Chapter [2.8]

Msink8 non-MOS Clean Sink

(msink8) ***(386)***

1.0 Equipment Purpose

1.1 Msink8 is a non-MOS clean sink. It serves as a pre-clean step to msink6, which is the final pre-furnace cleaning step. Wafers that have undergone processing must be cleaned at this sink immediately before being cleaned at msink6.

1.2 This sink contains of two heated piranha baths (sulfuric acid based), a room temperature dilute HF tanks (10:1 49% HF), and a general use 8” acid tank. There is one quick dump rinse station. The sink also includes an aspirator and a gooseneck.

1.3 This sink is compatible for wafers up to 8”.

1.4 This chapter will cover the cleaning steps for standard processes and what materials and chemicals are allowed.

2.0 Material Controls & Compatibility

2.1 NO METAL is allowed at this sink, including metal tweezers. Only teflon tweezers should be used here.

2.2 No photoresist - even hardbaked photoresist - is allowed at this sink. Photoresist must be stripped, or removed, before a wafer is allowed at this sink with a process such as 1165 remover.

2.3 Solvents are not allowed at this sink.

2.4 A fresh pair of poly gloves should always be worn on top of chemical gloves while using this sink.

2.5 If you accidentally contaminate a bath or cassette, please immediately contact process staff with the details, and place the contaminated cassette in the blue bin.

3.0 Training Procedure & Applicable Documents

3.1 Exam Tool

3.2 This tool requires an online exam before qualification.

3.3 Timeline (estimated time to completion: 1 week)

3.3.1 Get trained by any qualified member.

3.3.2 Take the online test in the Nanolab office (open 8A-12P, 1P-5P).

3.3.3 Arrange a qualification session with a superuser to show competency on the tool.

3.3.4 Note that sinkclass is a prerequisite for qualification on all sinks.

3.4 Msinks 6, 7, and 8 are grouped together for training and qualification.

3.5 Please see chapter 2.0 for general lab cleaning information: Sinks Overview

4.0 Definitions & Process Terminology

4.1 Quick dump rinse (QDR): DI water fills the sink followed by a quick dump to get rid of excess acid and/or contaminants.

4.2 Spin Rinse Dryer (SRD): DI rinse followed by dry cycle.

4.3 Tank: These are available to do large batches of chemical processing but cannot be heated up; available for room temperature only.

4.4 Bath: These are available for heated batch chemical work.

4.5 Exhaust alarm: This alarm shuts off power to the sink when the sink exhaust falls level falls below a certain limit (currently set at 0.8 inches of water; full scale is 1).

4.6 DI: De-ionized water used for clean processes with a resistivity of ~18 Mega Ohm-cm.

4.7 IPA: 2-propanol, or isopropyl alcohol. Available at certain sinks and around the lab in yellow-topped squeeze bottles. IPA should NEVER be used at this sink, no solvent use is allowed at acid sinks.

5.0 Safety

5.1 Follow general safety guidelines for the lab; the safety rules outlined in Chapter 1.01 - Marvell NanoLab Chemical Hygiene Plan and the following:

5.2 ***Personal Protective Equipment (PPE)*** must be worn at all times while operating this sink:

5.2.1 Chemical-resistant apron, face shield, and chemical-resistant gloves (either tan tripolymer multi-use or green single use ones) (chem) gloves.

5.2.2 Tan chem gloves can be purchased at the Nanolab Office (open 8A-12P, 1P-5P). During off hours, you may checkout gloves from the plastic box in the gowning room. Please only do this if the office is closed, or the supply may not last through the weekend. Green gloves are available near sinks throughout the lab.

