

# Cleanroom Safety Training

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Previous version by: Rahul Gupta

<https://imse.wustl.edu/clean-room-information>

**Last Updated: 6/20/2023**

# Cleanroom Access requirements

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1. Complete annual lab safety training (EH&S Initial Lab safety, all modules)  
*Required annually*
2. Lab specific training (Cleanroom training)  
*Required annually*
3. Submit IMSE Internal User's agreement signed by PI  
*(Does not apply to WashU class students)*
4. Sign-up for iLab Instrument Reservation System  
*(For WashU classes, TA/Lab Manager will reserve the instruments and validate each user training level)*

*Your WUSTL Card will be activated to allow entry inside the Cleanroom*

***NOTE:*** *Additional training* is required for any specific planned operation inside the Cleanroom including working with equipment, process, metrology and any chemical.

# Recent safety-related incidents

## Improper Handling of Chemical Wastes Results in Unstable Mixture – September 2012

### What happened?

A researcher was using nitric acid to clean glass slides and disposed of this along with aqueous washings from the slides into a glass chemical bottle containing nitric acid and water. The researcher then mistakenly added methanol to the acid waste bottle.

The addition of methanol to nitric acid can form methyl nitrate, which is potentially unstable and explosive. The researcher moved the waste bottle from the acid cabinet to the fume hood and waited a week. He observed gas bubbles in the container and opened the lid to release any built-up pressure. The solution bubbled vigorously, so he closed it. After placing the waste bottle behind the blast shield in the fume hood, the researcher contacted the EHS office.



Incident at  
UT Austin

Waste bottle  
behind blast shield.



### [2016 Incident at WashU](#)

Mixture of Acetone and Nitric acid led to explosion of glass bottle

# Main topics:

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- Emergency procedures
- Cleanroom operation
- Cleanroom dressing
  
- Chemicals handling
- Disposal of unwanted chemicals
  
- [Quiz link](#) (equivalent to signing bluebook)

# Main topics:

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- Emergency Procedures
- Cleanroom Operation
- Cleanroom Dressing
  
- Chemicals handling
- Disposal of Unwanted Chemicals

# Emergency Procedures

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- WashU police department **Phone 314 935 5555** (also for safety related calls)
- One phone is located in Class 100/1000 bay (314 935 7264) and other near kitchen area of the Rudolph Hall basement
- In case of any alarm or safety incident (or if you are not sure what to do), exit the cleanroom and building immediately and call WashU PD.
  - Do not leave the assembly area until you are told to do so, for head count

# Emergency Procedures

- Gas Alarms
  - A variety of toxic/flammable/corrosive/reactive gases are used in the Cleanroom
- Fire alarms
- Fire Handling
  - Small fire
  - Large fire
- Chemical Spill Handling



Gas alarms indicators in Cleanroom



Fire Alarm Indicator

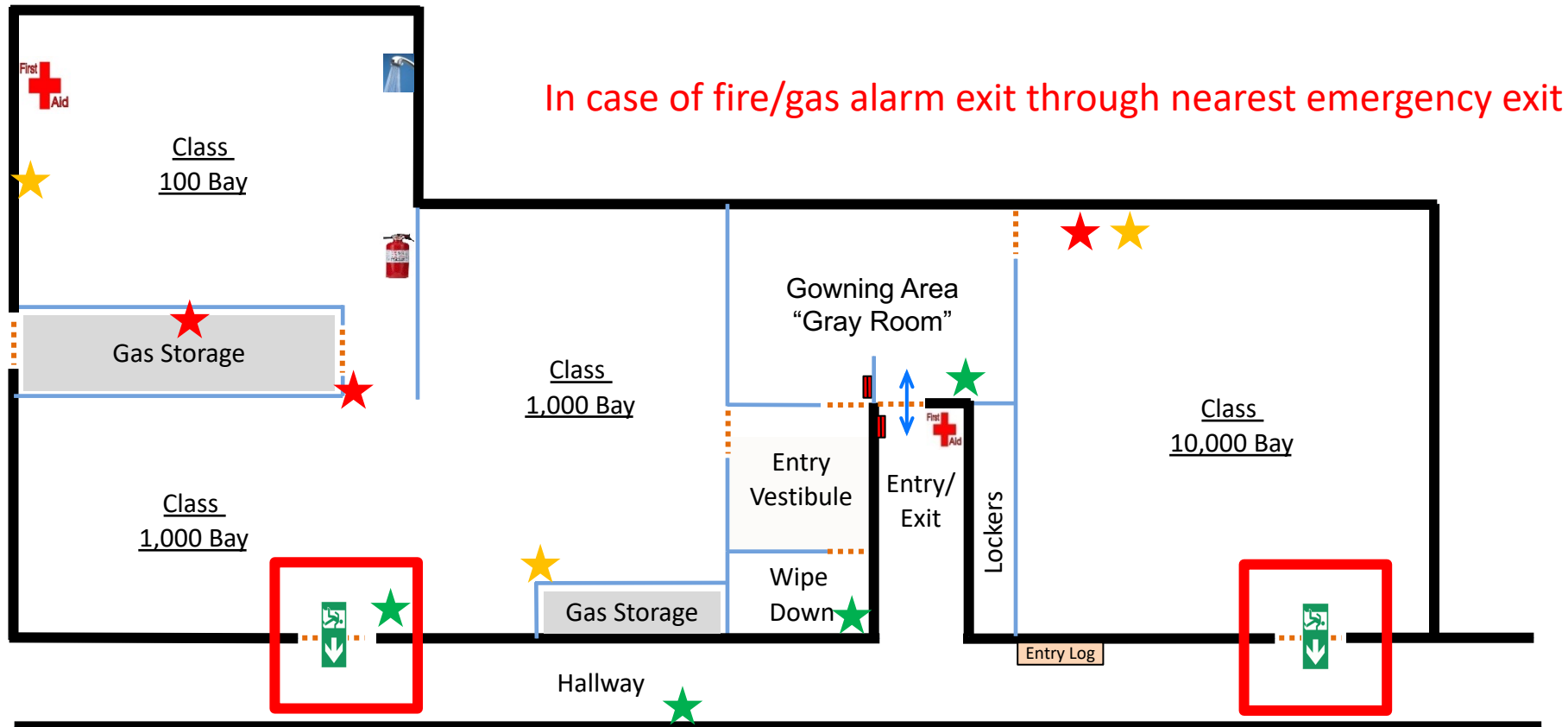


Fire Alarm Pull Station



Fire Extinguisher

# Cleanroom Layout – Alarm locations



- |                           |  |                           |  |                     |  |
|---------------------------|--|---------------------------|--|---------------------|--|
| • Main Entrance           |  | • Card Reader             |  | • Gas alarm         |  |
| • Emergency Exit          |  | • Sign-in Board/ Log book |  | • Fire Alarm        |  |
| • First Aid Kit           |  | • Fire Extinguisher       |  | • Fire Pull Station |  |
| • Shower/Eye Wash Station |  |                           |  |                     |  |



# Gas Alarm

- Two levels of gas alarms based on severity:
  - **Yellow** alarm – Gas has leaked, but the concentration is below TLV\*
  - **Red** alarm – Gas has leaked and the concentration is at TLV\* or higher. Immediate danger to life!

