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**Procedure
for**
Equipment Decontamination

REVISION

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2	DCN0708	Added Title Page, Updated CNSE terminology and logo. Modified Sections 1.5, and 3.1; Added Section 4.21 Chemical Mechanical Polishing (CMP).	10-19-11	Jennifer Trodden	Robert Segura

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1 PURPOSE AND SCOPE

- 1.1 The purpose of this procedure is to provide specific instruction for the decontaminating and/or removal of equipment and to ensure all equipment and support systems are decontaminated in a manner consistent with applicable codes, regulations and sound engineering practices.
- 1.2 This process ensures that equipment is decontaminated or removed in a manner that will allow lowest possible risk to employees, operations or maintenance activities.
- 1.3 The procedures outlined in this document are examples of procedure to apply to the decontamination and/or removal of equipment and support systems installed at the CNSE facility. Any equipment, which is being decontaminated and/or removed, must go through the equipment decontamination process.
- 1.4 This procedure applies to capital equipment and machinery used directly or indirectly in the manufacturing, testing, and development of products or in the operation of the facility or production support systems at CNSE.
- 1.5 The CNSE Tenant, Contract or Sub-Contract Equipment Engineer shall comply with the appropriate decontamination procedures. [The following list of procedures should be used for guidance and only where decontamination procedures may not exist. Tenant, contractor and sub-contractors may use their own decontamination procedures provided that such procedures are more stringent than those outlined below.](#)
- [Diffusion Furnaces,](#)
 - [Photoresist Spin Tracks and Developers,](#)
 - [Etchers and Ashers,](#)
 - [Chemical Vapor Deposition Systems,](#)
 - [Ion Implanter,](#)
 - [Sputters,](#)
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 - [Wet Pumps,](#)
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 - [Acid Sinks,](#)
 - [Stripper Sinks,](#)
 - [Solvent Sinks,](#)
 - [Lead Contaminated Equipment,](#)
 - [Process Gas Lines,](#)
 - [Acid Drain Lines,](#)
 - [Exhaust Ventilation Ducting,](#)
 - [Floor, Walls, Trenches,](#)
 - [Gas Cabinets,](#)

- [Spin Rinse Dryers \(SRD\)](#),
- [Tube Cleaners](#),
- [Chemical Mechanical Polishing \(CMP\)](#).

1.6 By necessity, this document is limited in scope. The EHS representative and Equipment Engineer shall apply professional judgment and knowledge above that which is included in this specification.

This section is required on all documents.

2 RESPONSIBILITIES

- 2.1 The EHS Department is responsible for providing reviews of the decontamination procedure to ensure that each operation is conducted in a safe manner and all materials generated are disposed of appropriately.
- 2.2 The EHS Department is responsible for maintaining records of completed equipment decontamination/removal for one year.
- 2.3 In conjunction with obtaining and posting the Equipment Decommissioning/Removal Safety Sign-off Checklist at or near the subject equipment, the ANT, Tenant, Contract or Sub-Contract Equipment Engineer is responsible for performing the appropriate decontamination procedure, in a safe and timely manner, and disposing of materials generated appropriately.

3 SAFETY

- 3.1 Proper personal protective equipment must be worn at all times when decontaminating equipment. At a minimum, the following PPE should be used:
- Chemical resistant gloves
 - Safety glasses
 - Faceshield
 - Arm guards
 - Chemical apron
 - Cartridge respirator- for solvent fumes, [corrosive](#) fumes, [CMP particulates](#), dusts
 - Airline respirator or Self Contained Breathing Apparatus- for toxic gases
 - Tyvek Suit and Shoe Covers- for large jobs where the possibility that contamination may touch clothes. Work on potentially contaminated floors is an example.
- 3.2 Material Safety Data Sheets (MSDS) are available for all chemicals used at CNSE. Consult the MSDS before conducting decontamination to better

understand the hazards and needed precautions for chemicals involved. MSDS binders are located in the clean room gowning areas.

- 3.3 All hazardous waste materials generated from decontaminations must be properly handled as hazardous wastes in accordance with Hazardous Waste Management Plan. Materials must be properly bagged, sealed, and labeled as hazardous waste. Materials that are corrosive, flammable, oxidizer, or poisonous are all considered hazardous. Examples include decontamination wipes, residues removed from equipment, parts which cannot be cleaned, and used personal protective equipment.
- 3.4 Some decontamination work may require the use of a cartridge or airline respirator. Any employee who wishes to wear a respirator must first complete respirator safety training, complete a medical exam, and complete a respirator fit test. No facial hair is allowed for respirator users.
- 3.5 All sources of harmful energy must be locked out and tagged out to prevent accidental start-up or release of liquids/gases. Types of lock-outs will depend on the type of tools to be decontaminated and the energy sources involved. The LOTO procedure should be determined prior to starting work.
- 3.6 Any questions regarding decontamination procedures, use of personal protective equipment, chemical hazards, and waste disposal should be referred to the EHS Department site contact: Robert Segura 437-8627 or rsegura@uamail.albany.edu.

