

Hard copy of this document, if not marked "CONTROLLED" in red,
is by definition uncontrolled and may be out of date.

Standard Operating Procedure
for
Cleanroom Tool Maintenance

REVISION

Rev No.	DCN No.	Change Summary	Release Date	DCN Initiator	Document Owner
7	DCN3653	Email updates.	June 2024	Caitlin Treacy	Peter Reilly

Prior revision history, if applicable, is available from the Document Control Office.

1. PURPOSE AND SCOPE

This document establishes the requirements for performing maintenance on tools and/or their peripherals at NY CREATES' Albany NanoTech Complex, and the instructions for completing the Cleanroom Tool Maintenance Form.

NOTE: This procedure does not apply to the Wets tools and applies when the tool chamber(s) vacuum system is open such as: chamber openings, vacuum pump removals and fore-line removals. The only exceptions would be if a routine task (e.g., a MFC removal, cycle purge technique, etc.) cannot be carried out as outlined in the tool equipment manual, then this procedure should be followed.

The Cleanroom Tool Maintenance Form (**OPS-00005-F1**) shall be completed and reviewed prior to proceeding with any maintenance or cleaning activities in the cleanroom on tools that contain hazardous production materials (HPMs) or contain materials that if emitted have a high degree of risk associated with them. HPMs are materials that have a degree-of-hazard rating in health, flammability or reactivity of Class 3 or 4 as ranked by the National Fire Protection Agency. Cleanroom tool maintenance operations are not authorized without support from the Cleanroom Tool Maintenance Team. All operations that encompass the opening of HPM (Hazardous Production Materials) systems will be monitored by the Equipment Support Team (EST).

NOTE: If a chamber(s) is under vacuum and gases have not been turned back on, then monitoring does not have to be performed, but a tool maintenance request form still has to be submitted for approval. A statement by the requestor should be in the tool maintenance request form stating that the chambers have been under vacuum and gases have not been turned on.

2. SCOPE

This requirement is applicable to service engineers, Tool Owners, chemical and gas service suppliers, equipment technicians, and facility operators or anyone who performs hazardous work activities on tools and/or its peripherals at the Albany NanoTech Complex site.

3. DEFINITIONS

- 3.1 **Hazardous Production Materials (HPMs):** A solid, liquid or gas associated with semiconductor manufacturing that has a degree-of-hazard rating in health, flammability or reactivity of Class 3 or 4 as ranked by NFPA 704 and which is used directly in research, laboratory, or production processes which have as their end product materials that are not hazardous.
- 3.2 **Non-Routine Work:** Modifications, experiments, or maintenance tasks performed on equipment that house or use HPMs that carry a high level of risk and are considered unusual or non-routine.
- 3.3 **PPE:** Personal Protective Equipment; used to protect personnel from chemical and physical hazards. This includes: safety glasses, respiratory protection, hand protection, and protective clothing.
- 3.4 **Routine Work:** Modification or maintenance tasks performed on modules or tools that are determined to be non-risk as documented in work instructions.
- 3.5 **Tool Owner:** Engineer, technician, or facility operator who is responsible for the safe operation of the equipment, process module, or tool running process in the lab or facility.

4. RESPONSIBILITIES

- 4.1 The Tool Owner, Equipment Engineer, Researcher, or Requester is responsible for:
- Following the information provided in this procedure and for completing the Cleanroom Tool Maintenance Form (**OPS-00005-F1**) as necessary.
 - Coordinating the maintenance activity and obtaining approval for the activity.
 - Completion of all Items of Responsibility listed in Step 6.10.
 - Filling out the Non-Routine Hazardous Work Permit (**EHS-00062-F1**)
 - Filling out the Work Authorization Permit (**CFM-00004-F1**).
 - Modifying and or updating the Scope of Work (SOW), as needed.

- 4.2 The Senior Cleanroom Operations Manager or designee is responsible for:
- Coordinating the activity between the requestor and the Equipment Support Team.
- 4.3 The Equipment Support Team (EST) is responsible for:
- Verifying the Cleanroom Tool Maintenance Form (**OPS-00005-F1**) has been filled out completely and that all the information in the form is accurate.
 - Providing all required materials, such as the supplied air cart and monitoring equipment, etc. to the maintenance activity.
 - Setting up portable monitors, monitoring the area, halting the activity and if necessary, evacuating the area.
 - Completion of all Items of Responsibility listed in Section 6.10.
- 4.4 The NY CREATES Environmental, Health and Safety (EHS) department is responsible for:
- Ensuring preventive activities are taken to prevent unsafe conditions to humans, the facility, and the environment.

