

Center for Integrated Nano-Technologies

Integration Lab General Operating Procedure (IL General OP)

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1. PURPOSE

This document will provide all applicable information for the safe and proper use of the CINT Lithography Lab located in Room 1523. Any questions beyond the scope of this document should be directed to the equipment owner(s) or ES&H coordinator.

2. ACRONYMS

Many pieces of equipment and procedures are known by their associated acronym, it is important to become familiar with the following list to avoid confusion.

SNL- Sandia National Laboratories

CINT- Center for Integrated Nano-Technologies

IL – Integration Lab (Clean Room, Parts Clean, Ebeam Litho and SEM labs)

SOP/OP- Standard Operating Procedure/Operating Procedure

PR- Photoresist

ES&H – Environmental Safety and Health

S&S- Safeguards and Security

QA- Quality Assurance

UV- Ultra Violet

MSDS- Material Safety Data Sheets

SEM-Scanning Electron Microscope

Haz Mat- Hazardous Material

TGMS- Toxic Gas Monitoring System

Litho- Lithography

3. DEFINITIONS

Authorized User- Personnel with the required training and subsequent approval of the Integration Lab manager to use said equipment.

CINT Key Operator- Designated Key Operators are qualified to perform tool specific training of Authorized Users, and are responsible for the maintenance of the equipment.

Visitor- Personnel who have completed the training for Unescorted Access, but have not completed Equipment-Specific training.

ES&H Coordinator – Provides ES&H, S&S, and QA for CINT activities.

4. RESPONSIBILITIES

It is the responsibility of every employee, contractor, and visitor to ensure a safe and healthy working environment. There is no experiment or procedure at Sandia that is so urgent that it needs to be done in an unsafe manner, and it is everyone's obligation to refuse to do work that he or she believes to be unsafe. If there is an activity or situation that is of concern it is their immediate responsibility to contact a supervisor or ES&H representative.

5. TRAINING

The following Corporate-and Site-Specific training is required to obtain IL Unescorted Access. Additional training may also be required. IL Unescorted Access is a prerequisite for ALL Tool-Specific training.

5.1 Corporate Training

IL LAB103 is administered on-site. The remaining Corporate classes are available on the CINT Integration Lab Training page. Additional Corporate classes may be required for specific activities.

- CINT100 – CINT building 518 information
- ENV112 – Hazardous Waste and Environmental Management Training
- ESH100 – Environment, Safety and Health Awareness Training
- LAB100 – Laboratory Standard Information and Training
- IL LAB103 – Site Specific Laboratory Safety Training (administered on-site)
- MED105HF – Hydrofluoric Acid Safety Training

Additional Corporate Training classes may be required for specific activities.

5.2 Operations Training

Based on trainee requirements, the appropriate Operations Training is assigned to trainee.

- Training for Unescorted access to the Integration Lab
- Training for Specific Operations

5.3 Tool Specific Training

For each tool or operation, the user will receive Tool Specific training from a Key Operator. IL Staff will then authorize the user to perform the activity without supervision.

6. APPROVAL, NOTIFICATIONS, SCHEDULING

After completing all required training and signing all applicable documents, users will be issued an Integration Lab badge and granted swipe access to the IL. Badge must be worn above the waist outside the cleanroom suit at all times when in the Integration Lab. NOTE: The Integration Lab badge is NOT a substitute for the users' DOE issued badge. The DOE badge must also be worn at all times while in the CINT facility.

7. SAFETY PRECAUTIONS AND LIMITATIONS

It is important to be able to recognize hazardous conditions not only when directly using a machine, but while other users are using equipment as well. Applicable training must be met before using any specific tools, and it is always a good idea to become familiar with the equipment around you so that preemptive measures can be taken to mitigate hazards. During normal operation all Integration Lab tools are inherently safe and hold limited possibility of exposure to hazards. Only the CINT Key Operator(s) may perform maintenance. However to better inform the user the following list of potential hazards has been given for personal reference.

There are several major hazards present within the Integration Lab:

- Electrical Shock
- Chemical burns
- Fume inhalation
- Mechanical pinch hazards
- Vacuum and High Pressure systems
- Burn Hazards
- UV Burn Hazard/ UV-Light or Non-Ionizing Radiation Exposure
- Ozone Poisoning

7.1 Electrical Shock

Almost all pieces of cleanroom equipment contain components that could pose an electrical shock hazard, however most are set up in a way that non-maintenance use does not carry much inherent threat of shock. Only the CINT Key Operator(s) may open the tool or perform maintenance. However when working with components that have a shock risk ALWAYS first verify the system is turned off and unplug the system from the wall. After power has been turned off the user should verify that the system will not power up and that physical control of the electrical plug is maintained to prevent the tool from being energized during maintenance. 4

7.2 Chemical Burns

There are several chemical benches located within the lithography lab. A user must always be cautious when working with chemicals and follow the procedures outlined in the SOP. Serious and permanent damage can result from contact with the chemicals. It is also important to be aware of people in the vicinity to prevent another user from being injured by accidental exposure. As with all chemical handling it is a user's responsibility to be familiar with the appropriate MSDS, and to ensure that the smallest amounts necessary are used. Never keep a large container of ANY chemical out on the bench. Pour the minimum amount needed and keep containers closed in a safe uncluttered area. In case of exposure every room located in the Integration Lab has an emergency eye wash as well as a shower. However it is crucial to be informed on the chemicals you are using, as different types may require different treatment after exposure.

