

Operations Manual for the 6 foot Wet Chemistry Bench

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Description:

- 72" Open Wet Bench.
- Manufacturer: Reynolds Tech, East Syracuse, NY, ph: 315-437-0532
- Contains 2 dip tanks, two reflux quartz heated baths, glove rinse, DI and N2 spray guns, GFCI 120VAC receptacle, and two safety eyewash stations.
- Capable of handling small samples up to a full cassette of 6" wafers.
- Tank 1: Dip tank w/lid (Buffered Oxide Etch-BOE).
- Tank 2: Reflux heated bath (RCA Standard Clean 1-SC1).
- Tank 3: Dip Tank w/lid (2% HF).
- Tank 4: Dump Rinse w/lid.
- Tank 5: Reflux heated bath (RCA Standard Clean 2-SC2).

Location:

- Bay 102B-Ultra Clean CMOS Bay.

Restrictions:

- CMOS or electronic device processing only!
- No metal tweezers or cassettes.
- No unauthorized projects or individuals.
- No outside quartzware. Use only clean rinsed quartzware.
- Do not process wafers or substrates with metal on them.
- **Sample size:** Small pieces up to a full cassette of 25, 6" wafers.
- **[Failure to follow procedures can and will result in contamination that will ruin your experiment and ruin the experiments of everybody after you.](#)**

- Failure to follow the proper operating instructions or correct safety procedures can lead to losing your access privileges.
- The bench and glassware must be cleaned to original state after use.
- No glassware or chemicals shall be left on the bench after use!
- Clean tweezers in IPA and DI rinse. Do not lay tweezers on deck after cleaning. Place them into one of the clean beakers.

Safety and Required Personal Protective Equipment (PPE):

- Mix all chemicals inside the wet deck protective shields.
- Do not carry open chemicals across the room.
- **DANGER: THIS EQUIPMENT USES HYDROFLUORIC ACID.**
- The first-aid for HF burns is located on the headcase of the unit, and in the small refrigerator inside the Yellow Photo room A102.
- Pour chemicals with two hands, in case the bottle slips you can direct the bottle into the hood where the spill can be contained.
- **ALWAYS rinse and dry the deck surface when you complete your work.**
- Keep covers on tanks when not in use!
- If you get exposed to the chemicals, use the eyewash at the ends of the decks or the eyewash and safety showers located in the Class 1000 area.
- **DO NOT DRAIN THE HF ACID TANKS** (Tank 1 and Tank 3)
- ALWAYS wear your PPE.
 - Face shield with safety glasses.
 - High wrist chemical gloves and sleeves.
 - Acid apron

Process:

- RCA cleaning of wafers before processing in the CMOS diffusion furnace, LPCVD Furnaces or before metal deposition.
- Wet Etching of Silicon Dioxide films in 6:1 Buffered Oxide Etch (BOE). Etch rate is about 800 Angstroms/minute.

Operation: (See Deck Layout in this manual)

Power On:

1. On the left control panel, press the "POWER ON" button.
2. Leave system on!

Power Off:

1. Press the “EMO” button.
2. Leave system on unless there is a problem or instructed otherwise.

Tank 1- Dip Tank:

1. **Danger:** Contains HF.
2. Tank 1 has a pneumatic drain on the left control panel.
3. Placing the switch in the “Open” position drains the tank and “Close” keeps the drain valve shut. **DO NOT OPERATE THIS SWITCH!**
4. **This tank is not to be drained by Nanofab Users** (*Contact the Nanofab Technician if the tank draining is required!*).
5. If the volume of BOE is not sufficient to cover all your wafers, carefully add 6:1 BOE (semiconductor grade).