Audible and visual indication for both alarm levels

- What to do in case of either alarms?

## Yellow/Red level alarm

- Exit via the gowning area or emergency exit doors as soon as possible.
  - Notify IMSE staff.
  - Assemble at **First floor of Rudolph Hall** near the elevator to report your experiment details, etc.
  - IMSE staff will investigate alarm source with help from WUPD, EHS, Facility team.
- **If you believe someone has collapsed in the Cleanroom area, DO NOT attempt to retrieve them! Call WUPD at 935-5555 and request a Hazmat team.**

\*TLV = Threshold Limit Value i.e. a level to which a worker can be exposed day after day for a working lifetime without adverse effects

# Fire Alarm

- Watch for Fire Alarm Monitor/Indicator at all times during the Cleanroom operation.
- In case of small fire and if comfortable to do so, use Fire Extinguisher to extinguish the fire.
- In case of large fire, immediately exit the lab and pull Fire Alarm.
- Assemble at the assembly point #21 <https://emergency.wustl.edu/where-to-go/#evacuation>
- Do not leave the assembly point area until WUPD has arrived and has recorded your details, including your knowledge of other researchers working at same, experiments, etc.

**Assembly point #21**



# Chemical Spill Handling

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- In case of any chemical spill (large or small), DO NOT handle it alone.
  - Evacuate the lab area immediately and post signs so other researchers do not enter the same area.
  - Ask for IMSE staff support.
  - If IMSE staff is unavailable, call WUPD (935-5555) for help.

# Main topics:

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- Emergency Procedures
- Cleanroom Operation
- Cleanroom Dressing
  
- Chemicals handling
- Disposal of Unwanted Chemicals

# Cleanroom environment

- A cleanroom is an environment with a controlled level of contamination (e.g. dust, airborne microbes, aerosol particles, and chemical vapors) used in manufacturing or scientific research
- Comparison with standard laboratory



Standard Laboratory



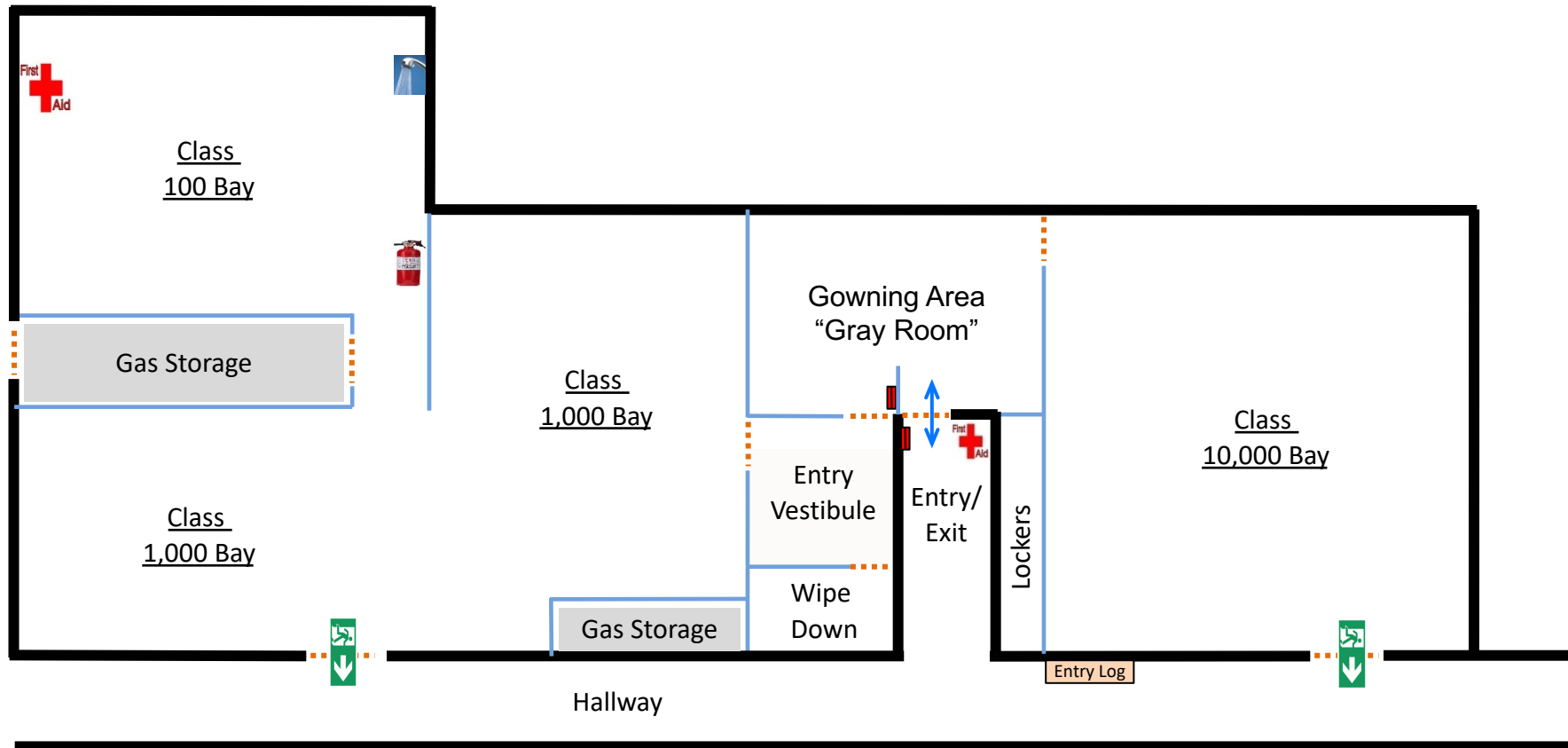
Cleanroom Lab






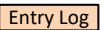

# Particle size distribution in Cleanroom

- US FED STD 209E Cleanroom Standards:

Class	Maximum particles/ft <sup>3</sup>					ISO equivalent
	≥0.1 μm	≥0.2 μm	≥0.3 μm	≥0.5 μm	≥5 μm	
1	35	7.5	3	1	0.007	ISO 3
10	350	75	30	10	0.07	ISO 4
100	3,500	750	300	100	0.7	ISO 5
1,000	35,000	7,500	3000	1,000	7	ISO 6
10,000	350,000	75,000	30,000	10,000	70	ISO 7
100,000	3.5×10 <sup>6</sup>	750,000	300,000	100,000	700	ISO 8

# Cleanroom Layout



- Main Entrance 
- Emergency Exit 
- First Aid Kit 
- Shower/Eye Wash Station 
- Card Reader 
- Sign-in Board/Log book 
- Fire Extinguisher 

# Cleanroom Cameras





# Cleanroom Operation

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- Regular working hours: 8 AM – 5 PM
- Working after hours (including weekends and holidays) require a buddy system and signing a waiver form
- Each user should swipe their cards even accompanying a colleague
- Never enter the Lab alone outside working hours
  - Make sure Lab Manager or IMSE staff is aware of your presence
  - Certain chemicals/processes may require buddy system
- Visitors (or un-trained personnel) should be only accompanied by IMSE staff
- Do not bring anything inside the Cleanroom (including chemicals) unless approved by Lab Manager

*These Policies are in place for everyone's safety and safe/efficient operation of Cleanroom*

# Cleanroom Operation (After-Hours)

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Submit after-hour request at:

<https://imse.wustl.edu/clean-room-information>

All requests must be submitted by 3 PM on the day after-hour access is requested. Cleanroom manager will reply by email for confirmation. Until then, request is not considered approved.