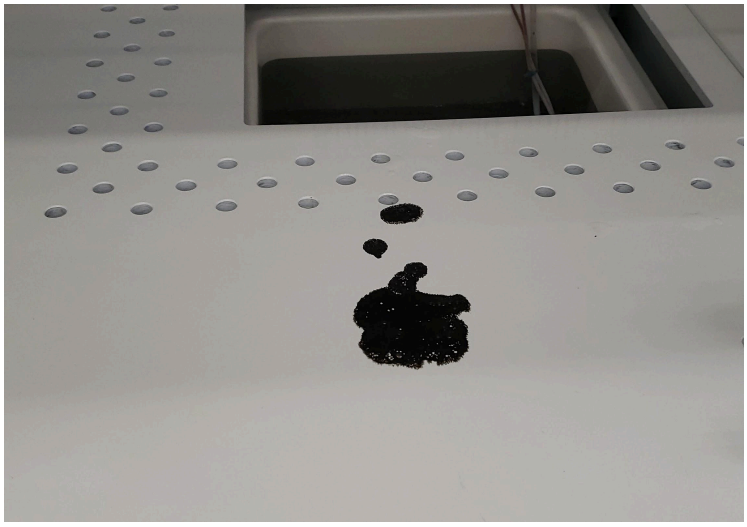
5.2.3 Chem gloves must always be the last thing on, and first thing off, so you do not accidentally leave residue chemical anywhere that another lab member may touch without proper safety gear (i.e. phones, doorknobs, table tops, etc.).

5.2.4 Chem gloves should be inspected for holes before each use, and multi-use gloves replaced regularly even if they appear to be in acceptable condition.

5.2.5 Lab members may purchase their own chemical aprons and faceshields. These can be stored in ziploc bags on the designated storage areas of the gowning room (shelves 12-4 and 12-5) or the metal rack in 391.

5.3 Solvent use is not allowed at this sink.

5.4 Technicloths may NEVER be left on the sink deck. Due to the air flow, they will likely quickly be picked up and land in the heated acid baths, which immediately contaminates the bath. The following picture demonstrates what happened when just a few drops of piranha were dripped on a technicloth on the sink deck. This caused a “burn” on the sink deck. This would also happen inside the bath if a technicloth touches the chemical. DO NOT USE TECHNICLOTHS AT MSINK6/8!!!!!



5.5 There is an automatic sprinkler system at this sink activated at 286 °F.

5.6 After loading your wafers into the cassette and attaching the handle, do a “shake test” to ensure that the handle is well attached, so that it doesn’t fall off in a bath of chemicals and splash back at you.

5.7 The deck hose is always on, in case of emergency.

5.8 Closest Safety Showers are located at the end of Bay 385. In the event of chemical exposure, follow all guidelines found in section 5.3 of the CHP, namely to rinse the affected area for 15 minutes either with a safety shower, eye wash, or deck hose. Take care to scrub around fingernails and cuticles. If you are exposed to HF, apply calcium gluconate gel after 15 minutes of rinsing.

5.9 Use only the provided Teflon, chemically resistant cassettes at this sink.

5.10 Dwyer Photohelic Exhaust Flow Meter: Monitors the sink exhaust flow and will shut down all electricity and water to the sink if there is too much or too little flow. An alarm will sound; press the SILENCE button and attempt to power back on. If continued alarm, promptly report on Mercury.

5.11 MPC-901 Emergency Alarm (11.1): Cuts power to the sink in emergencies. Push the big red STOP button to cut the power to this sink. Report on faults if safe to do so. Evacuate others around you if there is an emergency.

5.12 Wipe up any puddles you make, and dilute acid puddles with the water hose as necessary and then aspirate them.

5.13 Do not change the heater temperatures.

6.0 ***Process Data***

6.1 Please see the following links regarding etch rates and cleaning information. The general procedure is to clean in piranha, then QDR rinse, then HF, then QDR rinse. However, if you have an oxide on the surface that you do not want etched, the HF steps can be skipped. The QDR steps may never be skipped.