Tank 2-Heated Bath: (Tank 5 operation is identical to tank 2. Tank 5 controls are located on the right control panel on the headcase)

1. Turning on heater: Quartz Lined heated bath can be turned on by pressing “TANK 2 HEAT ON” button on the left control panel. The tank heat will not turn on if the liquid level is too low.
2. Setting bath temperature: The Tank 2 temperature controller will display the set point and the actual temperature.
 - a. **The upper display:** Indicates the process value, actual temperature, operating parameter values or an open sensor.
 - b. **The lower display:** Indicates the set point, output value, and parameters for data in the upper display, or error and alarm codes.
 - c. **Advance key:** Press to step through the operations, setup and calibration menus.
 - d. **Up and down arrow keys:** Increases or decreases the value of the displayed parameter.
 - i. Press lightly to increase or decrease value by one.

- ii. Press and hold down to increase or decrease the value at a rapid rate. New data will self enter in five seconds, or can be entered by pressing the advance key.
- e. **Infinity Key:**
 - i. Press once to clear any latched alarms. It also disables the deviation alarm output if silencing is enabled.
 - ii. Press again within five seconds to change from Auto to Manual or vice versa. While in manual mode, percent power is in the lower display.
- f. **% Percent Power Indicator Light**
 - i. Lit: the controller is in manual operation. Press the INFINITY key twice to enter automatic operation.
 - ii. Blinking: press the INFINITY key to toggle between auto and manual control. Returns to its previous state and stops blinking if the INFINITY key is not pressed within five seconds.
- g. **Output 1 Indicator Light:** Lit when output 1 is energized.
- h. **Output 2 Indicator Light:** Lit when output 2 is active. This output can be configured as a control or alarm output.

3. Turning heater off: Press the “TANK 2 HEAT OFF” button on the left control panel.
4. Draining Tank 2: Turn on the tank 2 aspirator with the “TANK 2 ASPIRATOR ON/OFF” button. Insert aspirator tube into the bath until contents is removed. Shut off tank 2 aspirator.
5. Using the Stirrer: This is controlled by the flow controller on the control panel. Turn the flow control until the stirrer begins to spin. **DO NOT EXCEED 80 SCFH** on the flow meter; this could dislodge the magnetic spinner.

Tank 3- Dip Tank:

1. **Danger:** Contains 2% HF.
2. Tank 3 has a pneumatic drain on the right control panel.

3. Placing the switch in the “Open” position drains the tank and “Close” keeps the drain valve shut. **DO NOT USE THIS SWITCH!**
4. **This tank is not to be drained by Nanofab Users** (*Contact the Nanofab Technician if the tank draining is required!*).
5. If the volume of 2% HF is not sufficient to cover all your wafers, carefully add HF and DI water to tank in the proper ratio.

Tank 4 – Dump Rinse (DR):

1. The dump rinse controller is preset by the Nanofab Process Staff and should not be modified without authorization from the Nanofab Staff.
2. The dump rinse is programmed with 2 modes:
 - a. Mode 1-Automatic: is used to process wafers.
 - b. Mode 2-Dummy Cycle: used to purge the tank and plumbing with fresh DI water.
3. Manual Operation: To manually fill the dump rinse tank, depress and hold the **F3** key on the display. To manually drain the tank press and hold the **F4** key on the display.
4. Automatic Operation: When power is first applied to the wet bench, the dump rinse (DR) tank will perform an initial fill cycle. This is to ensure that the tank is full. The DR will fill with DI water for a preset time (PLC timer T000). After the initial fill is complete, the operator may start the Automatic Cycle or the Dummy Cycle.
 - a. Dummy Cycle: The Dummy Cycle is started (and stopped) using the F1 key on the display. While this cycle is running, an Automatic cycle start signal will be ignored. The DR tank will drain (1), fill/spray (1), drain (2), fill/spray (2). At the end of this cycle, the sprays and fill will be off and the dump door will be closed. The DR is now ready for an Automatic Cycle or another Dummy cycle. **Note: The fill time and drain time used in the Dummy Cycle is the same time presets programmed in the Automatic Cycle.**
 - b. Automatic Cycle: The Automatic Cycle is started and stopped using the **CYCLE ON/OFF** pushbutton on the Headcase Control Panel. The DR will now proceed through the following steps:

1.) Quench Time:

Fill-On; Spray-Off; Dump-Door Closed.

