former user must pass the written and oral exams as per section 2.2.

Violations by special users, such as entering the MFF without the proper supervision, must also be brought to the CRC. After the charges are substantiated, CRC may decide by a majority vote to suspend the violator's access to the MFF for up to 14 days. During this period, she/he cannot enter the MFF (even with supervision) or take the qualification tests. After 14 days, his/her privileges as a user resume automatically.

Note: The cleanroom or MFF is a facility for the use of the students and run by the students. Although it is large enough and complicated enough from a facility point of view that there is permanent staff assigned, the permanent staff does not perform the research. Therefore, the lab is governed and operated by students who understand what their research needs are. Therefore, when people operate outside of the rules of the facility, it is up to the students to bring them into conformance with the rules. Safety is mandated by federal, state and local governments; compliance with the rules is mandatory. Otherwise, the essence of the MFF is that it is a student run organization and allows the students to experience the procedures of a commercial cleanroom. It becomes the users' responsibility to ensure the rules are followed in order to achieve the proper output from the cleanroom. The proper output is working devices without harm to fellow students, oneself and the environment.

3 Entering The MFF

Human beings are the largest source of particulate contamination in the cleanroom. Some reports indicate that humans shed 300 particles per second and more when they are very active. To keep this source of contamination to a minimum in the cleanroom, the users must enter the cleanroom properly. In order to enter, specialized garments are worn that act as a barrier to human particles (hair, skin flakes, etc.) and lint from clothing. These garments are not perfect, but they are a good start, providing protection of the cleanroom from the human. The entire cleanroom outfit consists of the following:

1. Coveralls – Body suits that cover the torso, legs and arms.
2. Caps – Worn on top of the head to contain hair. Bearded users are required to wear a hood that covers facial hair.
3. Booties – Disposable covers for the shoes. They are the first layer to contain particles from the shoes. Dedicated cleanroom shoes may be used in lieu of the booties.
4. Boots – Second layer of covers for the feet. Dedicated cleanroom shoes must have boots over them.
5. Gloves – Plastic gloves for the hands. Double gloving is recommended. The purpose is to keep the oils from the hands from contaminating any part of the cleanroom. They also keep skin particles from falling into the clean space or equipment. Double gloving allows you to change gloves without contaminating the surfaces of the cleanroom, including cleanroom clothing. (That's right, gloves should be worn while gowning. That is the procedure at all major semiconductor manufacturers.)
6. Glasses – Safety glasses are required.

The caps, boots, and safety glasses are stored in lockers assigned to each general user. Coveralls are hung on the locker rack. Garments for visitors and maintenance personnel are stored in a separate locker. The locker rack is in the gowning room. The booties are stored in a box near the shoe brush vacuum.

People should wear a minimum amount of clothing under the cleanroom garments. (In many new labs, surgical scrubs are the only clothing allowed under cleanroom clothing. Special cleanroom shoes are worn to eliminate the normal dirt from street shoes and there are special procedures for putting them on.) The dust and lint from clothing is a large contributor of particles. The particles are generated from frictional forces involved in the rubbing of the different garments. Please be aware of this when preparing to work in the cleanroom.

The following procedures for entry into the cleanroom must be followed:

NOTE: No Food or Drinks are allowed in the cleanroom.
No Smoking.
No Contact Lenses.

1. Entrance is obtained through the main door. The pass-through for samples is accessible at this point. Please adhere to the list of things allowed in the cleanroom. This list also explains the cleaning procedure for things you need to bring with you

- into the cleanroom (found in the *Cleanroom Procedures* handbook). Anything that you bring into the cleanroom must go through the pass-through, size permitting.
2. Upon entry to the transitional room, you will find an entry logbook. Please sign yourself, and any visitors (including maintenance personnel) that you will be supervising while in the cleanroom. Pay attention to any messages left on the logbook by previous users. These messages could include abnormal conditions that you need to be aware of while working in the cleanroom. **YOU MAY NOT BE ABLE TO DO SOME PROCESSES AS A RESULT.** If the conditions include failure of power, DI water, fume hood exhaust, etc., these may prevent you from safely working in the cleanroom or facility proper. In these cases, do not enter the cleanroom until the problem has been rectified.
 3. Brush each foot using the foot brusher located at the entrance of the cleanroom and immediately place it on the tack mat without placing it on the floor. If the tack mat is too dirty to remove dirt from the soles of your shoes, replace the tack mat.
 4. Place booties over your shoes. Use clean booties and throw away the dirty ones.
 5. You may now enter the gowning room; make sure the main entrance door from the hallway is closed before opening the door to the gowning room. The two doors may not be open at the same time.
 6. Upon entering the gowning room, you should put on a pair of gloves. This minimizes contamination of the cleanroom clothing with oils and flaking from the skin on your hands. This is also a good time to put those safety glasses on, even though they are not required until you enter the cleanroom.
 7. From your locker take out your cap and put it on, tucking in all hair.
 8. Remove your coverall from the locker rack where you stored it and put it on. Note there is a special way to do it without it touching the floor. You should learn this method so that dust is not picked up off the floor and onto the clothing prior to entering the cleanroom. Be sure to tuck the cap into the coverall.
 9. After obtaining the proper sized boots, sit on the bench to put them on, making sure you tuck the coveralls into the boot. Note that it is important to get the proper sized-boots as they can be a tripping hazard in the cleanroom.
 10. Be sure to walk on the tack mat before entering the cleanroom. Do not leave the boots behind on the tack mat as you enter.