Temporary white access card will be given in-person after approval and it needs to be returned by next working day (your student ID cards do not give you access to cleanrooms anymore).

NOTE: Limited assistance is available from WashU EHS and facilities after-hours. **IMSE staff won't be able to provide any support.** Your PI will be your primary contact for any safety issues and responsible for follow-up as necessary. **IMSE Staff will not be held responsible for any incident (or accident) that occurs after-hours.**

# Instrument scheduling and use

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ILab must be used at all times:

<https://imse.wustl.edu/facilities/iLab-calendar-access.html>

New users must sign-up:

[https://wustl.az1.qualtrics.com/jfe/form/SV\\_d73NjMOA1zrnexU](https://wustl.az1.qualtrics.com/jfe/form/SV_d73NjMOA1zrnexU)

ILab also shows whether you are trained and have independent access to operate the instrument.

Training request for specific instruments/processes must be submitted online:

[https://wustl.az1.qualtrics.com/jfe/form/SV\\_3t3somqDkp9vtQ2](https://wustl.az1.qualtrics.com/jfe/form/SV_3t3somqDkp9vtQ2)

In addition to the iLab use, each user should scan in to log-in the tool usage using IMSE app. For Apple users, the app can be downloaded at:

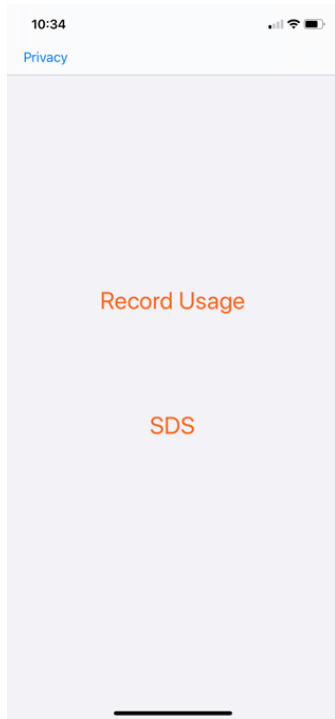
<https://apps.apple.com/us/app/washu-imse-facility-logger/id1477204116>

For Android users, the app can be downloaded at:

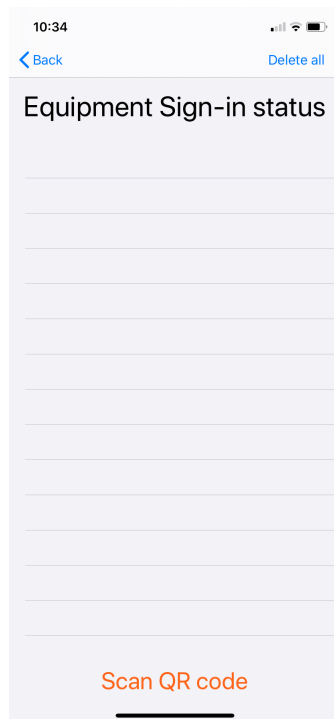
[https://play.google.com/store/apps/details?id=edu.wustl.imse.facilitylogger&hl=en\\_US&gl=US](https://play.google.com/store/apps/details?id=edu.wustl.imse.facilitylogger&hl=en_US&gl=US)

# How to use the app for logging in...

NOTE: iLab reservations must be made prior to using the App. If any error occurs, please email IMSE staff with sign-in and sign-out information along with instrument name.



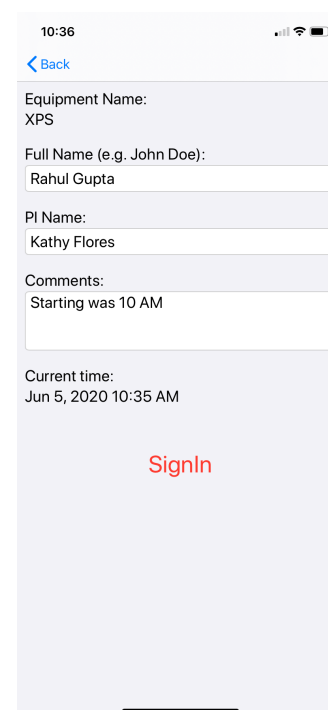
Step 1 – Open QR-ILog App



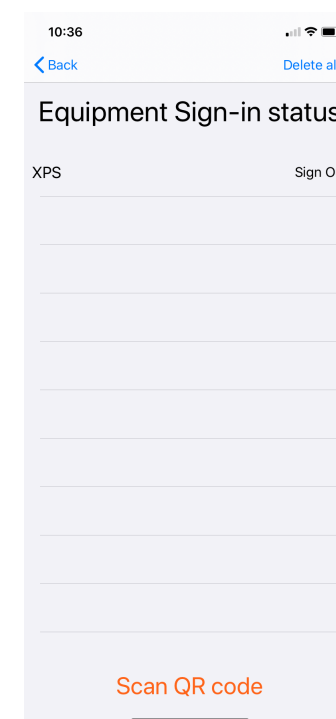
Step 2 – Click Scan QR code to sign-in



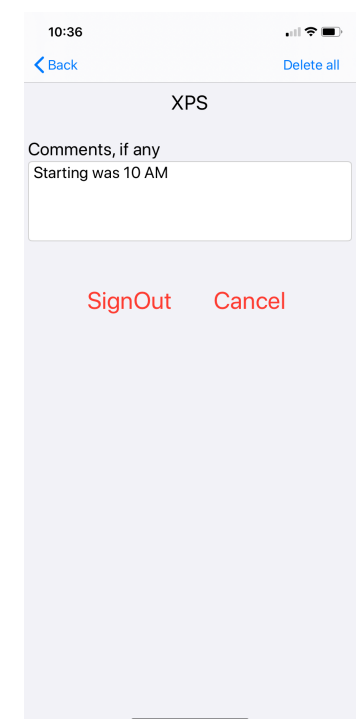
Step 3 – Place instrument QR Code under the camera



Step 4 – Fill your and PI's Full name (exactly as it appears on iLab). Add comments if needed. Click SignIn.



Step 5 – If no error, you should see Instrument name. Click "Sign-out" to record end time



Step 6 – Sign-out page, Update comments if needed.