2.) Drain Time:

Fill-Off; Spray-On; Dump-Door Open.

3.) Fill Time:

Fill-On; Spray-On; Dump-Door Closed.

4.) Cycle Complete:

Fill-On; Spray-Off; Dump-Door Closed.

IF: Cycle Counter is not equal to the PRESET COUNTS; repeat at STEP 2. Else: Alarm-On.

5.) Cycle Reset:

Fill-On; Spray-Off; Dump-Door Closed. Alarm-OFF.

5. **Programming:** To enter the PROGRAM mode, depress and hold the **F2** key on the display for five seconds. All four LED's on the display will flash after you have accessed the PROGRAM mode. Using PROGRAM KEY2 or PROGRAM KEY3, scroll to the screen containing the value you want to modify. Depress and hold PROGRAM KEY4 for 2 seconds. The value to be modified will flash. Use PROGRAM KEY1 to move the cursor to the digit to modify. PROGRAM KEY2 and PROGRAM KEY3 will change the value above the cursor. Depress and hold PROGRAM KEY4 for 2 seconds to store new value. To exit the PROGRAM mode, depress and hold the F2 key on the display for five seconds.

Aspirators:

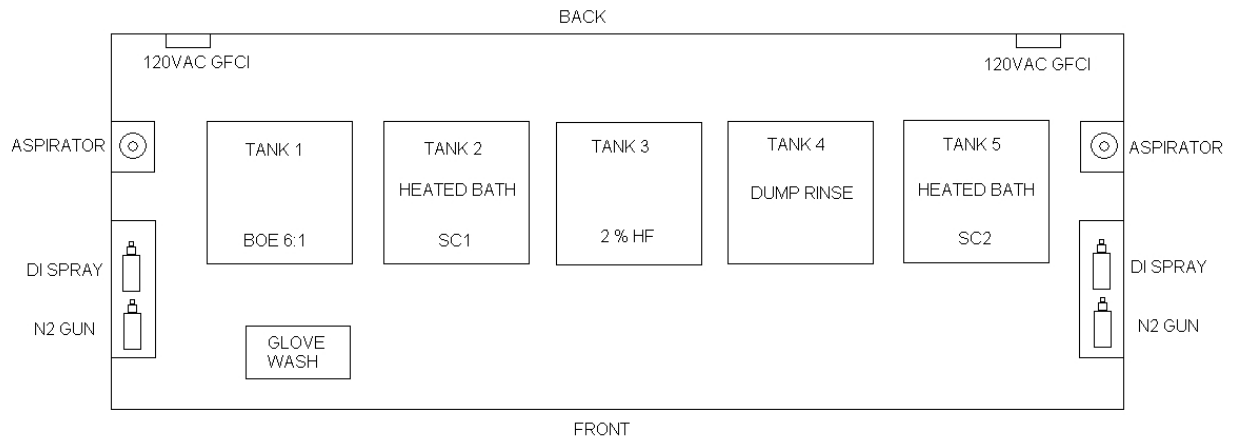
1. The aspirators are used to suction out the baths liquid contents.
2. **DO NOT ASPIRATE HOT LIQUIDS** let them neutralize and return to room temperature before siphoning out the contents.
3. Turn on the aspirator by placing the Aspirator button to "On". This will shut-off the bath heat so you are not heating an empty vessel.
4. Place tip of aspirator into liquid until empty.
5. Completely rinse the bath with the DI spray and aspirate out the rinse water.
6. The bath is now ready for use.

DI and N2 Spray Guns:

1. Remove gun from the deck.
2. Press trigger to use gun.

3. N2 has an “N2” Label on it. DI water is not marked. (see deck layout)
4. Place guns back into deck when not in use.

Deck Layout:



Appendix:

Cleaning Glassware:

- Rinse all glassware with DI water prior to using, even if it is from the clean glassware cabinet.
- After use, thoroughly rinse with DI water. Fill 1/3 full and swirl DI water around inside of glassware, repeat 5 times.
- Place all used and rinsed glassware on the dirty dishware cart in the bay, so that they may be cleaned using the Steam Scrubber (dishwasher).

