

Cleanroom User Protocol

Center for Nanoscale Systems (CNS)

Harvard University

(Revised: September, 2006)



General Perspective
Contamination Control
Cleanroom Material and Tool Handling
Chemical Handling
Safety and Emergence Plan
Tool Sharing and Housekeeping
New User Qualification Procedure



Purpose of the Protocol

Success

- Promote Successful Cleanroom Operation

Safety

- Ensure a Safety Working Environment

Satisfaction

- Develop Operational Strategies that Satisfy User's Needs



General Perspective

This protocol provides general guidance and basic awareness

Successful cleanroom maintenance really relies on individual user's understanding, participation and self-discipline

Everyone, whether faculty member, student user or staff engineer, is equally important to the success of the protocol

Trust, understanding and shared responsibility among all users ensures the success of every user



Contamination Types and Sources

Types of Contamination

- Particulate: dust, makeup, skin, hair, ...
- Chemical: oil, grease, sodium, perfume, ...
- Biological: bacteria, fungi, ...
- Radiation (ultraviolet light, ...)

Sources of Contamination

- People (~ 75%)
- Ventilation (~ 15%)
- Room structure (~ 5%)
- Equipment (~ 5%)



Contamination Control Strategy

Personnel Control

- Dress code
- Garments

Environmental Control

- Entrance/Exit control
- Supply, material and tool control
- Routine cleanroom cleaning and maintenance



Cleanroom User Dress Code

- Wear garments and gloves
- Wear safety glasses when handling chemicals and other hazard materials
- No sleeveless shirts (short-sleeve shirt is acceptable)
- No short pants and skirts in cleanroom-1 (legs should be covered for safety and contamination control)
- No slippers and sandals
- Don't wear jewelries with sharp-points that can puncture through rubber gloves
- Avoid long finger nails (same reason as above)
- No cellular phone use in the cleanroom



Garments are Required in Both Cleanrooms

Gowning Procedure (“Dressing Top-Down” and “Tucked In”)

- Hair covers are provided for those with long hair: cover entire head
- Hood: cover the cap or hair
- Face masks are provided for those with beard or moustache
- Coverall (bunny suit): tuck the hood and mask inside the bunny suit
- Booties: tuck the coverall pant legs inside the booties
- Gloves: tuck the coverall sleeves inside the gloves
- Safety glasses



Basics of Using Garments

- Garment should not be removed from cleanroom or gowning area
- Don't walk out of cleanroom with garments on except in the case of an emergency
- Change garment weekly (discarding in the assigned place)
- Don't wear contaminated garments
- Don't share or borrow garments; when in doubt, select a new set
- Don't reach under your garment when in the cleanroom



Garment Reuse and Storage

- **Items can be reused within a week:**
 - coverall (bunny suits): hang on the rack with the hanger assigned with your name
 - hood: stored inside the sleeves of your coverall
 - booties: hang with your coverall
 - safety glasses: stored in your tool box or inside the sleeves of your coverall
- **Items that should be discarded once used:**
 - hair caps
 - gloves
- **Items that may be reused in a short period:**
 - face masks: stored inside the sleeves of your coverall



Handling Cleanroom Materials and Tools

- **General Perspective:**
 - Don't bring non-cleanroom items into a cleanroom
 - Don't take cleanroom items out of a cleanroom
- **Writing Paper, Notebooks and Pens**
 - Only use cleanroom papers and notebooks inside a cleanroom
 - Use ball point or nylon tipped pens; don't use pencils and crayons
- **Wipes:**
 - Don't cut wipes in a cleanroom



Handling Cleanroom Materials and Tools (cont.)

- **Tools:**

- Prepare at least one tool box for storing your non-shared items
- Wafer processing tools, such as tweezers, scribes, timers, glassware, etc., should always stay inside your own tool box when not in use
- Always keep dedicated cleanroom tools inside the cleanrooms
- Don't bring non-cleaned tools into a cleanroom without cleaning and permission

- **Storage:**

- Store your tool box and other non-shared materials in the places assigned to you
- Don't take/use other users' non-shared items without their permission



Chemical Storage

- **New Chemicals:**
 - Do not bring any new chemicals into a cleanroom without permission
 - New chemicals should always come with Material Safety Data Sheets (MSDS)
- **Chemical Storage and Labeling:**
 - Large quantities of chemical supplies should be stored outside the cleanrooms in the assigned cabinets
 - Chemicals used inside a cleanroom should be stored inside the assigned cabinets
 - All chemicals, either purchased or self-mixed, should be clearly labeled according to the Haz-Mat handling procedure (see “Protocol for User Supplied Chemicals”)
 - In addition, owner’s name, group, contact information, and date of storage should be clearly labeled on the container



Transportation and Handling of Chemicals

- **Chemical Transportation:**

- Always use provided chemical carriers (bucket, cart, ...)
- Don't transport chemicals with open containers

- **Chemical Use:**

- Chemicals can only be applied **inside** the **assigned** acid/solvent benches and hoods
- Always put on chemical-resistant mask, gloves and apron before using any hazardous chemicals
- Don't leave any chemicals on bench tops or other public areas
- In the case of unavoidable short-period absence during a process, label the material, owner's name, contact information and returning time clearly near the material in use.