6.2 References:

6.2.1 https://nanolab.berkeley.edu/labmanual/chap1/JMEMSEtchRates2(2003).pdf

6.2.2 http://www.smfl.rit.edu/Process%20Information/Film%20Etch%20Rates.htm

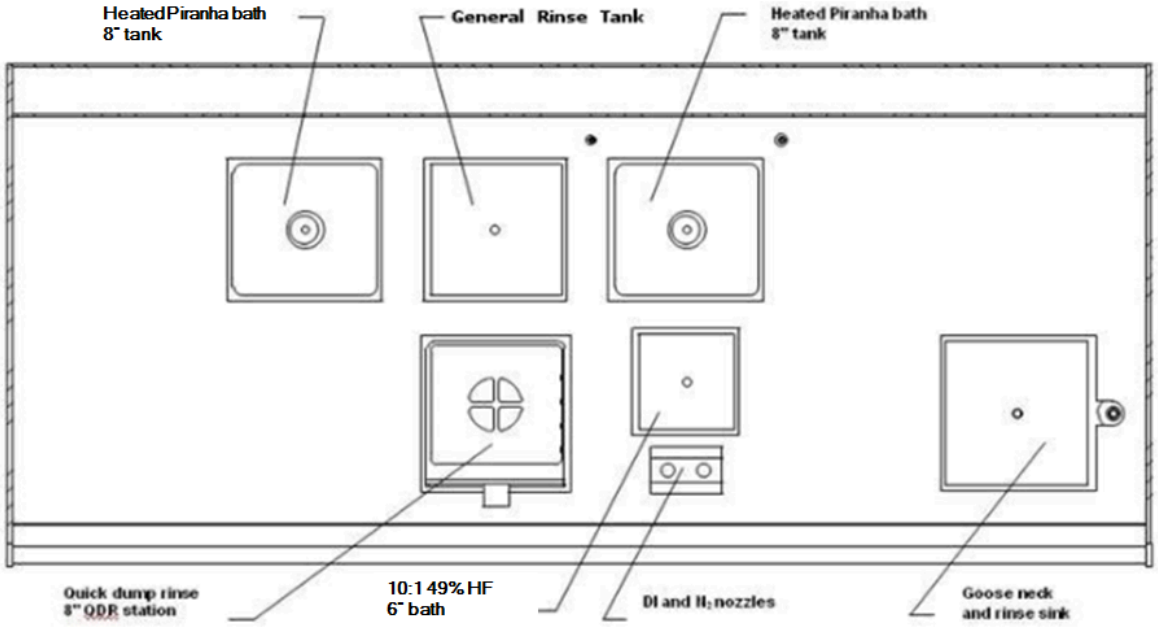
6.2.3 Kern W & Puotinen D A. Cleaning solutions based on hydrogen peroxide for use in silicon semiconductor technology. RCA Rev. 31:187-206, 1970.

6.2.4 http://jes.ecsdl.org/content/139/6/1751.full.pdf

6.2.5 http://jes.ecsdl.org/content/139/4/1180.abstract

6.2.6 http://www.erc.arizona.edu/education/mme%20course%20materials/MME%20Modules/Surface%20Prep%20Module/Surface%20Prep%20and%20Wet%20Process0930.ppt

7.0 Available Processes, Gases, Process Notes



7.1 A 2 step clean is recommended. Piranha will clean off organics, though leave a sulfur residue on the surface. After QDR, a dilute HF step is recommended to remove surface oxides and most of the sulfur residue.

7.2 This sink has 25 wafer cassettes for 4" and 6" wafers and a single wafer holder for 8" wafers. The cassettes are white teflon and stenciled with "MSINK-8" or "MEMS". These may only be used at msink8, and no other cassette may be used here.

7.3 Use the vacuum wand with the **black** curly cord to transfer wafers from your box to the Teflon™ cassettes.

7.4 The piranha and "make your own acid" containers can hold any size wafer up to 8". The dilute HF can hold any size wafer up to 6".

7.5 There are two heated piranha baths for cleaning off organic contamination, which are sulfuric acid heated to 120°C. Immediately prior to use, the user should "spike" either bath with 250 mL of H_2O_2. Do not change this temperature.

7.6 There is a "make your own acid" tank at room temperature. Members should consult with staff before using this tank. It generally is used for DHF etches of 8" wafers which would not fit into

the “standard” tank but can be used for other things as well, such as longer etches (there is a time limit of 10 minutes for the “standard” HF bath).