7.3 Fume Inhalation

As with all chemical handling it is necessary to remain aware of the dangers of fume inhalation. The benches all have integrated fume hoods, but it is a user's responsibility to ensure the fume hoods are running at an acceptable rate. Even with proper fume ventilation a user should never allow open chemical containers to accumulate in the hoods. An excess of chemical fumes can be harmful to a person physically and can also result in an explosion.

7.4 Mechanical Pinch Hazards

Any equipment that has moving parts will have some type of pinch hazard. It is important to be alert when working near moving parts. This is true not only when an Authorized User is engaged in direct use of equipment, but also when other workers are using tools in the area. All work should be performed in a safe, calm, and organized manner. This not only prevents injuries, but is conducive to quality work.

7.5 Vacuum and Pressurized Systems

The majority of equipment in the integration lab contain some type of pressure system. High pressure systems store an extremely large amount of energy, and a user should be absolutely certain of his or her ability to use the equipment before attempting any type of work. When using these types of systems it is crucial to obey the equipment specific SOP to ensure safe venting of the system. Opening up a system that has not been properly vented can be extremely dangerous and can also be detrimental to the equipment.

7.6 Burn Hazards

The lithography lab houses several hot plates. Both direct and indirect contact with the hot plates can be extremely dangerous. It is important to be aware of which hotplates are in use whenever working in the area. Also note that cool down time varies after a user has shut off hot plate. Always be cautious even if hot plates are off and never store any kind of equipment or chemicals in hot plate vicinity.

7.7 UV Burn Hazard

Prolonged exposure to diffused reflection from the Mask Aligner output beam or a few seconds of direct output beam exposure can cause skin burns or burns to the outer layer of the eye. As

with any UV light source always wear UV filtered glasses to protect eyes and limit exposure to UV radiation. During normal operation no equipment gives direct UV exposure.

7.8 Ozone Poisoning

Some equipment contains/uses ozone gas. Never use said equipment if proper ventilation of the gas is not available. If you suspect a leak or build up of gas clear the area immediately and contact the ES&H coordinator.

8. FIRE ALARM EVACUATION

All fire alarms should be treated as the real thing (Figure 1). The responsible EVAC team will ensure all workers are out of the area, do not attempt to evacuate others:

- Stop all work immediately regardless of process being undertaken.
- Go directly to nearest safe exit and leave lab. Do not de-gown; it's important to leave quickly. Do not panic.
- Assemble in the front parking lot.
- Stay out of area/building until EVAC personnel give the ok to return to work.
- All gear must be cleaned before reintroduction to cleanroom:
 - Place all washables in laundry basket (coveralls, smocks, boots, cloth head covers)
 - Wipe down safety glasses, face shields, chemical aprons, tweezers etc.
 - Discard disposable items (gloves, paper face & head covers, shoe covers)



Figure 1 Fire Alarm



Figure 2 TGMS light pole

9. TOXIC GAS MONITORING SYSTEM

The TGMS has barber polls located in Integration Lab main hall, and the 4 exterior corners of the Integration Lab (Figure 2). It has a three tiered light system. Green will be lit up during all normal

operations. In the event of a hazardous gas leak the barber poll may switch to yellow (Caution) or red (Evacuate). In either event please follow appropriate evacuation procedure:

GREEN

- Notify Integration Lab personnel if one or more the green lights are found off. Although the system is designed to protect against single point system failure, absence of a green light signals that a malfunction has occurred.

YELLOW

- Stop what you are working on and put work tools away immediately. If in the middle of a process find the next available safe stopping point to gather things and exit lab.
- De-gown as you would normally.
- Notify Integration Lab personnel of the situation.
- Stay out of lab until TGMS goes back to normal/green mode.

RED

- Stop all work immediately regardless of process being undertaken.
- Go directly to nearest safe exit and leave lab. Do not go through de-gowning procedure, it is important to leave the area as quickly as possible, however do so in a safe manner.
- Assemble in the front parking lot.
- Stay out of building until EVAC personnel give the ok to return to work.
- Place clean room garb in laundry basket and don a clean suit before re-entering.