# Safety

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- **Safety is everyone's responsibility.**
- Users should be alert at all times.
- All personnel must be aware of and comfortable with the ongoing experiments/processes/chemical operation.
- **Each User has a right to STOP any experiment** or report to Lab Manager/IMSE Staff immediately if he/she is not comfortable.
- Eating, drinking, chewing, smoking, handling contact lenses and applying cosmetics are strictly prohibited inside Cleanroom.
- All food or beverage items should be stored outside the Cleanroom.
- No foul play, horseplay, running, jokes or any kind of disturbance is allowed.

# Cleanroom Hygiene

Sources of Contamination	Measures for Hygiene
Shoes	Shoe scrubber, Two layer of shoe cover. Additional blue sticky door mat to trap particles
Clothing	Clean Gown
Hair	Hair net followed by Clean Hood
Beard	Beard net
Notebook Paper	Only Cleanroom paper/notebook allowed
Other items (cell phones, etc.)	Wipe down with 70% IPA-DI water solution. Bigger items can be wiped in "Wipe Down" Room

# Cleanroom Hygiene

Prohibited Items	Allowed Items
Cardboard and paper	Cleanroom paper and Cleanroom notebooks - Paper items sealed in plastic
Pencils	Pens
Cloth items	Synthetic fabrics(polyester, nylon)
Hats and coats	Plastic items

- All approved items that are brought into the Cleanroom must be wiped down to remove dust particles and oil.
- Any other items not mentioned here including large items, chemicals, etc. must be discussed and approved with Lab Manager first.

# User's Chemicals and Samples

- All chemicals and samples brought into the lab must be first approved by Lab Manager.  
Submit SDS for each chemical during review.
- All chemicals and samples must be clearly labeled with User name, PI name, chemical name, hazard nature and the starting date using the label printer inside the cleanroom.

AZ-5214E Photoresist (100%) Your Name PI Name Start Date: 1/1/16 <a href="mailto:abc@wustl.edu">abc@wustl.edu</a> Flammable, toxic
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- Unlabeled chemicals and samples are subject to disposal and reported to PI.
- Liquid-filled containers in fume hood must be labeled with chemical contents, user name, PI name, expected time of disposal and contact info(email or phone).
- All un-attended chemicals (including custom prepared solutions) in the fume hood require permission from Lab Manager and must be labeled with User name, date and chemical name.
- Solvent heating allowed only in attended (user must be around the fumehood) and reserved solvent fumehoods to a maximum temperature of 65 C.



# Infractions & Suspensions

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- Users found to be in violation of the policies, procedures, equipment SOPs and best practices presented in this lab specific presentation, Safety Manual and including communication via the Cleanroom Staff will be subject to the following:
  1. Verbal warning
  2. Written warning issued by Cleanroom manager with P.I. and IMSE Associate director cc-ed
  3. For instrument time misuse (not logging in or logging only part of the usage), 8-hr fine may be placed per instrument per day and/or cleanroom suspension. (escalated straight to the PI by Associate Director IMSE)
  4. Suspension from the cleanroom and/or losing tool/process access (that requires re-training on the specific tool/process)
- If a user is found to be in major violation (e.g. creating a danger to self, other users and/or the cleanroom), an immediate suspension from the cleanroom will result.

# Cleanroom Consumables

## Open Use

### Solvents:

- Acetone
- Isopropanol (IPA)
- Methanol
- Ethanol
- PG remover

### Acids:

- Hydrochloric Acid
- Hydrofluoric Acid
- BOE
- Nitric Acid
- Sulfuric Acid
- Phosphoric Acid
- Acetic Acid

### Developers:

- AZ400K
- MF319
- SU-8 Developer
- MIBK/IPA

## Chemicals

### Upon Request/\$

#### Photoresists

- AZP 4620
- SU8-2025
- SU8-2050
- S1805
- LOR
- PMMA (495K)
- PMMA (950K)
- Omni Coat
- MCC Primer

#### Soft Lithography:

- PDMS (sylgard curing/powder)
- POTS

## Other Consumables

### Open Use

- Cleanroom Wipes
- Plastic Pipettes
- Petri Dishes
- Aluminum Foil
- Glass Slides

### Upon Request/\$

- 4" Si Wafers
- 4" Borosilicate wafers
- 4" and 5" Soda Lime masks
- Mask carriers
- Wafer petri dishes
- Empty resist bottles

# Main topics:

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- Emergency Procedures
- Cleanroom Operation
- **Cleanroom Gowning**
  
- Chemicals handling
- Disposal of Unwanted Chemicals

# Cleanroom Dress Code

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- Standard laboratory dress code applies under all Cleanroom attire.
- Acceptable dress for lab user includes:
  - Full length skirts and pants
  - Closed toe shoes
- Unacceptable dress for lab users:
  - **Shorts and Capri pants are not allowed!**
  - **Sandals are not allowed!**

# Cleanroom Locker

- Users may store personal items in one of the unlabeled lockers outside of the gowning area for day-usage



IMSE is not liable for any valuables lost or stolen from these lockers!

- Frequent users may request their own locker to share with their group (only one per group)

# Cleanroom Gowning

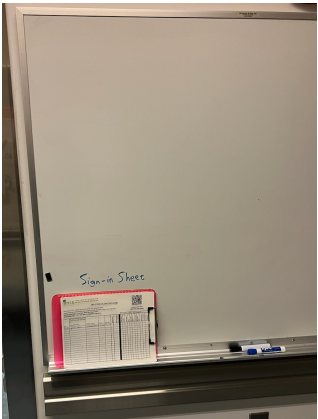
## - Blue Sticky mat

- Sticky Tac Mat Adhesives Floor Protectors are located at the entrances of all cleanroom doorways. These are used to remove any particulate contamination from the bottom of your foot ware. Step fully onto these mats before entering the cleanroom and **only with booties on.**



- If the mat has lost all adhesive strength, rip off top layer and dispose of in Gray Room trash.
- If there are no additional mats, contact Cleanroom staff immediately.

# Cleanroom gowning: Before entering the gowning area



imse INSTITUTE OF MATERIALS SCIENCE & ENGINEERING

Sign-in Sheet for Clean Room Entry

Check Name, Date, and Time when using this sheet. This sheet is for personal use only. It is not to be used for official business purposes. Do not write on this sheet. Do not use this sheet for any other purpose.