7.6.1 You must always use your own cleaned labware (beakers, etc.) for measuring chemicals. Do not use staff glassware.

7.6.2 Members are responsible for cleaning out the tank beforehand.

7.6.3 There MUST be an identification tag associated with this tank including the following information: member in charge of it, chemical, date, contact information.

7.7 There is one room temperature tank of dilute HF (ratio of 10:1) which will remove oxide from the surface and most of the sulfur residue.

7.8 Bottles of H_2O_2 are kept under the sink on the right side for member use. Do not start a new bottle if there is a started one. If you finish a bottle, place it in the large blue recycle bin immediately behind the sink. (This is for H_2O_2 bottles ONLY).

8.0 Equipment Operation

The general procedure at msink8 is as follows:

1- Piranha clean (~10 minutes)
2- QDR
3- Dilute HF step if applicable (depending on the exposed oxide restrictions of your process)
4- QDR

Detailed steps are below:

8.1 Put on safety gear in this order: Apron, face shield, safety gloves. Then put on a fresh pair of polyethylene (“poly”) gloves.

8.2 Load your wafers into a msink8 stenciled teflon cassette (should say “MSINK” or “MEMS”) using the BLACK vacuum wand or teflon tweezers. Metal tweezers are not allowed. Wafers should have photoresist stripped already.

8.3 Attach the teflon handle to the cassette and then do a “shake test” to make sure the handle is properly attached.

8.4 Clean your wafers using the heated piranha bath for 10 minutes. Immediately prior to use, spike the bath with 250 mL of H_2O_2 using the 500 mL beaker which is kept in the container with the teflon cassettes.

8.4.1 The maximum time in the “standard” piranha bath is 20 minutes. If you need a longer time than this, please consult process staff.

8.5 Slowly lift the wafers, letting the residual acid drip into the bath. Place into the QDR and run through 4 cycles. This is enough to increase the resistivity >10 Mega ohm-cm according to hand-held resistivity meters.

8.5.1 If the QDR is empty, hit “stop/reset”, then “start”

8.5.2 If the QDR is full, hit “open”, then “stop/reset”, then “start”

8.6 Next, place wafers into the dilute HF bath (10:1) for one minute if acceptable to your process.

8.6.1 Slowly lift the wafers, letting the residual acid drip into the bath. Place into the QDR and run through 4 cycles.

8.6.2

8.6.3 The maximum etch time in the "standard" HF bath is 10 minutes. If you need a longer HF etch than this, please use the "make your own" bath in the back/center of this sink, or else msink7.

8.7 Remove the wafers from the QDR. Remove the handle. Place the cassette into the SRD (either 4" or 6") until resistivity is > 12 Mega ohm -cm. The H-Bar should face in.

8.8 Here is the procedure for the SRD:

8.8.1 Arrive at SRD

8.8.2 Press timer button to start nitrogen flowing

8.8.3 Press STOP on SRD to clear low nitrogen pressure message.

8.8.4 Load and run SRD and remove wafers

8.8.5 Press timer button to stop nitrogen flow

8.9 If you empty a H_2O_2 bottle, it can be placed in the blue bin immediately behind msink6. If you empty any other chemical bottle, you must wash it in the bottlewash in chase 397 while wearing all safety gear, and then place in glass or plastic recycle bin.

8.10 Once msink8 processing is complete, transfer wafers to the msink6 cassette using the "cassette-to-cassette transfer arm" on the table between the sinks.

8.10.1 Put on new poly gloves immediately prior to the transfer.
8.10.2 Push the arm to transfer wafers from one side to the other.
8.10.3 Never use the msink6 furnace transfer boxes at this step.

8.11 If you are cleaning a sample approved at msink8 for use at an atomic layer deposition (ALD) system, please transfer it to bay 586 using the purple transfer cassette labeled "msink6/7/8 to ALD Transfer Cassette". This is stored on top of msink7. Always return the cassette to this location.

9.0 <u>Troubleshooting Guidelines</u>

9.1 Running low on aprons/face shields, or they are in bad condition?

9.1.1 Report a problem under "supply" on mercury describing the problem. If there are aprons with holes in them or any safety compromise, please throw them out immediately.

