

Clean Room Safety

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This document guides you through site specific cleanroom training. Access to CK 040 cleanroom is subject to the knowledge of and adherence to the guidelines below. The whole thing, including tests should take about 30 minutes if you are an average reader. **Any lack of compliance will result in an immediate withdrawal of laboratory access – no amount of tears, begging, or angry emails from your advisor will sway us.**

To best use this material watch the cleanroom gowning up video (no. 6 on this website <http://inside.mines.edu/~msingh/teaching.html>) first. After finishing reading this document you should be able to:

- 1. Know what cleanroom classifications mean
- 2. Know how cleanrooms are kept clean
- 3. Identify processes that need to be performed in a clean room
- 4. Identify types of contaminants and their sources
- 5. Identify materials that are not appropriate for the cleanroom
- 6. Identify activities that are not appropriate for the cleanroom
- 7. Identify precautions to be taken to keep the cleanroom clean like gowning

1. Cleanroom classification

Cleanroom classification is typically determined by the ISO and the cleanrooms are supposed to be called ISO1, ISO2 etc. However, no one talks like this. The most commonly used classification system has terminology like ‘class 100’, ‘class 1000’. The number after ‘class’ is the maximum number of particles larger than 0.5 um in diameter per cubic feet of space inside the cleanroom. That means the smaller numbers are cleaner cleanrooms. Our cleanroom is class 1000. For comparison the air outside is typically class 1,000,000. You can google to see clean room class to ISO translations.

2. How are cleanrooms kept clean

Cleanrooms are kept clean by recirculating the air inside them through HEPA (High Efficiency Particulate Air) filters. The number of times the total air in the room goes through the filter per minute decides how clean the cleanroom is. You will hear the sound of these filters running when you enter the cleanroom. Cleanroom design is a complicated subject that we will not cover here. Just know that the walls, floor, ceiling, HVAC system etc. were all designed very carefully to keep the cleanroom clean.

3. Why should anyone care about particles 0.5 um in size?

Contaminating particles are expensive for processes. They result in device failures (= frustration and time investment for the student at a university, = increased manufacturing costs in industry) The devices that are affected by contamination that is 0.5 um in size are those for which this length scale is important. They could be tiny transistors with the source and drain positioned less than 500 nm apart or they could be a thin film coating, like photoresist, which is of the order of microns in thickness.

4. Where does dirt come from and how do we keep it away?

To understand how to keep the clean room clean, we need to understand where contaminants come from. The sources of contamination are:

- a. People – People are the number one source of contamination in the cleanroom. We spew hair, skin flakes, oils, and lint from our clothing. Sounds gross, but, it is true. A sitting person generates 100,000 0.3 um particles per minute, while walking at 5mph generates 10,000,000. So, here are the rules for humans in the cleanroom:
 - (i) You need to be appropriately dressed and gowned (section on this later).
 - (ii) No running about or horseplay.
 - (iii) Absolutely no cosmetics, especially on areas not covered by gloves/gowns.
 - (iv) No blocking air return in the room by standing there or positioning equipment there.
 - (v) No touching your face with gloves.
 - (vi) Limit the number of trips in and out.
 - (vii) On snowy/rainy days, change into dry shoes before entering cleanroom.
- b. Materials – Materials are the second most important source of contamination in the cleanroom. The rules for limiting contamination due to them are as follows:
 - (i) Materials like paper, wood, cardboard, erasers, or pencils are not allowed in the cleanroom. Other high outgassing materials are also not allowed in the cleanroom. This ban includes all food and drinks.
 - (ii) Most glues and epoxies are not allowed including duct tape.
 - (iii) Your wallet is not allowed in the cleanroom unless it is in your pocket under the gown.
 - (iv) Only ball point pens and clean room paper are allowed.
 - (v) If you must take your laptop/cell phone in, wipe it with a clean room wipe soaked in isopropyl alcohol in the gowning area before you enter.

Preferably, leave it out. The same applies to all tools taken into the cleanroom.

- c. Processes – Please think about particulate matter your process might generate before bringing that process to the cleanroom. The following is a list of activities that are forbidden:
- (i) No drilling, grinding, sawing, filing.
 - (ii) No thread cutting, deburring.
 - (iii) No soldering, brazing, welding.
 - (iv) No heat stripping.
 - (v) No cutting with diagonal pliers.
 - (vi) No conformal coating or potting.
 - (vii) No painting.
 - (viii) No sweeping or dusting. Only wet clean room mop to be used for cleaning.

5. Gowning procedure

Watch the video to understand the gowning procedure. Here it is in writing.

- a. Step on sticky mat
- b. Lift a foot, cover with bootie, place inside (not on sticky mat). Repeat with other foot
- c. Wear gloves
- d. Wear hair net, face cover, glasses in whatever order you wish
- e. Wear bunny suit
- f. Wear boot covers (if available)
- g. Wear another set of gloves

If working with acids, additional protective equipment will need to be worn. What this is you will find out in the chemical safety training. While ungowning follow this procedure:

- a. Take off boot covers
- b. Take off bunny suit
- c. Remove hair net, face cover, glasses
- d. Remove gloves
- e. Lift one foot, remove bootie, place uncovered foot on sticky mat. Repeat with other foot.

Things you should trash after every use: gloves.

Things you can save in a bin with your name if you are a regular user (discard otherwise): hair net, face cover

Things you should put back in common receptacles for reuse by anyone: glasses, booties, bunny suit

Important note: Make sure the door to the gowning area and the door to the cleanroom are never open simultaneously.