Name	Date	Time

See notices  
Check-in  
sheet or on  
App



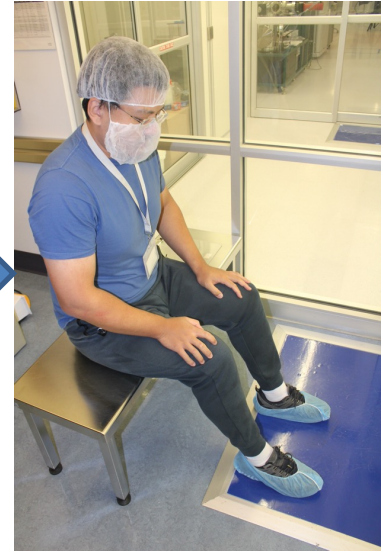
Clean shoes using  
motorized shoe-  
cleaner



Wear hair net and  
beard net (if  
applicable)



Put on shoe covers in a manner that you only  
step on the blue-tape while wearing shoe  
covers and shoe covers must not touch any  
other area outside the gowning room other  
than the blue tape



Swipe card  
to enter the  
gowning  
area



# Cleanroom gowning for Class 100/1000: Once inside the gowning area



Wear nitrile gloves



Gowning is top-down, so hood first



Wear the gown, try not to touch the floor with the gown's sleeves/legs



Put on the cleanroom boot covers



Safety goggles are mandatory inside the cleanroom



Wipe down outside items (laptop/cell phones/sample boxes/tweezers) using 70% IPA in water



Don't forget to log into the cleanroom using the app:



Don't forget safety goggles



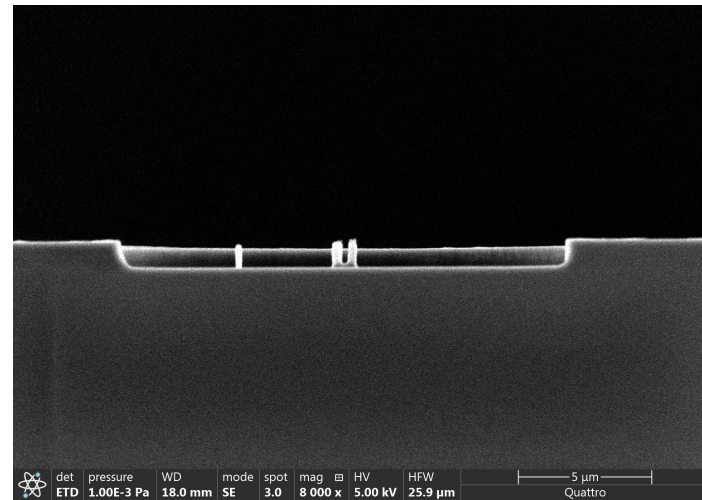
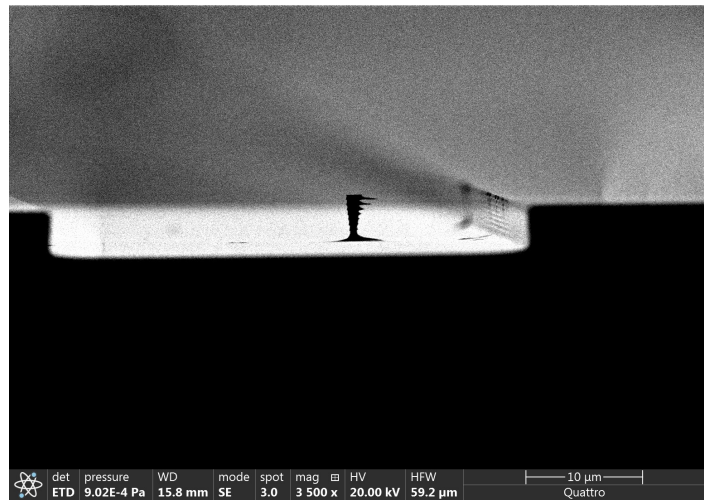
# De-gowning

De-gowning is bottom up:

1. Take-off boot covers first and store in zip-lock bag within plastic bins
2. Next take off coverall and hood, and hang them on the hanger (which is labelled with your name)
3. Put **1 Tick** (per day) on the Coverall around the chest area. After **10 ticks**, you must change the coverall and hood
4. Don't take off hairnet/beard-cover and blue shoe-covers, these must be removed when you go out of the gowning area and beyond the blue sticky tape



We need you for  
war on dust!



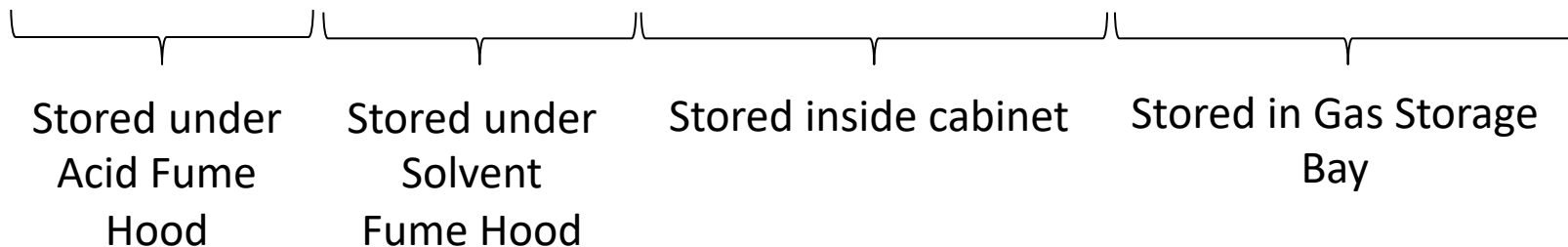
# Main topics:

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- Emergency Procedures
- Cleanroom Operation
- Cleanroom Dressing
  
- **Chemicals handling**
- Disposal of Unwanted Chemicals

# Chemicals Storage Inside the Cleanroom

Acids	Solvents	Developers	Gases	
Sulfuric Acid	Acetone	SU-8 Developer	BCl <sub>3</sub>	H <sub>2</sub>
Hydrochloric Acid	Iso-Propanol	MF-319	CH <sub>4</sub>	O <sub>2</sub>
Nitric Acid	Methanol	AZ 400K	NF <sub>3</sub>	Ar
HydroFluoric Acid	Ethanol	MIBK:IPA 1:3	Cl <sub>2</sub>	He
BOE	Remover PG		SF <sub>6</sub>	N <sub>2</sub>
Phosphoric acid				