9.2 There's no more H_2O_2.

9.2.1 Please check that you've pulled out the whole bin, and not just checked for the first two bottles. The bin can hold 6 bottles total. If there are no more, report a problem or contact process staff.

9.3 I just realized I made a mistake and contaminated the bath or cassette. What should I do?

9.3.1 Please report in Mercury and to staff immediately with as much information as you have. This allows staff to know how to clean it. Place contaminated cassette in the blue contaminated cassette bin. Turn off the heater if a heated bath is contaminated, and put a big note on the shield of the sink so other members know it is contaminated.

9.4 My wafer broke. What should I do?

9.4.1 First, try to retrieve the broken pieces using the 10" long Fluroware tweezers. Never put metal tweezers into the baths or tanks.

9.4.2 If you can't retrieve your wafers, report a problem on Mercury.

9.5 The level in the HF tank is low.

9.5.1 If it is very low, there is likely a leak. Report the problem.

9.5.2 If it's just a little bit low, water evaporates more quickly than HF. Use the deck hose to top off the water level until it covers your wafers. While we generally add acid to water, not the other way around, in this case it is acceptable because it is very diluted already.

9.6 Alarm sounds and power to the sink shuts off

9.6.1 Silence alarm and turn the power back on

9.6.2 If this fixes the problem, it was a one time problem - consider it fixed

9.6.3 If problem continues, report the problem on Mercury and do not use the sink

9.7 Photohelic differential pressure reading is outside the limits of the two bars

9.7.1 Report a fault

9.8 Rinse cycle stopped in the middle of QDR cycles:

9.8.1 Press open to dump out water

9.8.2 Press stop/reset key followed by the start key

9.8.3 If it continues to not work, report on faults. Rinse thoroughly with the deck hose to ensure that it is safe to handle, or wait until QDR is fixed.