You are now ready to enter the cleanroom to work.

GOOD LUCK!!

4 Leaving The MFF

Before leaving the MFF, be sure to do the following:

1. Clean up the work areas. Do not leave any of your property in undesignated areas.
2. Leave everything the way you found it before you leave (unless of course you cleaned up a mess). If you changed anything during your processing and want to keep the changes, leave a note indicating the changes so that the next user will know what you did. It is important that this be done, because if the next person using the space or the equipment it could adversely affect their process. These processing steps are expensive and when they accumulate over the total cost of a device, our devices become very expensive. Be considerate of the other people who are working in the cleanroom. Their projects are as important as yours.
3. If you are the last person to leave the MFF, make sure all the lights are off, the DI water is off and the necessary valves are closed. Some valves remain open all the time and are labeled as such. Make sure the appropriate chilled water valves are turned off to your equipment. In the event that humidity control is lost, your equipment will start condensing water vapor and may start to corrode as a result..
4. If you want to leave the MFF briefly in the middle of your process and you do not want it to be disturbed, you should leave a note at your work area. The note should state the process and the chemicals in use and the approximate time you plan to return. This note commits you to that time of return. One should not find the note the next day. If it is found the next day, remember you could be subjected to disciplinary action as you might have prevented someone else from working in that area. Be respectful at all times of those who are working around you in the cleanroom. Also note, that you do not need to log out of the logbook for short absences in this case.

Unlabeled chemicals in beakers, etc should never be left. Take extra precautions to make sure you have not created a safety hazard if you leaving a long-term process running. In the case of a 24 hour HF etch, you must make sure everything is labeled and the appropriate safety equipment is available and accessible in the event of an emergency. As a courtesy to the other Users, please annotate the fact on the white board outside the cleanroom.

When you leave the MFF, follow the entering procedures in reverse order (section 3). This means disrobing from the bottom up, in case you didn't catch the rule for gowning which is top down.

The following rules should be adhered to when leaving the MFF:

1. Always use the pass-through to bring your items out of the MFF. Do not carry them through the gowning room.
2. Store your cleanroom garments properly: cap and safety glasses in your locker, coveralls will be hung up, and boots will be placed on the lower shelf. Even if

leaving the cleanroom for a short period of time this rule will be followed. It is not acceptable practice to store these items on the benches.

3. On your way out, throw your gloves into the waste can. Do not leave them laying around because the person following you and most likely will clean up after you will not know whether your gloves are contaminated. For all practical purposes, they are contaminated now increasing the costs of disposal, i.e. the glove change necessary to move your old gloves. **DO NOT REUSE GLOVES, THEY CAN BE CONTAMINATED!**
4. Remove your booties and store them in the bootie box only if they are reasonably clean. Dirty booties will be thrown away. If they are visibly soiled they fit the definition of being dirty!
5. Sign out of the logbook. Write down any malfunctions or broken equipment in the cleanroom. That way the next user will be aware of it. Report the problem to any member of the CRC and leave a note for the manager in room 511. Also, annotate the white board outside the cleanroom.
6. Make sure the door is latched as you leave the cleanroom so that the air flow remains positive in the cleanroom with respect to the adjoining rooms.
7. On the material supply sheet, write down any items that you found to be in short supply. If you know how to order the supplies please do so.

5 CHEMICAL SPILL PROCEDURES

5.1 General

You should always exercise care in handling chemicals to prevent a spill. Accidental spills will occur. Preplanning can help to alleviate potential problems due to chemical spills. MFF general users must know the following general information before he/she can be qualified to use the facility:

1. In case of a serious spill, which is beyond your handling capability and requires immediate attention, phone 111 to call outside people to help you.
2. The location of the Spill Control Stations; they are extremely helpful in controlling and containing spills.
3. Should you require the use of a respirator, you must call 111 for help. Unless you have been fitted with your own personal respirator and have the appropriate cartridges for the chemical, you are not allowed to don a respirator. See the MFF manager or your safety representative for further details.
4. All general users should know the properties for all chemicals that they use. Most importantly the characteristics that should be known are: toxicity, flammability, whether it contains HF (hydrofluoric acid), first aid information, etc.
5. Inside each Spill Control Station you will find:
 - a. A pair of goggles.
 - b. Two pairs of gloves; one pair for solvents, the other pair is for handling acids.
 - c. Several spill control pillows.
 - d. A box of sorbent pads for small spills.
 - e. A box of plastic bags for short-term storage of saturated spill control pillows.