5. ASSOCIATED DOCUMENTS

CFM-00004-F1: Work Authorization Permit

EHS-00010: Personal Protective Equipment Requirements

EHS-00015: NY CREATES Respiratory Protection Program

EHS-00031: TGMS Operation and Maintenance

EHS-00062-F1: Non-Routine Hazardous Work Permit

OPS-00005-F1: Cleanroom Tool Maintenance Form

6. INSTRUCTION STEPS

6.1 Requested By

The Cleanroom Tool Maintenance Form (**OPS-00005-F1**) should be completed by the Tool Owner, Equipment Engineer, Researcher, or Requester completing the work. Those that are not familiar with the materials that have been run through the tool or its peripherals shall consult the Tool Owner or process engineer to ensure that they are completing the form accurately. If the form is incorrectly annotated as determined by the CNSE Equipment Support Team, a new form must be resubmitted and approved prior to beginning any cleanroom maintenance activity. Submit the form to Equipment_Support_Team@ny-creates.org

NOTE: All cleanroom tool maintenance requires a Cleanroom Tool Maintenance Form be submitted. If multiple tool maintenance forms are submitted for the same time of the day, the Equipment Support Team will prioritize the chamber openings. Cleanroom tool maintenance operations must NOT be performed without support from the Equipment Support Team. The Equipment Support Team must be present to sample all tools, modules, chambers, forelines, etc. for hazardous conditions.

6.2 Date of Request

All routine work requests will be performed between the hours of 7:00 AM - 7:00 AM (24 hrs), 7 days a week. All requests should be submitted at least 12 hours before the activity takes place. Emergency requests will be handled on an as-needed basis.

6.3 Number of Pump and Purge Cycles

6.3.1 The tool's chamber, foreline, vacuum pump or scrubber must be cleaned prior to the maintenance activity. This cleaning is often referred to as pump purging, which is done by filling the chamber with a clean, non-toxic gas and drawing this gas and the residual gas through the foreline, vacuum pump, and out to the scrubber. This routine is performed several times in an attempt to flush out any residual gases that may remain in the part of the tool that must be serviced.

6.3.2 The number of pump and purge cycles is specified by the manufacturer of the equipment being purged.

NOTE: Effective purging is not always possible with some tools or processes; therefore, the EHS/ERT department and Equipment Engineer should be consulted prior to proceeding with the activity to determine if additional safeguards will be needed.

6.3.3 The Tool Owner, Equipment Engineer, Researcher or Requester, etc. are required to provide verification of pump and/or purge cycles, prior to the start of any operation.

6.4 **Secure the Area**

6.4.1 Danger tape must be setup at a minimum of ten feet (10') from the maintenance area in order to secure the area affected. If workers leave the work area unattended, they must post signage with date and time of work start and completion, and a contact name and phone number. The signs shall read:

“Restricted Access – Ongoing Maintenance Activity
Authorized Personnel with Required PPE Only”

NOTE: If the maintenance activity is conducted in an enclosed walled area, the signage shall be placed at the entry locations.

6.4.2 The Requestor will provide and apply appropriate signage after the area has been secured by the agency performing the maintenance.

6.5 **Personal Protective Equipment (PPE)**

6.5.1 Depending on the activity to be performed those performing maintenance may be required to wear PPE. Refer to the SOPs, job hazard assessments, Personal Protective Equipment Requirements (**EHS-00010**), and NY CREATES Respiratory Protection Program (**EHS-00015**) for PPE requirements.

6.6 **Specialized Equipment Requirements (If Any)**

6.6.1 Snorkel exhaust must be available for all cleanroom maintenance. This supplemental exhaust is used to capture any residual gases that may remain in the tool or equipment that is being worked on. This exhaust should be positioned as close to the opening as possible (≤ 5 ”).

6.6.2 If the activity also has the possibility of generating sparks or smoke or has the possibility of catching on fire, a fire extinguisher must be made available in the immediate area.

6.7 TGMS Maintenance Mode

Tools and/or adjacent system(s) (i.e. <10' away) that could be affected by the activity shall be put in TGMS Maintenance Mode during the activity, by the person performing the activity, and Security must be notified. Any exceptions require approval by EST and EHS. Coordination with nearby tools or systems must be done prior to putting such systems into TGMS Maintenance Mode. TGMS Maintenance Mode is used in order to disable evacuation horns and alarms in the affected cleanroom. Please refer **EHS-00031** for specific instructions regarding placing a tool into TGMS Maintenance Mode.

When forelines require cleaning in place, the tool (and possibly nearby tools) must remain in Maintenance Mode during the cleaning process.

NOTE: After the work is complete, the tool must be taken out of Maintenance Mode and Security must be notified.