10. GOWNING PROTOCOL

It is important to become familiar with the Integration Lab prior to beginning any work. The following section is an overview of the usage of the Integration Lab located in the CINT Core Facility (Bldg 518). A user must adhere to all the outlined Integration Lab guidelines at all times. A user may not enter the cleanroom without first completing and signing all applicable SOP's and training.

10.1 Clean Room Gowning

The Pre-Gown Room (Rm 1507) is preparatory for entering the Gowning Room (1508). After entering 1507 the user should complete the following procedure (where applicable) before entering the Integration Lab.

PRE-GOWNING ROOM

STEP 1) Prior to entering the pre-gowning room be sure and write the users name on the board next to the door. Place a marker stating that said user is "in" the cleanroom. Upon leaving move marker to "out" location, this allows other users and safe personal to know who is in the cleanroom.

STEP 2) Swipe badge to enter Pre-Gown room. After entering, pull door closed until it latches.

STEP 3) Step on tacky mat with both feet, then clean shoes by placing one foot at a time into the shoe cleaner (Figure 10-1), located immediately left of the door. Once your shoe is in cleaner gently press the bar forward and hold for a few seconds. Repeat with other foot.

STEP 2) Store all excess personal items in the lockers provided (Figure 10-1).

STEP 3) Pick up a pair of safety goggles located on the wall next to the Gowning Room door (Figure 10-2) and enter the Gowning Room.



Figure 10-1



Figure 10-2

GOWNING ROOM

STEP 1) Upon entering the gowning room use the bench at the left to put on shoe covers (Figure 10-3). Shoe, beard, and hair covers can generally be used a few times before being thrown away. So, there are black boxes located below the bench for storage (Figure 10-4).

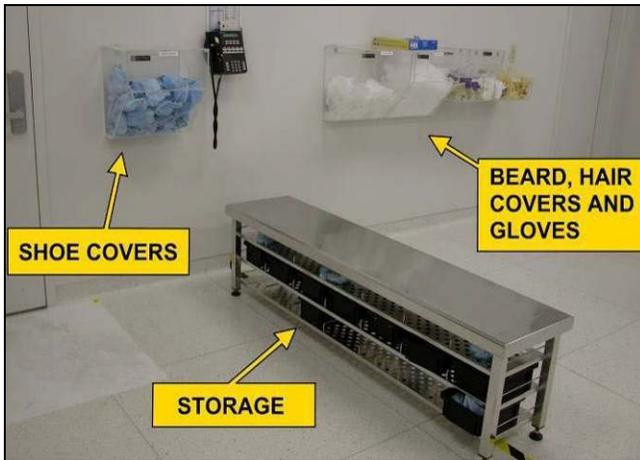


Figure 10-3



Figure 10-4

STEP 2) After putting on shoe covers, swing feet over the bench (Figure 10-5). Bins with beard covers, hair covers, and gloves are located on the wall to the left in the clean portion of the room. Put these items on in that order (Figure 10-6). Make sure that beard cover is placed over the nose, and do not forget to put on protective eye wear.



Figure 10-5



Figure 10-6

STEP 3) Pick out a suit and boots from the storage rack (Figure 10-7), and remove them from their plastic bag. There are hangers located in the center of the room for storing your suit, as well as a rack for storing boots. A user should wear the same suit/boots for a week. At the end of the week (Fridays) the suit/boots need to be placed in the laundry bin across the room for cleaning.



Figure 10-7



Figure 10-8

STEP 4) Step into cleanroom suit (Figure 10-8) and zip it up entirely. Unzip the boots before attempting to put them on (Figure 10-9). The boots have a zip in back, a clip on the lower front, and another clip on the top front. Fasten all clips on the boots so there isn't difficulty walking in them (Figure 10-10). Flip feet over the bench after boots are on properly (Figure 10-11).



Figure 10-9



Figure 10-10



Figure 10-11

STEP 5) Double check that all equipment is on appropriately before entering cleanroom (Figure 10-12). Enter Integration Lab and shut door behind you (Figure 10-13).



Figure 10-12



Figure 10-13

Upon leaving the Integration Lab de-gown in reverse order, place boots in boot rack (Figure 8-14), hang up suit, and store covers in storage containers.

10.2 Parts Clean Gowning

Access to the Parts Cleaning Room does not require full gowning, rather a cleanroom smock is used.

STEP 1) Upon entering the room, directly to the right is a station (Figure 10-14) with shoe, beard, and hair covers. Put all of these items on in that order (Figure 10-15).



Figure 10-14



Figure 10-15

STEP 2) Open and put on an appropriate sized cleanroom smock (Figure 10-16).

STEP 3) Put on gloves and protective eye wear (Figure 10-17).