4 DECONTAMINATION PROCEDURES

4.1 Diffusion Furnaces

4.1.1 Hazards

- Flammable Gases (Hydrogen, Silane, Trans-LC),
- Toxic Gases (Hydrogen Chloride, Phosphine, Ammonia, Dichlorosilane, Phosphorous Oxychloride),
- Pyrophoric Residues (Silane, Dichlorosilane),
- High Voltage.

4.1.2 Procedure

- Gas lines cycle purged and disconnected. Cap off gas lines at the gas cylinder and the tool end. See specific procedure for proper decontamination of gas lines.
- Remove gas bottles from gas cabinets. Remove bubblers from jungle area. Remove all contaminated bubbler tubing and either decontaminate or dispose of as hazardous waste.
- Remove quartz tubes and clean in tube cleaner to remove contamination.
- Power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Disconnect vacuum pumps and remove any pump oil. For proper decontamination of wet and dry vacuum pumps see specific procedure.
- Tool exhaust should be left in place until a thorough inspection of the diffusion tube area is made to determine if chemical contamination is present. If contamination is present, remove particles with a HEPA vacuum or wipe with a wet towel.
- Disconnect the scavenger area, tube area exhaust ducts, support brackets, etc. and seal the main exhaust duct to maintain system exhaust to other tools in the area. **WARNING:** scavenger exhaust area can contain highly corrosive liquids and/or solids.
- Dismantle the furnace cabinet into manageable components for decontamination and eventual movement out of the cleanroom area. Wipe down or vacuum all surfaces to remove dusts and other contamination. Surfaces should have a pH of between 5 and 9. If necessary, use liquid acid neutralizer.
- Check the pH of the following surfaces to ensure decontamination: scavenger exhaust boxes, loading table, each shelf in the gas jungle box, gas regulator boxes, and floor.
- If the furnace will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.

- If the tool or contaminated components (such as the scavenger exhaust) will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.
- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedures in removing contaminated exhaust ducting.
- Ensure floor and wall surfaces are wiped down in accordance with clean room protocols.

4.2 Photoresist Spin Tracks and Developers

4.2.1 Hazards

- Flammable Liquids (Photoresists),
- Corrosive Liquids (Positive Developer).

4.2.2 Procedure

- All spin tracks, coaters, and developers should be emptied of chemicals from their supply cabinets. Properly dispose as hazardous waste.
- Purge all lines to remove residual chemicals. Use water to purge positive developer lines. Use acetone to purge positive photoresist lines. Use xylene to purge negative photoresist lines. It may be necessary to disconnect internal lines to enable “gravity flow” drainage of residual liquids from pumps and lines.
- Power switches should be locked-out and tagged out at the main breaker panel. Test the “on” switch to ensure that the tool will not power up.
- Remove the spin cups and clean at the solvent cleaning sink. Clean the drain cups under the chucks. Remove solids and residues as much as possible. Discoloration is allowed.
- Clean the internal cabinet area. Remove solids and residues as much as possible. Discoloration is allowed. Surfaces should have a pH of between 5 and 9. Check the following surfaces for pH: cabinet floor and trays, spin cup areas, top surfaces on unit, insides of doors, floor

- Once all surfaces have been cleaned and pH tested, remove the exhaust ducts. Warning: the ducts may contain liquids sucked from the tracks. Be prepared to collect and properly dispose as hazardous waste. See specific procedures for removing contaminated exhaust ducting.
- If the track will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- If the tool or contaminated components will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.
- Remove all chemical identification labels and signs from the outside of the tool.
- Ensure floor and wall surfaces are wiped down in accordance with clean room protocols.

4.3 Etchers and Ashers

4.3.1 Hazards

- Toxic Gases (Hydrogen Chloride, Chlorine, Hydrogen Bromide),
- Perfluorocompounds (Freon, Breakdown products from plasma-fluoride containing),
- High Voltage.

4.3.2 Procedure

- Gas lines cycle purged and disconnected. Cap off gas lines at the gas cylinder and the tool end. See specific procedure for proper decontamination of gas lines.
- Remove gas bottles from gas cabinets.
- Power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Disconnect vacuum pumps and remove any pump oil. See specific procedure for proper decontamination of wet and dry vacuum pumps.

- Tool exhaust should be left in place until thorough inspections of the chambers are made to determine if chemical contamination is present. If contamination is present, remove particles with a HEPA vacuum or wipe with a wet towel.
- Dismantle the tool into manageable components for decontamination and eventual movement out of the cleanroom area. Wipe down or HEPA-vacuum all surfaces to remove dusts and other contamination. Surfaces should have a pH of between 5 and 9. If necessary, use liquid acid neutralizer. Check surfaces for fluoride contamination with Spilfyter strips. Fluoride should be non-detectable. Check the following surfaces for pH and fluoride: inside surfaces of chamber, outside surface of tool, floor.
- Remove any pump filters and properly dispose. WARNING: filters can contain toxic process byproduct solids.
- Disconnect the exhaust ducts and seal the main exhaust duct to maintain system exhaust to other tools in the area.
- If the tool will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- If the tool or contaminated components (such as the scavenger exhaust) will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.
- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedures in removing contaminated exhaust ducting.
- Ensure floor and wall surfaces are wiped down in accordance with clean room protocols.

