



# **MICROVOID®**

**CS-41-SS-6FT**

**Wet Process Chemical Station**

**OPERATION & MAINTENANCE MANUAL**

**INSTALLATION SITE:**

**Australian National University**

**EQUIPMENT ID TAG / SERIAL #:**

**WB02 / 14807-2**

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# Table of Contents

1.0	INTRODUCTION .....	5
2.0	WARRANTY .....	5
3.0	THEORY OF OPERATION .....	5
4.0	INSTALLATION .....	5
5.0	HOOD MATERIAL.....	6
6.0	GENERAL MAINTENANCE & CLEANING .....	6
6.1	Exterior Maintenance: .....	6
6.2	Replacement of LED Lamps:.....	6
6.3	Manufacturer’s recommended procedures: .....	7
7.0	AIRFLOW MEASUREMENT.....	7
8.0	PROGRAMMABLE LOGIC CONTROLLER (PLC).....	7
9.0	TOUCH SCREEN CONTROLLER (HMI).....	7
10.0	CONTROLS SCREEN .....	8
11.0	CHEMICAL CANISTER LEVEL SCREEN.....	10
12.0	CANISTER SCALES.....	11
13.0	CANISTER LOW LEVEL ALARM .....	11
14.0	CARBOY ALARM .....	12

15.0	MAIN MAINTENANCE SCREEN .....	13
15.1	Agitation Setup screen: .....	14
15.2	Aspirator Setup screen:.....	15
16.0	EMERGENCY POWER OFF PUSHBUTTON (STOP).....	16
17.0	LIGHTING (LED).....	17
18.0	EXHAUST FAILURE ALARM AND PHOTOHELIC® GAUGE .....	17
19.0	EYE SHIELD.....	18
20.0	LEAK DETECTED.....	18
21.0	HIGH LIQUID LEVEL IN TUB .....	19
22.0	ACTIVE ALARMS .....	20
23.0	T-923 AMBIENT BATH .....	21
23.1	Ambient Bath Main Control Screen:.....	21
23.2	Ambient Bath Fill Control Screen:.....	22
23.3	Ambient Bath Low Level Alarm .....	24
23.4	Ambient Bath Overfill Alarm.....	25
24.0	T-987 PVDF QUICK DUMP RINSER.....	26
24.1	QDR Main Control Screen:.....	26
24.2	QDR Setup Screen: .....	29
25.0	CHILLED ULTRASONIC BATH.....	31
25.1	Chilled Ultrasonic Bath Main Control Screen:.....	31
25.2	Chilled Ultrasonic Bath Fill Control Screen:.....	33
25.3	Chilled Ultrasonic Bath Low Level Alarm .....	35
25.4	Chilled Ultrasonic Bath Overfill Alarm.....	36
25.5	Chiller Maintenance Screen.....	37
25.6	Chiller Liquid Low Level Alarm .....	38
25.7	Chiller Overtemp Alarm.....	38

26.0	AMBIENT ULTRASONIC BATH .....	39
26.1	Ultrasonic Bath Main Control Screen: .....	39
26.2	Ultrasonic Bath Fill Control Screen: .....	41
26.3	Ultrasonic Bath Low Level Alarm.....	42
26.4	Ultrasonic Bath Overfill Alarm .....	43
27.0	NITROGEN BLOW OFF GUNS .....	44
28.0	DI SPRAY GUNS.....	44
29.0	WAFER HANDLING VACUUM WAND.....	44
30.0	LIQUID ASPIRATOR .....	45
31.0	RECIRCULATING DI LOOP SYSTEM.....	45
32.0	CIRCUIT BREAKERS.....	46
33.0	CONTROL INTERFACE CONNECTOR.....	46
34.0	CARBON DIOXIDE FIRE SUPPRESSION SYSTEM.....	46
35.0	SERVICE CONNECTIONS.....	48
36.0	ELECTRICAL REQUIRMENTS.....	49
37.0	PARTS LIST.....	50
38.0	UNIT PRINTS .....	56
39.0	QUALITY CONTROL .....	56
40.0	COMPONENT MANUALS.....	56

## 1.0 INTRODUCTION

Air Control, Inc. is pleased to have supplied you with a Microvoid® Model CS-41 Chemical Process Station. As one of the pioneers in the field of fume containment and wet processing, Air Control is committed to the manufacture of equipment exhibiting high standards of performance and workmanship. Our Customer Service department is prepared and eager to be of service to you should any problems occur in the use of this equipment.

## 2.0 WARRANTY

This unit has passed a thorough quality control test and is shipped free of visual defects. The unit (except for filters, lamps, and other consumables) is warranted to be free of defects in materials and workmanship for a period of (12) twelve months from the date of shipment. Liability is exclusively limited to repair or replacement of defective parts. Purchased, self-contained, sub-systems installed within the hood carry their own warranty periods, not covered by the hood manufacturer.