Transportation and Handling of Chemicals (cont.)

- **Chemical Wastes:**

- Follow the instructions of waste material handling procedure to discard waste chemicals (see labels on the benches)
- For unclear items, contact a staff member first
- Clearly label waste containers (use provided tags)
- Don't reuse empty containers without permission
- Don't put chemicals back into their original containers

- **In Case of Large Chemical Spills:**

- Immediately report large chemical spills to safety representatives or cleanroom staff members before cleaning by yourself



Emergency Response and Evacuation

- **General Perspective:**

- Always follow the rules/protocols set by the university, then CNS
- In an emergency that requires evacuation, leave the cleanroom immediately – don't try to undress first!
- Inform other users in the cleanroom. Report the incident to cleanroom supervisor immediately

- **In Case of Building Fire Alarm:**

- Hit EMO switch on the machines that are using toxic gases
- Hit EGO switch near the entrance/exit of the cleanroom
- Follow the protocol given by the university for evacuation and assembly

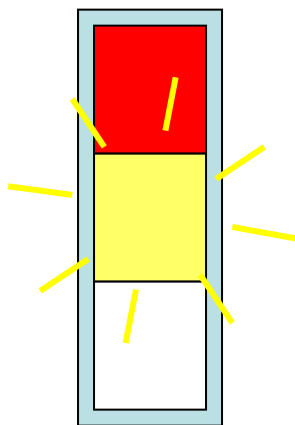
- **In Case of Large Chemicals Spills:**

- Immediately report the incident to safety representatives or cleanroom staff member before cleaning by yourself

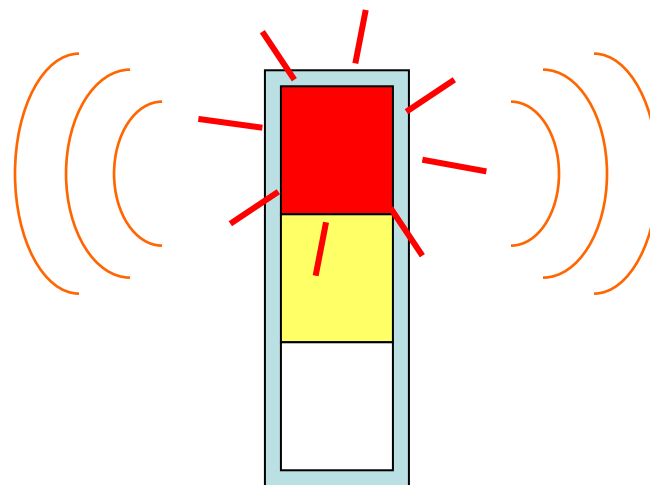


Response to Local (Cleanroom) Alarms

- Toxic gases in both cleanrooms are monitored by a Toxic Gas Monitor-Control System (TGMCS). Should any unexpected, health-threatening events happen, the system will send out two types of alarms inside the cleanrooms:



Amber (Yellow) Lights Only



Red Lights with Audio Alarms



Response to Local (Cleanroom) Alarms (cont.)

- **In the Case of Amber (Yellow) Visual-Only Alarm:**

What has happened?

- Low-level toxic or combustible gas leakage
- High-level toxic or combustible gas leakage in non-breathing zone
- Mechanic failures in some utility equipment, such as gas cabinet, gas sensor, ventilation, etc

What will TGMCS do?

- Send a message to CNS monitoring station and University Operation Center
- Shut down the gas cabinet

What should you do?

- Immediately evacuate from the cleanroom
- Report the incident to CNS staff



Response to Local (Cleanroom) Alarms (cont.)

In the Case of Red Visual and Audio Alarm:

What has happened?

- High-level toxic or combustible gas leakage in breathing zone

What will TGMCS do?

- Send a message to both CNS monitoring station and University Operation Center
- Shut down the gas cabinet