RCA Clean Recipe (Standard RCA)

Step 1: Standard Clean 1 (SC1)

- Strips organic residue and debris from the surface of the wafers.
- **Add:** DI Water: Ammonium Hydroxide: Hydrogen Peroxide in the following ratio

5:1:1; DI H₂O: NH₄OH: H₂O₂ (add in this order)
- **Tip:** Add about 5 liters of DI water, and then add the NH₄OH (1 liter) and start heating to set point, then add your oxidizer when you are at or close to the set point temperature. The heater will not turn on if you are below the liquid level limit (two N₂ bubbler hoses).
- Heat Bath to 75-80 Degrees C (above 80 C, reduces the cleaning time)

- Add H₂O₂ (1 Liter), let bath return to temp.
- Add your wafers to the bath when reaction becomes aggressive.
- Clean for up to ten minutes, the cleaning action continues for about thirty minutes and can be useful to clean more wafers. The bath cleaning action is reduced when the reaction of the bath slows or stops.

Step 2: Rinse

- Rinse in dump rinser until resistivity stabilizes.
- KEEP WAFERS WET AT ALL TIMES.

Step 3: 2% HF

- Dip in 2% HF to remove oxidized Hydrocarbons from Step 1.
- Etch for 10-20 seconds.
- Immediately rinse in the dump rinse.

Step 4: Rinse

Step 5: Standard Clean 2 (SC2)

- Removes (dissolves) metal ion impurities from the wafer surface left after SC1.
- **Add:** DI Water: Hydrochloric Acid: Hydrogen Peroxide in the following ratio

5:1:1; DI H₂O: HCl: H₂O₂ (add in this order)

- **Tip:** Add about 5 liters of DI water, and then add the HCl (1 liter) and start heating to set point, then add your oxidizer when you are at or close to the set point temperature. The heater will not turn on if you are below the liquid level limit (two N₂ bubbler hoses). You can reduce heat on this bath, because the reaction generates heat and can raise the temperature to 90 C from a set point of 80 C.

- Heat Bath to 75-80 Degrees C (above 80 C, reduces the cleaning time)
- Add H₂O₂ (1 Liter), let bath return to temp.
- Add your wafers to the bath when reaction becomes aggressive (bubbling).
- Clean for up to ten minutes, the cleaning action continues for about thirty minutes and can be useful to clean more wafers. The bath cleaning action is reduced when the reaction of the bath slows or stops.

Step 6: Rinse

- Rinse in dump rinser until resistivity stabilizes.
- KEEP WAFERS WET AT ALL TIMES.

Step 7: Spin Rinse Dry (SRD)

- Place wafers into SRD with the H-bar in and then press start.
- If there is an *Error* message, press stop to reset, then press start.
- Remove wafers carefully when done.

Process Monitoring and Wet Deck Maintenance

- The BOE and 2% HF mixes shall be changed at least once per month or if there are materials visible in the solution.
- The etch rate of the BOE will be monitored weekly. If the etch rate is not > 800 Angstroms/minute, the bath shall be refreshed.
- The etch rate of 2% must be determined after preparing, and monitored weekly to ensure its performance. This product typically etches oxides in 10's of Angstroms /min.

Changing out Acid Bath Contents

- To empty the HF dip tanks, contact a Nanofab Staff member, **Nanofab users cannot drain acid tanks.**
- Aspirate or use the pneumatic drain to empty the tank into the sump. Run the QDR during the draining process to aid dilution. This will drain to the acid neutralization system safely.
- Prior to adding new chemical, rinse the container several times with DI water, making sure to cover the entire interior with the rinse water.
- Obtain Electronic Grade (CMOS Grade) chemical products only, and add to the tank to a level about ½” above the process cassette for full wafer coverage.
- For 2% HF, the ratio is 50:1, DI H₂O: HF (49%). BOE is premixed and can be added directly from the bottle.