**DO NOT Mix Acids and Solvents storage**

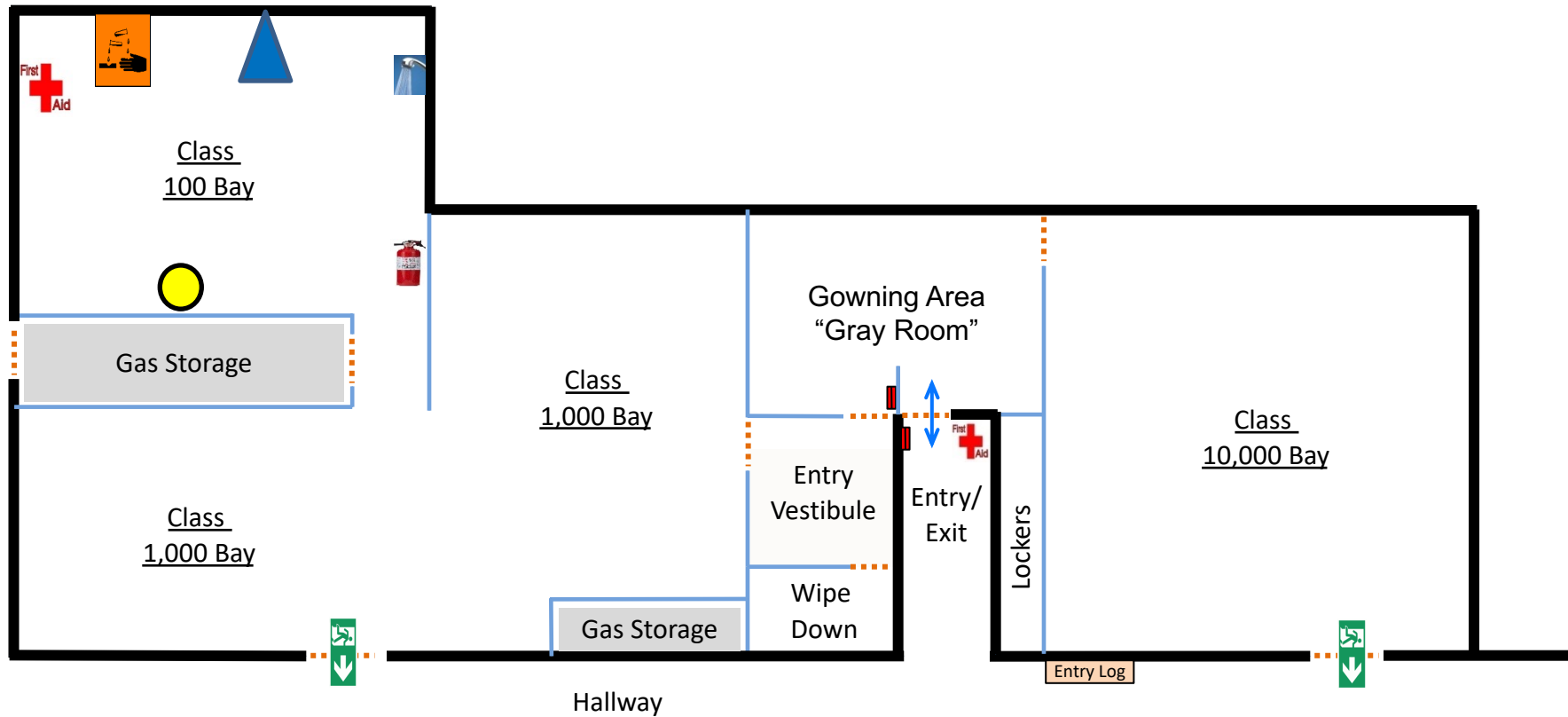
**DO NOT Mix Flammable and Oxidizer Gases storage**





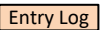





Use secondary container for transport of liquid chemicals.

Always read SDS for each chemical ([Link](#))

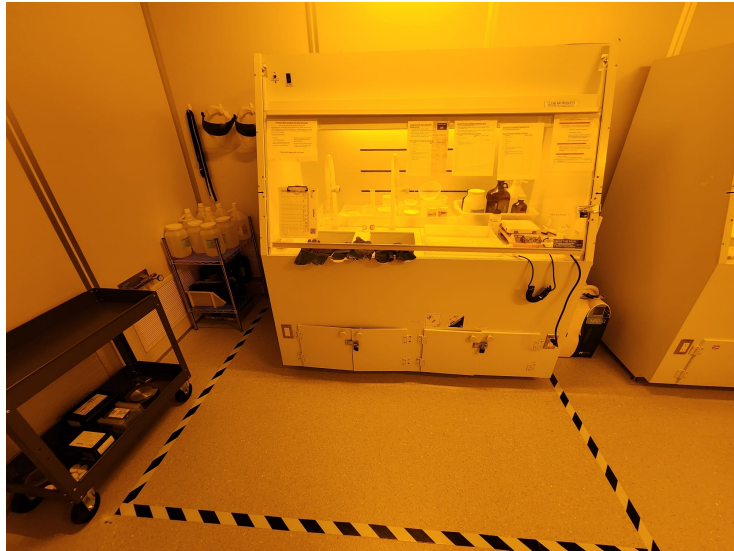
*For complete list of approved chemicals, see Lab Manager*

# Cleanroom Fume Hoods Location

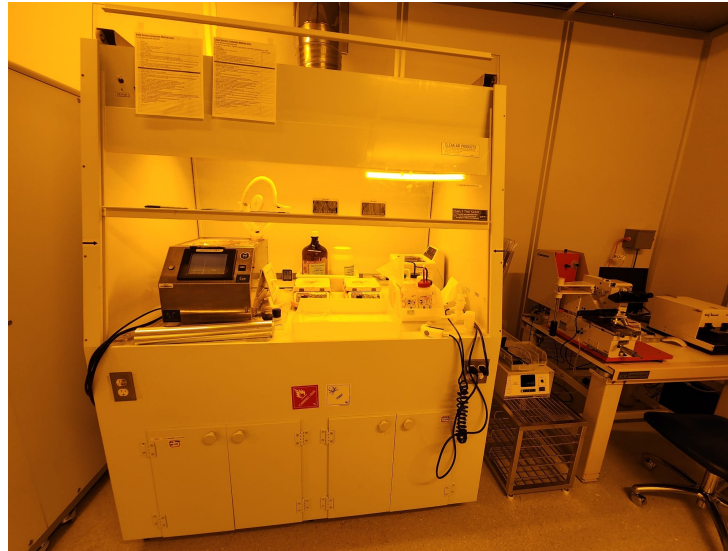


- |                           |   |                           |   |                       |   |
|---------------------------|---|---------------------------|---|-----------------------|---|
| • Main Entrance           |  | • Card Reader             |  | • Acid Fume Hood      |  |
| • Emergency Exit          |  | • Sign-in Board/ Log book |  | • Solvent Fume Hood 2 |  |
| • First Aid Kit           |  | • Fire Extinguisher       |  | • Solvent Fume Hood 1 |  |
| • Shower/Eye Wash Station |  |                           |   |                       |   |

# Fume hood view



Acid Hood



Solvent Hood 1



Solvent Hood 2

- **DO NOT mix chemicals between Acid and Solvent fume hood**
- Keep the working area clean at all times
- All chemicals/custom mixtures in fume hoods require labeling
- **All un-attended chemical storage inside fume hoods requires explicit permission from Lab Manager**
- Solvent heating allowed only in attended and reserved solvent fumehoods to a maximum **temperature of 65C**
- Solvent fumehood 1 is allocated for spin coating of photo resists, while solvent fumehood 2 is allocated for spin coating of Electron beam lithography resists
- Fumehood sessions begin as soon as you arrive at the hood and end once you have removed all glassware, disposed off of all the waste and filled out waste sheets
- Spinners need to be logged in separate from the fumehoods on the IMSE app

# Fume Hood operation

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## When to Use Fume Hoods:

- Fume hoods are essential for the safety of both you and fellow lab users.
- Fume hoods trap the volatile toxic/harmful vapors/dust and prevent exposure to users.