10.0 Study Guide

10.1 Study Guide to be added

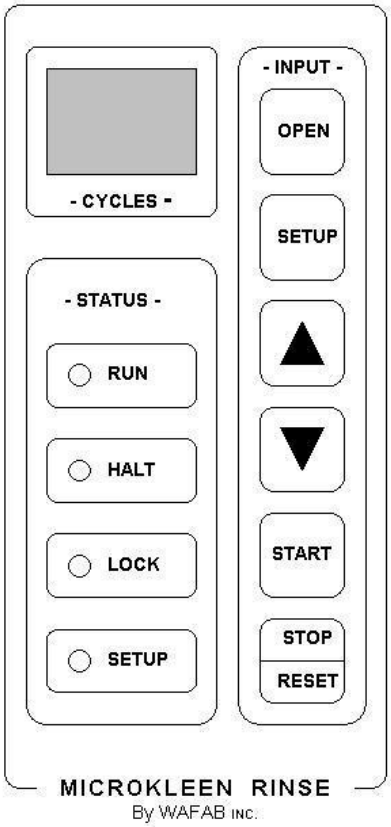
11.0 Appendices

11.1 Control Key Descriptions:

8850-2 RESISTIVITY MONITOR

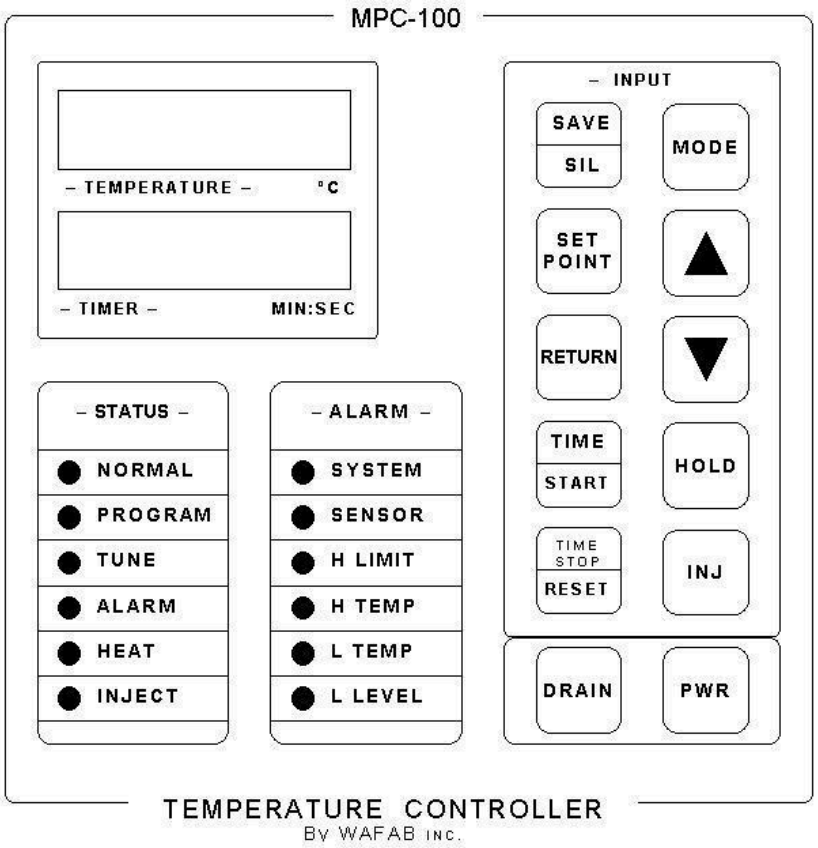
UP/DOWN Toggles between resistivity/temperature readings, loop output and last calibration date.

MPC-301 DUMP RINSER (QDR) KEYS/FUNCTIONS



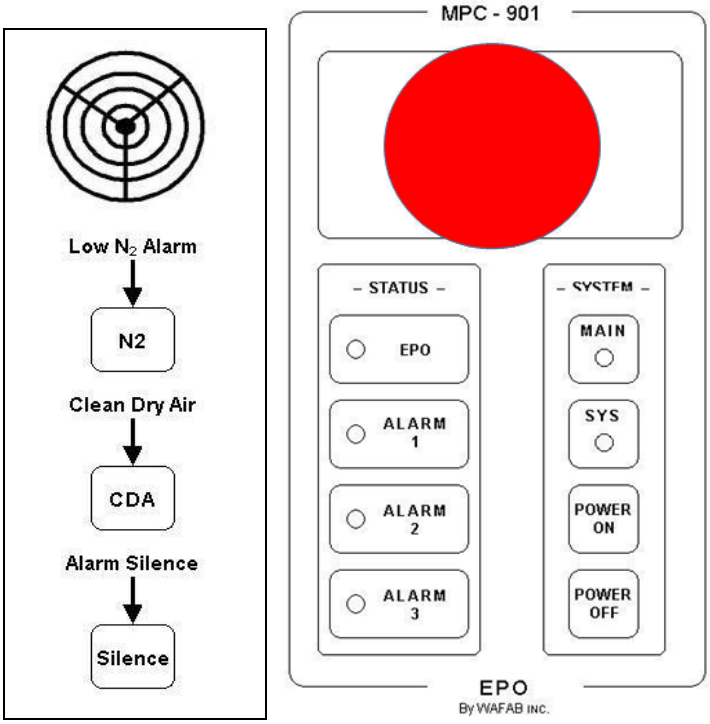
START	- Activates the dump rinse cycle/ Reactivates dump rinse cycle.
STOP/RESET	- Deactivates the Dump Rinser. - Silences alarm. - Automatically reset itself in preparation for another run. - Exits program mode.
OPEN	- When the system is running, it halts the operation temporarily. When it is in STANDBY mode, it dumps the tank manually. This will allow you dump the water from the last QDR cycle. Leave the tank empty, after you are done with your process (manually dump the water).
SETUP	- Parameters to be written in the EEPROM memory.