4.4 Chemical Vapor Deposition Systems

4.4.1 Hazards

- Toxic Gases (Phosphine, Diborane, Ammonia, Silane),
- Perfluorocompounds (Freon, process byproducts- contain fluoride),
- High Voltage.

4.4.2 Procedure

- Gas lines cycle purged and disconnected. Cap off gas lines at the gas cylinder and the tool end. See specific procedure for proper decontamination of gas lines.
- Remove gas bottles from gas cabinets.
- Power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Disconnect vacuum pumps and remove any pump oil. See specific procedures for proper decontamination of wet and dry vacuum pumps.
- Tool exhaust should be left in place until thorough inspections of the chambers are made to determine if chemical contamination is present. If contamination is present, remove particles with a HEPA vacuum or wipe with a wet towel.
- Dismantle the tool into manageable components for decontamination and eventual movement out of the cleanroom area. Wipe down or HEPA-vacuum all surfaces to remove dusts and other contamination. Surfaces should have a pH of between 5 and 9. If necessary, use liquid acid neutralizer. Check surfaces for fluoride contamination with Spilfyter strips. Fluoride should be non-detectable. Check the following surfaces for pH and fluoride: inside surfaces of chamber, outside surface of tool, floor.
- Remove any pump filters and properly dispose. WARNING: filters can contain toxic process byproduct solids.
- Disconnect the exhaust ducts and seal the main exhaust duct to maintain system exhaust to other tools in the area.
- If the tool will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- If the tool or contaminated components (such as the scavenger exhaust) will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.

- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedures in removing contaminated exhaust ducting.
- Ensure floor and wall surfaces are wiped down in accordance with clean room protocols.

4.5 Ion Planter

4.5.1 Hazards

- Toxic Gases (Arsine, Phosphine, Boron Trifluoride),
- Toxic Solids (Arsenic Trioxide),
- Extremely High Voltage.

4.5.2 Procedure

- Gas lines cycle purged and disconnected. Cap off gas lines at the gas cylinder and the tool end. See specific procedure for proper decontamination of gas lines.
- Remove gas bottles from gas cabinets inside tool.
- At this time, ANT will not perform ion implant decontaminations due to the complexity. Only the tool manufacturer or approved decontamination vendors with ion implant experience will be used. Specific procedures will be identified at that time.
- Tool exhaust should be left in place until thorough inspections of the chambers are made to determine if chemical contamination is present. If contamination is present, remove particles with a HEPA vacuum or wipe with a wet towel. Contact the EHS department to arrange for wipe sampling of surfaces for possible arsenic contamination. Sampling should occur inside the chamber surfaces, in the source cabinets, in the area of the vacuum pumps, and the floor areas directly beneath the unit.
- Disconnect the exhaust ducts and seal the main exhaust duct to maintain system exhaust to other tools in the area. **WARNING:** Ducting may contain pyrophoric solids. Use Hot Work permit procedures to prevent fire. **WARNING:** Ducting may contain Arsenic Trioxide dust that is highly toxic and carcinogenic. Care must be taken in minimizing the disturbance of this dust.

- If the tool will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- If the tool or contaminated components (such as the scavenger exhaust) will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.
- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedures in removing contaminated exhaust ducting.
- Ensure floor and wall surfaces are wiped down in accordance with clean room protocols.

4.6 Sputters

4.6.1 Hazards

- High Voltage,
- RF Power Supplies,
- Capacitors.

4.6.2 Procedure

- Remove source materials and targets.
- Power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Disconnect vacuum pumps and remove any pump oil. See specific procedures for proper decontamination of wet and dry vacuum pumps.
- Disconnect liquid nitrogen lines.
- Disconnect any exhaust ducts.
- Drain any water lines.

- Dismantle tool into manageable components. Seal with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.

4.7 Ovens

4.7.1 Hazards

- High Voltage,
- Corrosive/Toxic Residues (possible residual contamination).

4.7.2 Procedure

- Power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Tool exhaust should be left in place until a thorough inspection of the oven interior is made to determine if chemical contamination is present. If contamination is present, remove particles with a HEPA vacuum or wipe with a wet towel. Surfaces should have a pH of between 5 and 9. If necessary, use liquid acid neutralizer. Check the following surfaces for pH: inside areas of the oven, top surface of the oven, oven door.
- Disconnect the exhaust ducts and seal the main exhaust duct to maintain system exhaust to other tools in the area.
- If the tool will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- Contaminated components will be disposed, bag labeled and sealed. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.
- See specific procedures in removing contaminated exhaust ducting.