## How to Use Fume Hoods effectively:

- Keep the fume hood sash closed at all times.
- The Hood sash should be lifted only high enough (<14" opening) to allow your arms to enter the hood.
- Hazardous materials should be at least 6 inches behind the sash of the fume hood.
- Do Not block duct openings inside the hood
- **Don't get your head inside the fumehood!**

## Chemical Storage in Fume Hood:

- All chemicals/custom mixtures in Fume Hood require labeling.
- All un-attended chemicals require permission from Lab Manager.

**Additional Hands-on Training will be provided for each chemical/instrument/process inside the fume hood**



# Fume Hood Safety and Hygiene

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## Hygiene

- It is your responsibility to help maintain the hygiene of the Fume hood
- Clean glass wares, wipes, slides, tweezers, etc. before leaving the lab
- Dispose any trash safely.

## Safe Practices

- Gloves usually become contaminated during experiment
  - Do Not touch other instruments/doors knobs/chairs, etc. with potentially dirty gloves
  - Ask your colleague to record your data to prevent contamination of lab notebook
- Keep containers closed at all times. Never take open containers of chemicals outside the fume hood
- No chemical (even non-hazardous) can be disposed down the drain
- Never stick your face inside the fume hood.
- Wipe up small spills inside the hood Immediately
- **If a hazardous chemical spill occurs outside or inside the fume hood, you should evacuate the lab immediately and notify IMSE staff and University Police(5-5555).**

# Acid Fume Hood operation

*When working with the acid hood, users are required to wear additional layers of protection to safeguard against splashes and accidental exposure. These layers are in addition to the previously discussed gowning required of all Class 1,000/100 Cleanroom users.*

## Additional PPE Requirements:

- Acid Apron
- Face Shield (over glasses)
- Neoprene Gloves (over inner nitrile gloves). Rinse with water before and after each use.
- Neoprene sleeves will be required for all corrosive applications.
- Working with HF (any concentration) or handling large storage containers (of any acid) in acid hood requires at least two trained users present in cleanroom.
- Working with dilute non-HF acids (<5% concentration) allowed with IMSE staff aware of and monitoring on their camera
- Acid hood lock key can be only obtained from Lab Manager. It CANNOT be transferred to other users in Cleanroom without reporting to Lab Manager
- **Never work alone with Acid Hood.**



Additional PPE: Apron, Face Shield, Neoprene sleeve and gloves



When gowned up for acid-work stay within the yellow lines

# Working with HF (or BOE)

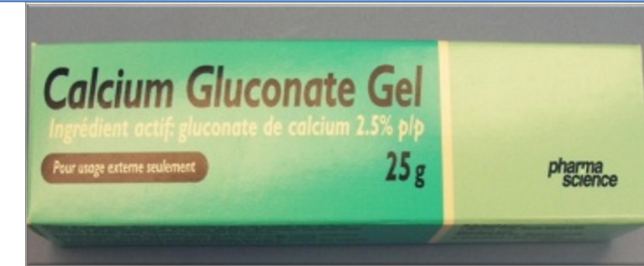
- The Acid hood contains Hydrofluoric Acid, both in its pure (HF) state and as an active component of Buffered Oxide Etch (BOE)
- Hydrofluoric Acid is VERY dangerous and requires additional special training
- Additional PPE required. NOTE: Nitrile gloves are not compatible with HF
- NEVER use Hydrofluoric Acid alone. Buddy system is mandatory
- HF etches glass. Only use HF resistant beakers (see SDS)
- Store HF waste in a separate HF waste containers
- **Additional Training is required**
- **If a hazardous chemical spill occurs outside or inside the fume hood, you should evacuate the lab immediately and notify IMSE staff and University Police(5-5555)**



# Handling HF (potential) exposure

## Procedure:

1. Ask buddy to call campus police (5-5555) immediately.
  2. After (potential) exposure of HF, Remove contaminated clothing, immediate wash burned area with shower for 5 minutes. In case of splash on eyes, use eye wash keeping eyes open.  
(Buddy can call 55555/IMSE staff and help only if HF trained and wears proper PPE)
  3. Apply 2.5% calcium gluconate gel on the exposed region.
  4. Repeat #2-3 until the medical help arrives.
- Calcium gluconate is a topical antidote that should be applied liberally after any HF exposure.
  - Any Potential exposure should be reported and taken seriously with medical attention. HF burns have delayed pain and life is in immediate danger.
  - **Always follow proper notification protocol and report accidents and emergency situations to IMSE staff.**



Calcium Gluconate gel  
kept in First Aid Kit

# Main topics:

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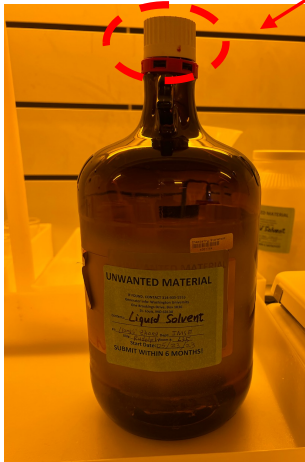
- Emergency Procedures
- Cleanroom Operation
- Cleanroom Dressing
  
- Chemicals handling
- **Disposal of Unwanted Chemicals**

# Types of Waste Streams

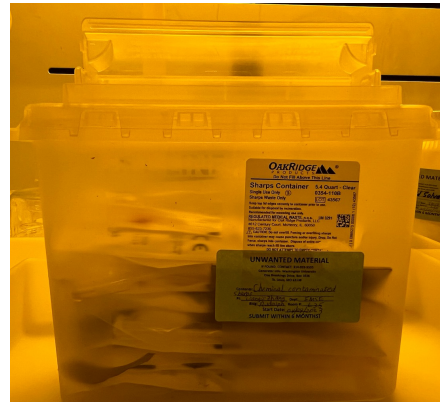
Waste Streams	Type	Location
Acid waste	Liquid	Acid hood
HF waste	Liquid	Acid hood
Solvent waste	Liquid/Solid	Solvent hood
Sharps waste	Solid	Solvent hood
Solid contaminated (metals Au/Ag/Cr etc)	Solid	CR 1000
Non-chemical contaminated solids (General Trash)	Solid	CR 100 / CR 1000
User's Chemical waste	Liquid/Solid	Depending on the process