The spill control pillows contain “foamed sand” that will absorb and contain all types of acids, caustic, solvent or oil spills. They do NOT contain neutralizing agents that will make the spilled liquids less toxic, hazardous or flammable. They are simply made from inert materials designed to absorb and retain liquids without deterioration, disintegration, or solidifying. The chemical-saturated pillows should be handled with extreme care. The Emergency Chemical Response (2-0254) team should be notified immediately so that the saturated pillows may be disposed of properly.

5.2 Handling of Spilled Liquids

Note: The following steps contain the proper procedure for handling a spill in the cleanroom. If you are unsure of the process or believe the spill is larger than your capabilities, do not hesitate to call 111. It is more important that we get people to respond to the situation. Remember, you ARE handling the situation in the best way possible if you call for help. If you felt you needed help, then you made the right call.

1. Do not panic.
2. Notify people in the immediate area about the spill. This includes all those in the cleanroom at the time. All unnecessary people should be evacuated.
3. Extinguish all sources of ignition. This includes hot plates, motors, vacuum pumps, ion gauges, etc. in the immediate area.
4. In case of an emergency where outside help is desperately needed, or the evacuation of the occupants of Becton is warranted, pull the fire alarm. (It is better to be safe than sorry).
5. If your clothing has been contaminated by the spill, REMOVE IT! (This is not the time to be modest). If your skin has been contaminated, flush the affected area for at least 15 minutes, after removing any contaminated clothing. Use the nearby showerhead and eye wash to rinse your body and eyes if necessary. Seek medical attention at University Health Services.
6. Avoid breathing vapors of spilled chemicals. Use a respirator when necessary. Several respirators for emergency use have been placed in the spill control stations.
7. You must wear protective clothing, chemical splash goggles and gloves. In addition, if you handle the spill by hand, you must wear additional acid and/or solvent resistant gloves.
8. Block the flow of the spill with the proper spill control pillows (HF or non-HF) to prevent further spread of the chemicals.
9. Place the spill control pillow over the spill and allow the absorptive action of the pillow to absorb the spill.
10. Use sorbent pads for small spills and to clean up residues remaining from larger spills.
11. Pick up the spill-saturated pillows with the scoop and brush, and place them in the disposable plastic bag. Do not contaminate the outside of the bag with the spilled chemical. If you do, obtain another bag and place the contaminated bag inside the new one. These bags can be found in any of the spill control stations. Be sure to seal the bag when done.
12. Neutralize the floor properly. If the spill was an acid spill, neutralize the floor with sodium carbonate. Sweep the remains into a dust pan and place the residue into the plastic bag for disposal.
13. Clean the floor with appropriate solvent, most likely DI water, and use additional pillows to pick up the diluted remains.
14. Scrub the floor surface with soap and water. Clean the floor using the routine cleanroom floor cleaning procedures.

15. Carefully pick up and clean any bottles that were splashed and immersed in the liquid. Cartons that have splashed or immersed should be sealed in a bag for waste disposal. Do not attempt to clean the carton as it will be quite messy and decontamination is highly unlikely without destroying the carton anyway.
16. Again, make sure all areas have been effectively cleaned.
17. Seal every disposable bag you used during the clean-up and clearly label the contents of each bag.
18. Contact the Chemical Safety Department (2-0254) immediately and ask them to dispose of the bags.
19. Notify the CRC committee about the spill and the clean-up activities. Identify the cause, and recommend remedial action.
20. If you use the spill control materials, annotate for a request of replacement on the Cleanroom Material Supply sheet.
21. Fill out and sign an accident report as detailed in Section 5.4.

5.3 Handling of Spilled Solids

If solid chemicals should spill, and are of low toxicity, they may be swept up and placed in a solid waste container. For more toxic materials, the use of a vacuum cleaner equipped with a Hepa-filter must be used. This vacuum may be obtained, as a loaner, from the Occupational Safety Department (2-0256).

5.4 Reporting Accidents

In the event of ANY accident in the cleanroom, a complete accident report must be filled out within 3 working days and personally handed to all members of the CRC, the faculty advisor and the council of engineering safety officer. If a CRC member is not accessible, that report may be e-mailed to that individual only. These reports are then filed in the cleanroom MSDS notebook. You are then expected to attend the next CRC meeting to brief and discuss the incident.