4.8 Wet Pumps

4.8.1 Hazards

- Toxic Gases (absorbed into oil from process).

4.8.2 Procedure

- Power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Many pumps are equipped with oil filters and/or drains that will permit draining the oil with the pump in place. Drain all the oil. Remove all filters. Dispose as hazardous waste.
- Keep Fomblin Oil separate since this material is very expensive and can be recycled.
- Tool exhaust should be left in place until a thorough inspection is made to determine if chemical contamination is present. If contamination is present, remove particles with a HEPA vacuum or wipe with a wet towel. Surfaces should have a pH of between 5 and 9. If necessary, use liquid acid neutralizer. Check the following areas for pH: inside surface, outside surfaces, floor
- Disconnect the exhaust ducts and seal the main exhaust duct to maintain system exhaust to other tools in the area.
- If the pump will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- Contaminated components will be disposed, bag labeled and sealed. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.
- See specific procedures in removing contaminated exhaust ducting.

4.9 Dry Pumps

4.9.1 Hazards

- Toxic Solids (residues accumulated from process).

4.9.2 Procedure

- Power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Tool exhaust should be left in place until a thorough inspection is made to determine if chemical contamination is present. If contamination is present, remove particles with a HEPA vacuum or

wipe with a wet towel. Surfaces should have a pH of between 5 and 9. If necessary, use liquid acid neutralizer. Check the following surfaces for pH: inside surface, outside surfaces, floor.

- Disconnect the exhaust ducts and seal the main exhaust duct to maintain system exhaust to other tools in the area.
- If the pump will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- Contaminated components will be disposed, bag labeled and sealed. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.
- See specific procedures in removing contaminated exhaust ducting.

4.10 **Acid Sinks**

4.10.1 Hazards

- Corrosive Liquids (Sulfuric Acid, Hydrofluoric Acid, Phosphoric Acid),
- Fluorides.

4.10.2 Procedure

- Drain process chemicals from the baths. Flush baths with water and drain to remove any residuals.
- Remove any circulation bath filters and dispose as hazardous waste. Flush the filter system with water to remove residual acid.
- The entire sink should be cleaned while still connected to drains and exhaust. Wash with high pressure, hot water to remove residues. This includes the sink baths, sink deck, sink plenum, and rear portions. Ensure recirculating baths and internal pumps are purged with water to remove acid residues. If necessary, use liquid acid neutralizer to bring the pH to between 5 and 9. Drain all water from lines and the plenum. If necessary, compressed air or nitrogen can be hooked to the lines to push out any remaining water.
- Test the sink for pH with pH paper to ensure all surfaces are between 5 and 9. Test the sink for fluoride with Spilfyter strips to ensure there are no detectable amounts of fluoride on surfaces. If tests indicate the presence of acid residues, repeat 2.3. Check the following surfaces for pH and fluoride: plenum floor and trays, each

acid bath, sink deck surfaces, sink controller “touch pads”, sink sides, back of sink, floor.

- Once the sink is verified as clean, power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Disconnect DI water lines, drain lines, and sink exhaust. Check the pH of the drain line and exhaust connections remaining on the sink. If necessary, use liquid neutralizer to ensure these surfaces have a pH between 5 and 9. Cap-off the DI water and drain lines to prevent leakage or spills from the main trunks. Block off the main exhaust trunk so that exhaust on other equipment is not affected.
WARNING: the ducts may contain liquids sucked from the sinks. Be prepared to collect and properly dispose as hazardous waste. See Specific procedure 17 for procedures in removing contaminated exhaust ducting.
- If the sink will be disposed, remove internal components, baths, heater trays and containers, etc. and transport them outside to the designated decontamination area. Sink parts will be further decontaminated using a hot pressure washer. Wipe test as per 2.4 to ensure no residues are present.
- If the sink will be disposed, dismantle the sink by cutting into manageable specific procedures with a saw and/or hammer. If necessary, further wash the specific procedures to ensure the pH is between 5 and 9 and that there are no detectable traces of fluoride. Place the cleaned pieces into a disposal bin.
- If the sink will be relocated or sold, disregard 2.7 and place sink components removed for cleaning back into the sink. Shrink-wrap the sink to protect the outer surfaces from damage. Affix a decontamination label to the outside of the unit.
- If contaminated components will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as plastic scrap.
- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedures for removing acid drain lines.
- See specific procedures in removing contaminated exhaust ducting.

- Ensure floor and wall surfaces are wiped down in accordance with Specific procedure 18. If necessary, wipe down the floor with liquid acid neutralizer. If floor tiles are badly contaminated, they may need to be removed and disposed as hazardous waste.