# Types of Waste Containers

Vented cap should be replaced with sealed cap before removing from Fume Hood



Separate container for Solvent and Acid waste



Sharps Waste Container



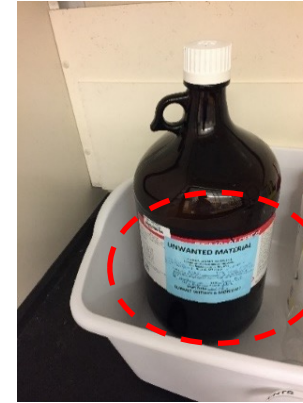
Solid Waste Container



Trash bin for non-contaminated waste

# Disposal of Unwanted Materials

- Read User Instructions next to each Waste Stream
- A separate 'Unwanted Material Content' sheet is located near each waste container
- Estimate the volume of waste to be added to waste container: 100 mL = 'X', 50 mL = '/' or '\'. This is only an ESTIMATE.
- Fill the 'Unwanted Material Content' sheet with appropriate chemical amount and check mark for the chemical being added to waste container.
- If a chemical is not listed, contact Lab Manager before adding to make sure it is compatible to the given waste stream
- **DO NOT Overfill waste container**
- **For Acid Waste Only: Once waste container is 2/3<sup>rd</sup> full, contact the Lab Manager immediately at 5-6774.**
- If in doubt, contact the Lab Manager. **Do not make assumptions.**
- If you see waste bottle and/or containers are full, leave the full bottle/container as is and take an empty container from the shelf next to the acid fume hood, do inform IMSE staff via email



**Liquid Solvent Unwanted Material only:**

Chemical	Volume (x = 100mL)
<input type="checkbox"/> Acetone (100%)	
<input type="checkbox"/> AZ 400K developer - [Water, Potassium borates]	
<input type="checkbox"/> Ethyl Alcohol (100%)	
<input type="checkbox"/> Isopropyl Alcohol (100%)	
<input type="checkbox"/> Methyl Alcohol 100%	
<input type="checkbox"/> MF-319 - [Water (>95.0%), Tetramethylammonium hydroxide (2.2%), Surfactant <1%]	
<input type="checkbox"/> MIBK/IPA - [Isopropyl Alcohol (20-80%), Methyl Isobutyl Ketone (20-80%)]	
<input type="checkbox"/> Remover PG - [N-Methyl Pyrrolidinone (CAS: 872-50-4) >99%, Proprietary Surfactant <1%]	
<input type="checkbox"/> SUB Developer - [1-Methoxy-2-Propanol Acetate (98-100)]	
<input type="checkbox"/> LOR-108 - [Cyclopentanone, 1-methoxy-2-propanol, Polyaliphatic imide copolymer, dye]	
<input type="checkbox"/> Water	
<input type="checkbox"/> A-Thinner - Anisole 99%	
<input type="checkbox"/> AZ-327 Developer - Tetramethylammonium hydroxide	
<input type="checkbox"/> AZ P4620 - 1-methoxy-2-propanol acetate	
<input type="checkbox"/> A25214E - [1-Methoxy-2-Propanol Acetate, Diazosulphoquinonesulfonic esters, 2-methoxy-1-propanol acetate, Cresol novolak resin, phenolic compound]	
<input type="checkbox"/> Black paint (magnesium, silicates, carbon, kaolin clay, naphtha, ethyl benzene, methyl ethyl ketone, testors, mineral spirits)	
<input type="checkbox"/> 2-butanol	
<input type="checkbox"/> CO-26 - [Water, Tetramethylammonium hydroxide (2.4%)]	
<input type="checkbox"/> Chloroform	
<input type="checkbox"/> EBR PG - [1,3 Dioxolane (70-80%), Propylene glycol monomethyl ether (20-30%)]	
<input type="checkbox"/> KL R 15 - [propylene glycol monomethyl ether acetate, Mixed cresol novolak resin, Diazo Photoactive Compound, Proprietary dye, Proprietary Additives]	
<input type="checkbox"/> MCC Primer 80/20 - [1-Methoxy-2-propanol acetate, 1,1,1,3,3,3-hexamethyldisilazane 15-25%]	
<input type="checkbox"/> MF-26 - [Tetramethylammonium hydroxide 2-2.5%, Water 96.5 - 99%, Polyglycol <1%]	
<input type="checkbox"/> MMAE (S) MAA - [Ethyl lactate (75-100%), Polymethylmethacrylate/methacrylic acid (5-25%)]	
<input type="checkbox"/> Omnicat - [Cyclopentanone (70-90%), 1-methoxy-2-propanol (10-20%)]	
<input type="checkbox"/> PA400R (HD MS) - [Propylene Glycol Monomethyl Ether Acetate >95%, d-Limonene <5%]	
<input type="checkbox"/> PA401D (HD MS) - [Cyclopentanone >60%]	
<input type="checkbox"/> S50 PMMA - [Anisole (85-99%), Polymethylmethacrylate (1-15%)]	
<input type="checkbox"/> S1805 - [Propylene Glycol monomethyl ether acetate, Cresol novolak resin, Diazo Photoactive compound, Cresol, Fluoroaliphatic polymer esters]	
<input type="checkbox"/> SC 1827 - [Diazo Photoactive Compound, Nonionic surfactant, Mixed cresol novolak resin, propylene glycol monomethyl ether acetate, Cresol]	
<input type="checkbox"/> SUB Resists - [Gamma Butyrolactone, Mixed Triarylsulfonium/Hexafluoroantimonate Salt, Propylene Carbonate, Epoxy Resin]	
<input type="checkbox"/> SUB 2000 - [Epoxy resin, Cyclopentanone, Hexafluoroantimonate Salt, Propylene Carbonate, Triarylsulfonium salt]	
<input type="checkbox"/> SUB 3000 - [Epoxy resin, Cyclopentanone, Formaldehyde polymer, Cycloaliphatic epoxy resin, Propylene carbonate, polyglycidyl ether, Bis-triarylsulfonium hexafluoroantimonate salt, Aromatic sulfonium hexafluoroantimonate salt, 3-(2,3-epoxypropoxy)propyltrimethoxysilane]	
<input type="checkbox"/> ZEP 520A - Anisole (89%), Methyl Styrene/Chloromethyl Acrylate Copolymer (11%)	
<input type="checkbox"/> ZED-N50 - [n-Amyl acetate (>99%)]	



Storage of empty waste bottles and containers

**Improper disposal endangers everyone in the cleanroom and will result in a suspension of cleanroom privileges**

An example of EHS Blue 'Unwanted label' and additional sheet for chemicals list details



# Cleanroom IMSE Staff



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# Appendix

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# Appendix – I: Liquid Nitrogen Use

- Read WashU EHS training document
  - <https://ehs.wustl.edu/documents/>
  - <https://wustl.box.com/s/y3plx9utn77nkxkrqjmm7ope0f0vvs1>
- Read Safety Data Sheet
  - <https://wustl.box.com/s/ik1xfq75coc8genl5vuhgv59v8pqmtyn>
  - <https://imse.wustl.edu/clean-room-information>
- Dangers
  - Cryogenic burns
  - May cause frostbite.
  - May displace oxygen and cause rapid suffocation.
- Personal Protective Equipment
  - Long pants
  - Closed toe shoes
  - Full arm shirt (or cleanroom gown)
  - Face shield
  - Cryogenic Gloves
- Make sure the room has heavy air circulation
- Portable Oxygen monitor may be required for closed room environments
- Only use during regular hours 8 AM – 5 PM