6.8 Job Briefing

Prior to commencing work, the task owner shall conduct a job briefing with the Equipment Support Team and other affected personnel. The briefing shall cover at least the following subjects:

- Scope of work
- Sequence of tasks
- Potential hazards
- Monitoring points
- Snorkel placement locations
 - Prior to starting the operation, determine where the snorkel will be placed in case of an emergency and communicate this to all involved in the operation.
 - When verifying the tool's ability to "clean" a chamber, snorkel placement must be carefully considered. The monitoring tubing must be placed in the direct vicinity of the chamber, fore-line, etc. and be allowed to retrieve a sample BEFORE the snorkel is allowed to remove contents from the chamber.

- If the snorkel is placed at the point of the opening when the chamber is first opened, and prior to retrieving the sample, the chamber will be partially purged by the snorkel, resulting in a skewed test result that does not reflect the actual condition of the chamber. The snorkel should be powered on and standing by in close proximity to the operation in the event that the emission levels are exceeded, and the snorkel is immediately required.
 - Personal protective equipment requirements
 - Emergency procedures
 - Communication methods and team organization (who is who: task owner, safety officer, team lead, etc.)

6.9 Detection

- 6.9.1 All activities that could result in process gases being emitted into the ambient cleanroom environment must be monitored using portable gas detection.
- 6.9.2 Once the Equipment Support Team receives the completed Cleanroom Tool Maintenance Form, they must determine the Threshold Limit Value (TLV) of the gases that have been run to determine which gases to monitor. Gases to be monitored will be based on those with the lowest TLV or their by-products. Portable monitors will be set-up to detect at least two different families of gases (for example, hydrides, mineral acids, amines, etc.) that have been run through the tool or its peripherals.
- 6.9.3 The Equipment Support Team (EST) will site the current HPM spreadsheet to determine the previously monitored gases to ensure the same gases are monitored in order to validate successful monitoring events. For any questions, consult EHS.
- 6.9.4 An action level of one quarter the TLV ($\frac{1}{4}$ TLV) is determined and communicated to the parties involved before the activity takes place. Readings that are above this action limit but below the TLV that last longer than one (1) minute will result in the activity being halted. Complaints of an odor in the area should also halt the activity.
- 6.9.5 The Equipment Support Team should record readings above zero every 30 seconds at operator's breathing zone, then at the snorkel exhaust, then in ambient air after the chamber has been fully opened. For anything requiring paper tape meters, a longer monitoring time will be required (e.g., AsH₃ requires 5 minutes).

- 6.9.6 The sampling tubes used for monitoring placed at no further than 1-2” from the open area, but not inside the tool or equipment.
- 6.9.7 Readings that are above zero should be documented and noted on **OPS-00005-F1** and the EST spreadsheet. EHS must also be notified.
- 6.9.8 If the results of the monitoring reveal zero detection, then monitoring is no longer necessary, and the work can resume.
- 6.10 **Completion**
- 6.10.1 This section details the responsibilities of the Tool Owner (**TO**) and the Equipment Support Team (**EST**) upon completion of the operation.
- Has system(s) been taken out of maintenance mode and reactivated?
 - Has the waste been placed in the hazardous waste container or placed in the chemical pass-through for Air Liquide to pick-up?
 - Has local snorkel exhaust hose been removed?
 - Have caution tape and signs been removed?
- 6.10.2 Upon completion of the operation, the Equipment Support Team is required to ensure that all equipment is serviced and ready for the next operation.
- 6.10.3 Return Breathing Air Cylinder Cart(s) to storage area.
- CAUTION:** Ensure Cylinders are closed and capped prior to transport.
- 6.10.4 The Equipment Support Team will transport the Breathing Air Cart to the storage area upon completion. If the cart is still in use when the Equipment Support Team departs the scene, or if the cart is used without the presence of the Equipment Support Team, the Tool Owner is responsible for placing the cart in the fab/subfab materials pass-through and contacting the Equipment Support Team and/or the Senior Cleanroom Operations Manager or Production Lead, to notify them that he/she is done with the cart. The Equipment Support Team will then transport the cart to the storage area.
- 6.10.5 The Equipment Support Team will evaluate if there is sufficient air for the next use (minimum 1000 lb.) and contact Air Liquide and/or B-Lann if the cylinders require refilling. The Equipment Support Team will replace the empty cylinder with a full cylinder from the spare cylinder rack in the storage area. The Equipment Support Team will deliver the empty cylinder(s) to the loading dock and retrieve the full cylinders from the loading dock and transport them to the appropriate storage area.

6.10.6 The Equipment Support Team will ensure the following actions have been completed prior to storing the Breathing Air Cart and the cleanroom maintenance cart:

- 1) Wipe, clean, and properly store all respirator masks.
- 2) Remove unnecessary items from cart.
- 3) Place sensors in appropriate storage areas.
- 4) Ensure that the following items are on the Breathing Air Cart and in good working order:
 - a) 2 masks
 - b) 2 regulators
 - c) 2 air hoses