4.11 Stripper Sinks

4.11.1 Hazards

- Flammable Liquids (Isopropyl Alcohol- IPA),
- Corrosive Liquids (Organic Acid Stripper- 922, Organic Base Stripper- 265).

4.11.2 Procedure

- Drain stripper and isopropyl alcohol from the baths. Flush baths with isopropyl alcohol and drain to cart or waste container to remove any residuals. Remove wastes from the waste collection container if applicable.
- The entire sink should be cleaned while still connected to drains and exhaust. Clean with IPA wipes to remove any residues. This includes the sink baths, sink deck, sink plenum, and rear portions. Ensure recirculating baths and internal pumps are purged with water to remove acid residues. If necessary, use liquid acid or base neutralizer to bring the pH to between 5 and 9. Remove solids and residues as much as possible. Discoloration is allowed.
- Test the sink for pH with pH paper to ensure all surfaces are between 5 and 9. If tests indicate the presence of acid or base residues, repeat 2.2. Use a Spilfyter strip to determine if organic chemicals are detectable. Check the following surfaces for pH: plenum floor and trays, each acid bath, sink deck surfaces, sink controller “touch pads”, sink sides, back of sink, floor
- Once the sink is verified as clean, power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Disconnect DI water lines, drain lines, and sink exhaust. Block off the main exhaust trunk so that exhaust on other equipment is not affected. Warning: the ducts may contain liquids sucked from the sinks. Be prepared to collect and properly dispose as hazardous waste. See specific procedures for removing contaminated exhaust ducting.

- If the sink will be disposed, remove internal components, baths, heater trays and containers, etc. and transport them outside to the designated decontamination area. Sink parts will be further decontaminated using a hot pressure washer and detergent. Collect the rinse water and dispose as hazardous waste. Wipe test as per previous specific procedure to ensure no residues are present.
- If the sink will be disposed, dismantle the sink by cutting into manageable specific procedures with a saw and/or hammer. If necessary, further wash the specific procedures to ensure the pH is between 5 and 9 and that there are no visual traces of stripper. Place the cleaned pieces into a disposal bin.
- If the sink will be relocated or sold, disregard 4.7 and place sink components removed for cleaning back into the sink. Shrink-wrap the sink to protect the outer surfaces from damage. Affix a decontamination label to the outside of the unit.
- If contaminated components will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as plastic scrap.
- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedures in removing contaminated exhaust ducting.
- Ensure floor and wall surfaces are wiped down in accordance with clean room protocols. If necessary, wipe down the floor with liquid acid or base neutralizer. If floor tiles are badly contaminated, they may need to be removed and disposed as hazardous waste.

4.12 Solvent Sinks

4.12.1 Hazards

- Flammable Liquids (Isopropyl Alcohol, Acetone, Photoresist).

4.12.2 Procedure

- Drain solvent from the baths. Remove wastes from the waste collection container if applicable.
- The entire sink should be cleaned while still connected to drains and exhaust. Clean with IPA or Acetone wipes to remove any residues. If necessary, use a scrapper to remove dried photoresist. This includes the sink baths, sink deck, sink plenum, and rear portions.

Remove solids and residues as much as possible. Discoloration is allowed.

- Visually inspect all sink components for free liquids, sludges, and residues. If still present, repeat 2.2.
- Once the sink is verified as clean, power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Disconnect drain lines, and sink exhaust. Block off the main exhaust trunk so that exhaust on other equipment is not affected.
WARNING: the ducts may contain liquids sucked from the sinks. Be prepared to collect and properly dispose as hazardous waste. See specific procedures for removing contaminated exhaust ducting.
- If the sink will be disposed, remove internal components, baths, heater trays and containers, etc. and transport them outside to the designated decontamination area. Sink parts will be further decontaminated using a hot pressure washer and detergent. Collect the rinse water and dispose as hazardous waste. Visually inspect to ensure no residues are present.
- If the sink will be disposed, dismantle the sink by cutting into manageable specific procedures with a saw and/or hammer. Place the cleaned pieces into a disposal bin.
- If the sink will be relocated or sold, disregard 2.7 and place sink components removed for cleaning back into the sink. Shrink-wrap the sink to protect the outer surfaces from damage. Affix a decontamination label to the outside of the unit.
- If contaminated components will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as plastic scrap.
- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedures in removing contaminated exhaust ducting.
- Ensure floor and wall surfaces are wiped down in accordance with clean room protocols. If floor tiles are badly contaminated, they may need to be removed and disposed as hazardous waste.

4.13 **Lead Contaminated Equipment**

4.13.1 Hazards

- Poison Dusts (Lead),
- Corrosive/Flammable Liquids (Flux).