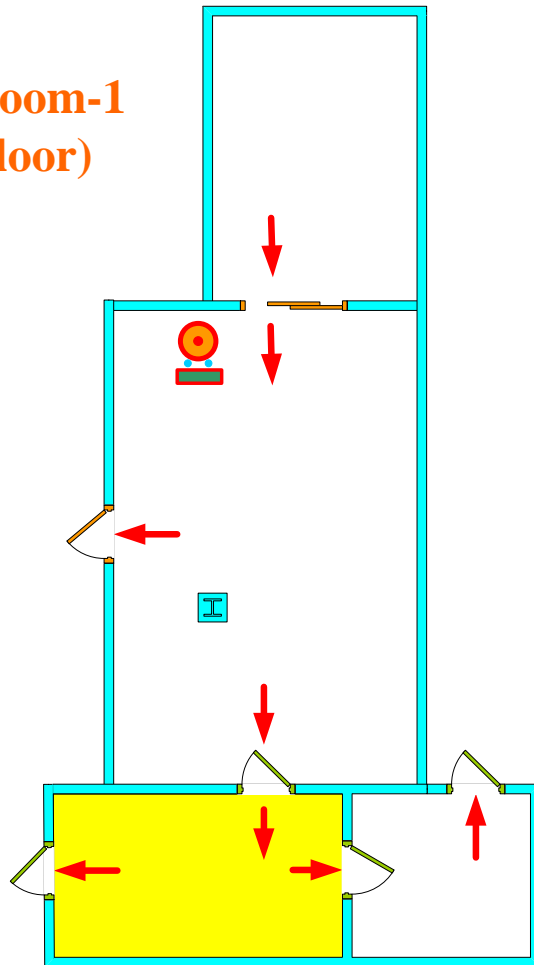
What should you do?

- Hit EGO switch near the entrance/exit of the cleanroom
- Immediately evacuate from the cleanroom and McKay building, and proceed to McKay Assembly Area. Do not leave the assembly area until notified so
- Immediately report the incident to CNS staff

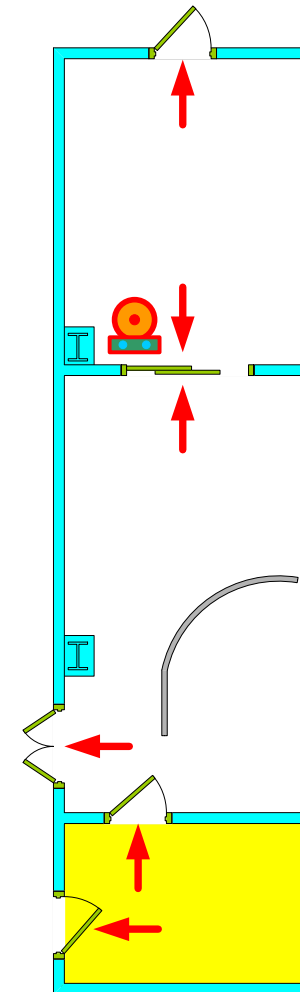


Location of Emergence Exits & Safety Equipment

Cleanroom-1
(2nd floor)



Cleanroom-2
(Basement)



Equipment Sharing and Maintenance

- All users must be trained and qualified by CNS Nanofabrication Facility staff members before being allowed to use equipment
- Using equipment is generally based on a “first-come-first-served,” basis. However, certain priorities may apply according to the agreement among faculty members or scheduling protocols
- Users must schedule time prior to operating equipment. Equipment sign-up sheets (or on-line signup) will be available to all qualified users
- It is every user’s responsibility to fill in the logbook during and after using equipment
- It is every user’s responsibility to immediately report any unusual occurrences to the engineer in charge
- It is every users’ responsibility to try their best to keep equipment in operating condition



Housekeeping

- **General Perspective:**

- Keeping cleanrooms clean and organized is every users responsibility
- Enforcement procedures may be necessary to ensure safe and effective operations

- **Public Areas:**

- Always clean up the working space you have used before moving to the next station
- Don't leave/store anything on public areas, such as machine tops, bench surfaces, on/under tables, etc., without permission from a cleanroom supervisor

- **Items Belonging to Individuals:**

- Keep non-shared items, such as tool boxes, wafers, glassware, etc., in the storage area assigned to you when not in use



New User Qualification Procedure

- **General Requirement to Access Cleanroom:**

(for detailed procedure, please go to CNS' website)

- Enroll as a CNS/NNIN user
- Complete “DEAS/Physics/Chemistry Lab Safety Training”
- Read and understand this protocol
- Take and pass the online Cleanroom User Protocol (CUP) Quiz
- Read the DEAS/Physics/EPS Dept. Safety Manual
- Read the User Supplied Chemical Protocol
- Complete New User Cleanroom Orientation
- Upon the completion of all the trainings, cleanroom access will be issued to the new user. Access should not be shared among users.



Tool Qualification Procedure

- Only qualified users are allowed to schedule and use equipment
- A first-time user is encouraged to observe the tool operation from qualified groupmates or users prior to official training
- Official training will be conducted by assigned CNS staff, please check CNS website for names of staff-in-charge for each tool.
- Final qualification will be given by CNS staff
- Retraining may be necessary if a user hasn't used a specific tool for a long period of time



Cleanroom Protocol Violations

- First offense: User's PI will be sent a note
- Second offense: User will be given a 3 day suspension where no CNS facilities may be used and User's PI will be sent a note
- Third offense: User will be given a one month suspension where no CNS facilities may be used and User's PI will be sent a note. Also, Users status as a General Nanofabrication Facility User will be revoked until the User goes back through all of the steps required to become a General User.