Figure 10-16



Figure 10-17

Upon leaving the Parts Cleaning Room de-gown in reverse order, and store gowning items in an appropriate box. There is a coat rack provided in that area to allow re-use of the cleanroom smock.

10.3 Bringing Materials into Cleanroom

Several items, especially those which generate high particle levels or introduce potential hazards, are prohibited, including:

- non-cleanroom paper/books – documents may be enclosed in sheet protectors, or printed/photocopied onto cleanroom paper

- cardboard
- pencils
- heavy makeup
- any type of device/object/action that gives off particulate matter
- chemicals – contact IL Staff if you wish to introduce a new chemical to the cleanroom
- food
- drinks – however, drinking water is available in the gowning room
- cameras/videos – pre-approval required

All approved items brought into the cleanroom must first be cleaned to ensure a low particulate level is maintained:

- Don cleanroom gloves.
- With a solvent saturated or dry polyester wipe, clean all exposed surfaces. If item will be opened in the cleanroom, wipe interior as well (skip interior wipe for items which have been packaged in cleanroom conditions).
- If wipe is visibly soiled, repeat.

10.4 Pass-throughs

Pass-throughs are used to bring other items into the cleanroom. All items must be approved before being brought in. Below is a map showing the various pass-throughs (marked with an ‘x’). The main one at the end of the hall (Figure 10-18) is for large equipment move-in. Anything that needs to be brought through needs the approval of IL Staff. The pass-through from the Parts Clean room is used for transferring clean/dirty parts into and out of the cleaning room (Figure 10-19). All items must first be properly cleaned in the parts cleaning room before entering the cleanroom. The final pass-through is located between the supply closets and is used for chemicals and supplies. (Figure 10-20).

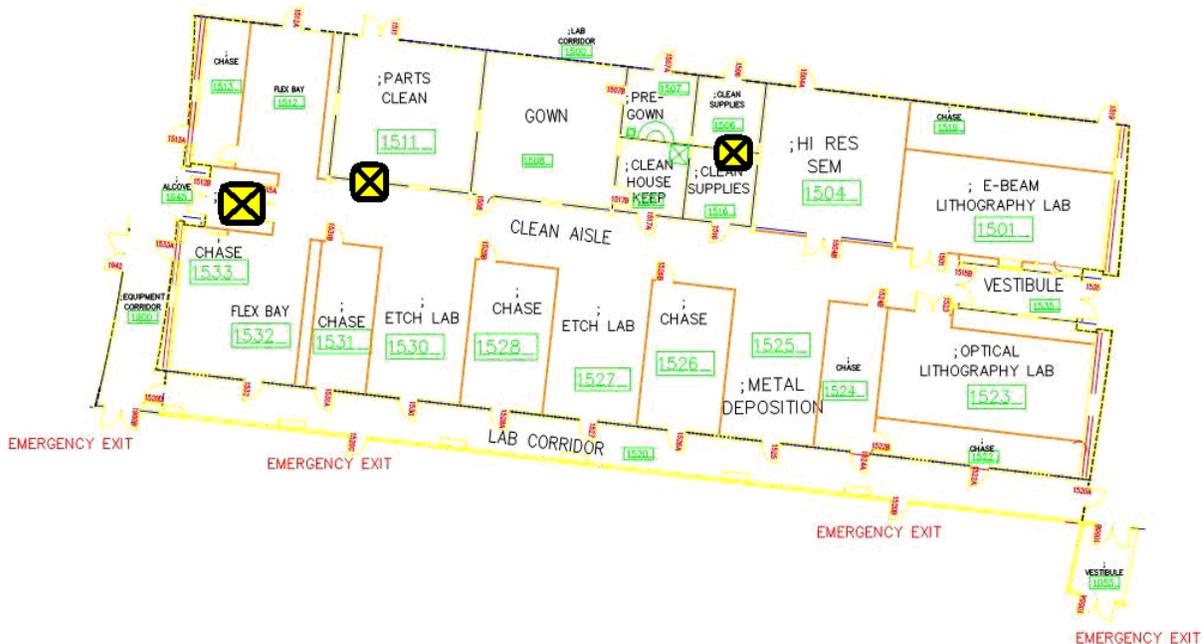




Figure 10-8



Figure 8-19



Figure 8-20

10.5 Cleanroom Etiquette

Users must treat all other workers in the Integration Lab with respect and courtesy at all times. Absolutely no disrespectful or reckless behavior will be allowed. Engaging in prohibited behavior can result in Integration Lab access being revoked. Always be aware of prohibited items/behaviors:

- Horseplay
- Running
- Any hazardous or potentially dangerous actions

It is *every* user's responsibility to ensure a safe, productive, and positive working environment. Failure to adhere to any rules is detrimental not only the user's personal work/safety, but also all others around them.