4.13.2 Procedure

- Remove all solder from the equipment. Remove any containers of solder flux and dispose as hazardous waste.
- Remove all solder dross and lead dust. Carefully transfer into a collection container with the use of a scoop or brush. Minimize the generation of lead dust as much as possible. Dispose of lead solder dross and lead dust as hazardous waste.
- Wipe down the tool using wipes soaked with a Trisodium Phosphate (TSP) solution to remove any remaining lead residues. Use a scraper to remove any melted lead solids. Clean until all surfaces are free of lead solids and dust.
- Test all tool surfaces for lead contamination using a “D-Lead Test Kit”. A bright yellow color appears when lead is present. If lead is detected, repeat 2.3. If the wipe tests indicate that all lead dust has been removed, contact the Environmental/Safety Department to arrange for laboratory verification testing. Wipe samples will be taken to ensure surfaces are less than 4 micrograms lead per 100 cm².
- Once the tool is verified as clean, power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Disconnect the exhaust ducts and seal the main exhaust duct to maintain system exhaust to other tools in the area.
- If the tool will be reused at another location or sold, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- Contaminated components will be disposed, bag labeled and sealed. Dispose as hazardous wastes. Non-contaminated components can be sent out as metal scrap.

- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedures in removing contaminated exhaust ducting.
- WARNING: ducting may contain lead dust. Be prepared to collect dust that may be disturbed.

4.14 **Process Gas Lines**

4.14.1 Hazards

- Toxic Gases (Phosphine, Diborane, Hydrogen Chloride, Chlorine, Dichlorosilane, Ammonia),
- Flammable Gases (Hydrogen, Silane),
- Pyrophoric Solids (Dichlorosilane, Silane).

4.14.2 Procedure

- Process gas lines must be completely purged. A cyclical purge must be performed for a minimum of 40 cycles and a 24-hour continuous purge with an inert gas to the treatment system before attempting opening of the lines.
- In the case of Silane, perform a 100-cycle purge and a 48-hour continuous purge.
- The initial opening of toxic gas lines should only be attempted with the use of an airline respirator or a self-contained breathing apparatus (SCBA) until it has been assured that there is no out-gassing and the purge is complete. WARNING: make sure that there are no “dead-ends” or closed valves in the gas line run. Tracing the gas lines using a ring along the length of the gas line will make sure this is the correct line to be removed and eliminate possible dead-ends.
- Gas lines that will be left in place must be placed under a vacuum and capped on both ends. Each end must be labeled “not in use” to identify that it has been properly purged.
- Lines that will be removed should be cut away with 3-foot bolt cutters. Cut the piping into 2 to 2 ½ foot long specific procedures. Gas lines that may contain residues, such as pyrophoric solids or corrosive liquid, will need to be decontaminated by soaking in water for 24 hours. Gases of concern include Dichlorosilane, Silane and Hydrogen Chloride. Properly purged gas lines that contained gases

such as Nitrogen, Argon, Helium, Freons, Hydrogen, Oxygen, or Nitrogen Trifluoride can be disposed of as scrap metal.

4.15 **Acid Drain Lines**

4.15.1 Hazards

- Corrosives (Sulfuric Acid, Hydrofluoric Acid, Positive Developer),
- Fluorides.

4.15.2 Procedure

- Acid drain lines should be flushed with large amounts of water prior to being disconnected from the tool.
- Prior to disassembly, the Fire Department needs to be contacted to determine if pressure testing or visual inspection is required.
- When the pipeline is ready for disassembly, a low point in the drain line should be identified and a hole drilled into the bottom portion to ensure all free liquids have been drained out. Any liquid collected should be tested for pH to determine the level of contamination remaining inside. Liquids should be disposed in the acid neutralization treatment system no matter the pH.
- Cut the piping into manageable specific procedures, bag, and remove to a decontamination area for additional decontamination and testing. Use a detergent and a hot water pressure cleaner to further decontaminate the pipe specific procedures. Drain all liquids to the acid neutralization treatment system.
- Check each specific procedure for pH and Fluoride. If the pH is between 5 and 9 and the Fluoride level is non-detectable using Spilfyter strips, it is considered decontaminated and can be disposed as non-hazardous waste.
- If the piping cannot be adequately decontaminated or a conservative approach is needed, the specific procedures need to be containerized and sent off-site as hazardous waste. For small jobs, the specific procedures should fit into a 55-gallon open top drum. For larger jobs, the specific procedures may need to go into a disposal bin.

4.16 Exhaust Ventilation Ducting

4.16.1 Hazards

- Corrosive Residues (Sulfuric Acid, Hydrochloric Acid, Hydrofluoric Acid, Positive Developer),
- Flammable Residues (Photoresist, Isopropyl Alcohol, Strippers),
- Pyrophoric Residues (Dichlorosilane, Silane)