MPC-100 TEMPERATURE CONTROLLER KEY/FUNCTION



PWR	Turns on/off the master power for the temperature controller.
HOLD	Turns on/off the heat to the bath.
TIME/START	Starts the timer.
TIME STOP/RESET	Stops or resets the timer in operation mode.
ALARM SIL	Silences the timer and other alarm conditions. - Cancels flashing alpha code in the displays. - Examines the process set point and the Time Preset.
DRAIN	**DRAIN** key can be pressed twice to empty the baths/tanks. Make sure chemical baths are sufficiently cooled down (65ºC) before draining, to protect drain line/s. You can drain a small amount of chemical/s by pressing the DRAIN button twice, then once again when you want to stop draining.
PROGRAM	**PROG** key access to change or step through various setup parameters. Note: Staff are only allowed to edit/change the program.
MODE	**Mode** key enables access to parameter change or step through various parameters. Note: staff are only allowed to edit/change the program.
SAVE	**SAVE** key permanently save the system setup parameters.
RESET	**STOP/RESET** this key is utilized to exit the PROGRAM mode.

ALARM CONTROLLER KEY/FUNCTION



POWER ON	Main power on for top control panels.
EPO	Big red button for emergency stop on the entire sink operation.
SILENCE ALARM	Silence the plenum flush lockout alarm.
ALARM RESET	Reset the plenum flush system.

11.2 Spin Rinse/Dryer Help Messages

HELP-0 **Power Failure**	The power failed while the unit was operating. Check the electrical lines in the unit, and for a blown fuse. Press **START** to reset the microprocessor. The rinser/dryer indexes the rotor and resets to the beginning of the interrupted cycle.
HELP-1 **Bladder Pressure**	There is inadequate nitrogen pressure to inflate the door seal. Check the door bladder, the nitrogen pressure, and the pressure switch. Be sure there is 20-21 psi on RG2 and that the pressure switch turns off when the pressure reaches 17-18 psi.
HELP-2 **Nitrogen Pres**	There is insufficient pressure in the system nitrogen line. Check the nitrogen pressure switch (PSW1). It should be set to approximately 13 psi. Check the system line for leaks. Be sure that the pressure at RG1 is 23 psi dynamic. Check the Clean Coil thermostat and reset if necessary.
HELP-3 **Door Open**	The door is not completely closed. Check the door. If the door is properly aligned, check the micro-switch actuating arm.
HELP-4 **Index Failure**	The unit is not able to index the rotor. Check the rotor positioner.
HELP-5 **Excessive Speed**	The rotor speed has exceeded 3400 RPM. Retry the cycle a few minutes. If the problem persists, there is a hardware problem. Call maintenance or VERTEQ for assistance.

11.3 RCA1, and RCA2 Clean Tanks

The heated baths and rinse tanks in sink 6 and sink 8 in the VLSI area are periodically RCA1 and RCA2 cleaned. These are different size tanks, therefore will need different amount of RCA1 and RCA2 to fill up the tank. Use the following table to calculate correct amount per size of the tank to get RCA cleaned:

RCA1				
Chemical Mix Ratio		**Heated Piranha Tank (~25 liters)**	**6-inch HCl Tank (8.5 liters)**	**8-inch HF Tank (21 liters)**
DI water NH_4OH H_2O_2	5 parts < 1 part 1 part	19 L 2.5 liters (1 bottle) 3.75 liters (1 bottle)	6 liters 1 liters 1.5 liters	15.5 liters 2.5 liters (1 bottle) 3 liters
RCA2				
DI water HCl H_2O_2	6 parts ~1 part ~1 part	18 liters 2.5 liters (1 bottle) 4.5 liters	6.5 liters 1 liters 1.5 liters	15 liters 2.5 liters (1 bottle) 3.5 liters

Control Programs

The control programs and parameter set up for Heated baths and Quick dump rinse station

MPC-100 Temp. Controller for Heated Piranha Etch Bath	
CR	10
FP	10.0
RE	1.0
RA	1.0
OF	0.0
AC1	0.0
AC2	0.0
PS	120.0
DR	80.0
DP	10:00
HI	5.0
LO	10.0
CS	10:00
PA	:30
Cd	1:00
CD	d1

MPC-301 Dump Rinse Station	
CY	2
FP	75
DP	5.0
SD	0
AD	0
N2	N
AC	0
PC	5
DC	0
PN	1
Nb	10
SL	0