4.16.2 Procedure

- Ensure the entire length of affected ducting is inspected for the presence of free liquids prior to disturbing. If free liquids are identified, they must first be drained. Locate a low spot in the ducting and carefully drill a drain hole in the bottom. Collect the liquids and dispose as hazardous waste.
- Cut the ductwork into manageable sizes and bag the open ends to prevent spillage of any contents. **WARNING:** Working with ducting associated with tools using pump oil, solvents, or stripper may involve flammable or combustible vapors. Hot Work Permit procedures should be followed to prevent the possibility of fire.
- **WARNING:** Some ducting associated with processes involving Silane or Dichlorosilane may contain pyrophoric residues. These must be handled carefully to prevent the possibility of reaction. If necessary, react the residues in water as the ducting is opened. Hot Work Permit procedures should be followed to prevent the possibility of fire.
- Remove the sealed ducting specific procedures to the decontamination area. Ducting associated with corrosive materials only can be decontaminated with a high-pressure washer and detergent. Collect the rinsate and dispose through the acid neutralization treatment system. Any ducting associated with solvents, oils, or stripper will most likely require disposal as hazardous waste. ANT will make a determination through visual inspection as the ducting is removed.
- Test the ducting for pH with pH paper to ensure all surfaces are between 5 and 9. Test the ducting for fluoride with Spilfyter strips to ensure there are no detectable amounts of fluoride on surfaces. If tests indicate the presence of acid residues, repeat 2.3.

4.17 **Floor, Walls, Trenches**

4.17.1 Hazards

- Corrosive Residues (Sulfuric Acid, Hydrofluoric Acid),
- Fluorides,
- Toxic Dust (Lead).

4.17.2 Procedure

- Floors, walls and trenches will be decontaminated by steam cleaning and/or wipe cleaning with a biodegradable detergent.
- All surfaces will be tested for the appropriate chemical contaminants to ensure they meet the decontamination criteria listed in Specific procedure 1.
- If decontamination is not feasible, the contaminated floor tiles or wall specific procedures will be removed and disposed as hazardous waste.

4.18 **Gas Cabinets**

4.18.1 Hazards

- Corrosive Residues (Hydrogen Chloride, Dichlorosilane),
- Toxic Gases (Phosphine, Diborane, Dichlorosilane, Chlorine, Ammonia)
- Pyrophorics (Silane)

4.18.2 Procedure

- Ensure that the gas lines have been completely purged in accordance with its specific procedure.
- Cap the gas cylinder and remove to the gas cylinder storage area for return to the gas bottle vendor. Ensure the bottle status tag is “empty”.
- Wipe down the inside of the cabinet with wet towels. If necessary, use liquid neutralizer for corrosive residues. Test the cabinet surfaces both inside and out for pH using pH paper. The pH should be between 5 and 9. If necessary, steam cleaning the inside surfaces

- Check the jungle process gas lines for any free liquids. If present, they must be either disposed as hazardous waste or properly decontaminated until liquid free. Dichlorosilane gas lines can commonly have this issue.
- Disconnect the gas cabinet from the exhaust ducting. See specific procedure for ducting removal and decontamination. WARNING: care must be taken since there may be hazardous liquids accumulated in the ducting.
- Disconnect the process gas lines from the cabinet and cap off the open end. See specific procedure for purging and removal of process gas lines.
- Disconnect and shutdown any associated toxic gas monitors. Disconnect the fire sprinkler head.
- Remove all chemical identification labels and signs from the outside of the cabinet.
- If the cabinet is to be sold or reused, wrap with plastic to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- If the cabinet must be disposed, send out as scrap metal. If it cannot be decontaminated, it must be disposed as hazardous waste.

4.19 Spin Rinse Dryers (SRD)

4.19.1 Hazards

- Corrosive Residues (Sulfuric Acid, Hydrofluoric Acid).

4.19.2 Procedure

- Wipe down all surfaces with a wet towel until the pH is between 5 and 9. If necessary, use liquid acid neutralizer. Check the following for pH: inside spin chambers, top surface, side surface, front surfaces (including gaps between SRD unit and frame), floor.
- Disconnect the water and drain lines. Ensure the associated water line is valved off. Cap off the drain line.
- If the SRD will be disposed, remove internal components, baths, heater trays and containers, etc. and transport them outside to the designated decontamination area. SRD parts will be further decontaminated using a hot pressure washer and detergent. Collect the rinse water and dispose as hazardous waste. Visually inspect to ensure no residues are present.

- If the SRD will be disposed, dismantle by cutting into manageable specific procedures with a saw and/or hammer. Place the cleaned pieces into a disposal bin.
- If the SRD will be relocated or sold, disregard 2.4. Shrink-wrap the SRD to protect the outer surfaces from damage. Affix a decontamination label to the outside of the unit.
- If contaminated components will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as plastic scrap.

4.20 Tube Cleaners

4.20.1 Hazards

- Corrosive Liquids (Hydrofluoric Acid, Nitric Acid),
- Fluoride.

4.20.2 Procedure

- Drain process chemicals from the tube cleaner tanks. Flush with water and drain to remove any residuals.
- Remove any circulation bath filters and dispose as hazardous waste. Flush the filter system with water to remove residual acid.
- The entire tube cleaner should be cleaned while still connected to drains and exhaust. Wash with high pressure, hot water to remove residues. If necessary, use liquid acid neutralizer to bring the pH to between 5 and 9. Drain all water from lines. If necessary, compressed air or nitrogen can be hooked to the lines to push out any remaining water. Ensure the tanks are free of any remaining water.
- Test pH with pH paper to ensure all surfaces are between 5 and 9. Test for fluoride with Spilfyter strips to ensure there are no detectable amounts of fluoride on surfaces. If tests indicate the presence of acid residues, repeat 2.3. Check the following surfaces for pH and fluoride: inside walls, inside “floor”, inside tank, tank tray, sink controller “touch pads”, outside sides, back of unit, floor.
- Once the tube cleaner is verified as clean, power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lockout is effective. Once

determined safe to do so, all power connections should be disconnected and labeled.

- Disconnect DI water lines, drain lines, and exhaust. Check the pH of the drain line and exhaust connections remaining on the tube cleaner. If necessary, use liquid neutralizer to ensure these surfaces have a pH between 5 and 9. Cap-off the DI water and drain lines to prevent leakage or spills from the main trunks. Block off the main exhaust trunk so that exhaust on other equipment is not affected. **WARNING:** the ducts may contain liquids sucked from the sinks. Be prepared to collect and properly dispose as hazardous waste. See specific procedures in removing contaminated exhaust ducting.
- If the tube cleaner will be disposed, remove internal components, tanks, etc. and transport them outside to the designated decontamination area. Parts will be further decontaminated using a hot pressure washer. Wipe test as per 2.4 to ensure no residues are present.
- If the tube cleaner will be disposed, dismantle by cutting into manageable specific procedures with a saw and/or hammer. If necessary, further wash the specific procedures to ensure the pH is between 5 and 9 and that there are no detectable traces of fluoride. Place the cleaned pieces into a disposal bin.
- If the tube cleaner will be relocated or sold, disregard 2.7 and shrink-wrap the sink to protect the outer surfaces from damage. Affix a decontamination label to the outside of the unit.
- If contaminated components will be disposed, bag label and seal. Dispose as hazardous wastes. Non-contaminated components can be sent out as plastic scrap.
- Remove all chemical identification labels and signs from the outside of the tool.
- See specific procedure for removing acid drain lines.
- See specific procedure for removing contaminated exhaust ducting.
- Ensure floor and wall surfaces are wiped down in accordance with cleanroom protocols. If necessary, wipe down the floor with liquid acid neutralizer. If floor tiles are badly contaminated, they may need to be removed and disposed as hazardous waste.

4.21 Chemical Mechanical Polishing (CMP)

4.21.1 Hazards

- Slurries (corrosive materials, nano or ultra-fine particles),

4.21.2 Procedure

- Flush all lines with DI water, once clean disconnect and cap off delivery lines at the distribution end and then at the tool end.
- Remove CMP slurries from chemical dispense units.
- Power switches should be locked-out and tagged-out at the main breaker switch. Test the “power on” switch to ensure the lock-out is effective. Once determined safe to do so, all power connections should be disconnected and labeled.
- Tool exhaust should be left in place until thorough inspections of the chambers are made to determine if chemical contamination is present. If contamination is present, remove particles with a ULPA vacuum or wipe with a wet towel.
- Chambers or parts of the tool where slurries have solidified should be wetted so that slurry is a paste and then rinsed appropriately.
- Dismantle the tool into manageable components for decontamination and eventual movement out of the cleanroom area. Wipe down or ULPA-vacuum all surfaces to remove dusts and other contamination. Surfaces should have a pH of between 5 and 9. If necessary, use liquid acid neutralizer. Check the following surfaces for pH: inside surfaces of chamber, outside surface of tool, floor.
- Remove any pump filters and properly dispose. Filters can contain particulate contamination so should be bagged and disposed of as a non-hazardous waste.
- Disconnect the exhaust ducts and seal the main exhaust duct to maintain system exhaust to other tools in the area.
- If the tool will be reused at another location, wrap the components with shrink-wrap to maintain cleanliness. Affix a decontamination label to the outside of the unit.
- If the tool or contaminated components (such as pads, filters, etc) will be disposed, bag label and seal. Dispose as non-hazardous

wastes. Non-contaminated or decontaminated metal components can be sent out as metal scrap.

- Remove all chemical identification labels and signs from the outside of the tool.
- Ensure floor and wall surfaces are wiped down in accordance with clean room protocols.

5 TRAINING

5.1 CNSE, Tenant, Contract or Sub-Contract t employees can perform tool decommissioning of tools so long as the following training courses have been completed and are up to date:

- General Safety,
- Chemical Safety,
- Hazardous Waste Handling,
- Hazardous Gas Handling (for tools involving toxic gases),
- Respirator Safety (if a respirator must be used),
- Lock-out/Tag-out Safety.

6 RECORDS

Records of equipment decontamination will be kept on file in the EHS Department for one year.