**Note: Modifications or alterations to the unit may void the warranty.**

## 3.0 THEORY OF OPERATION

Microvoid® Model CS-41 Chemical Process Station is designed for use in solvent environments. A variety of process tanks and sub-assemblies are available to facilitate specific processes.

Microvoid® Chemical Process Stations are designed to be connected to a facility exhaust system. Multiple adjustable exhaust ports within the hood allow for airflow balancing.

Electrical systems within the hoods are designed for safe operation in prescribed environments. All internal components are pre-wired to a single customer connection point.

All systems are pre-plumbed internally with customer connection points on the rear of the hood.

## 4.0 INSTALLATION

The unit is shipped on a skid. The hood can be lifted from the skid with a forklift. Forks should be open as wide as possible and position the forks beneath the station. Use extreme caution to avoid hitting the plumbing manifolds. Position the forks so they are completely under the hood, engaging the front and rear rails of the frame. Blocking may be required to keep the station level. Lift the hood with the front and

rear vertical edges on the forks. Handle the hood slowly and avoid uneven floor surfaces.

Set the hood in place. Level the hood as required by adjusting the leveling pads. Connect utilities as described on the Hood Drawing. Use compatible materials and observe pressure ratings for plumbing connections. Rated electrical voltage and amperage are listed on the electrical drawing and on the hoods data plate.

## 5.0 HOOD MATERIAL

This hood is manufactured of 316L stainless steel. This material is suitable for use with most solvents. Refer to standard chemical resistance charts or contact Air Control for specific chemical resistance data.

## 6.0 GENERAL MAINTENANCE & CLEANING

### 6.1 Exterior Maintenance:

Plastic and Stainless Steel hoods can be cleaned with filtered IPA and non-shedding cloths or an approved plastic cleaner for the specific material.

**Note: Do not use isopropyl alcohol on the eye shield. The eye shield should only be cleaned with an approved plastic cleaner. Alcohol-based cleaners may damage the eye shield material. Do not use abrasive cleaners on any of the hood surfaces.**

### 6.2 Replacement of LED Lamps:

LED lamps are installed over the work area in a sealed compartment behind the head casing. To access the lamps, reach over the electrical compartment. The box top panel, which is held in place with several retaining screws, can then be removed.

**Note: Always turn the electrical power off prior to changing lamps.**

Carefully remove the old lamps from the fixture and dispose of properly. Install the new lamps into the fixture. Ensure that the lamp pins are securely in their socket. Restore electrical power and check new lamps for operation. Replace clear cover panel.

**Note: Should the new lamps not work, refer to the electrical schematic for possible trouble shooting.**

### 6.3 Manufacturer's recommended procedures:

All installed subassemblies should be maintained per manufacturer's recommended procedures. See accompanying manuals for manufacturer's recommendations.

## 7.0 AIRFLOW MEASUREMENT

The Model CS-41 will safely contain fumes with face velocities of 80 LFM (Linear Feet per Minute) or more. Most models have a hinged eyeshield leaving from 16-18" of fixed open access area. Place the eyeshield in the down position, leaving only the 16"-18" height open to airflow into the hood. Make sure the adjustable louvers at the rear of the deck are wide open.

Using a hot wire anemometer or Velgrid multi-point sensor, take a grid of several face measurements, with a reading every 6" horizontally and vertically across the open face area. The airflow should be 100 LFM, not to exceed 120 LFM. The hinged eyeshield is to be opened only to temporarily move apparatus in or out, but should be left in the down position for all wet station operations and testing.

The open face area of the CS-41 unit is taken as a vertical plane from the edge of the viewing shield straight down to the deck. For future ASHRAE 110 testing, the tracer gas canister is placed 6 inches back from this vertical plane.

**Note: If the airflow is found to be less than 80 LFM, or greater than 120 LFM, consult building maintenance to adjust airflow to place it within the safe operating range of 80 - 120 LFM.**

## 8.0 PROGRAMMABLE LOGIC CONTROLLER (PLC)

This hood is equipped with a programmable logic controller (PLC). The PLC controls the main electrical, pneumatic, and timing functions of the components within the station. The Touch Screen (described below) is the user's communication link to the PLC.

The PLC is installed in the front of the electrical compartment. The controller has been pre-programmed and tested prior to shipment. Should problems arise in the operation of the PLC or should changes be required, contact Air Control, Inc. for assistance.

## 9.0 TOUCH SCREEN CONTROLLER (HMI)

The Touch Screen provides a means of controlling the functions of the process station.

The Touch Screen also displays alarm conditions for the various systems in the process station. The Main Screen is shown below:



This screen is the first screen that comes up on the touchscreen controller when the hood is powered up. It lists the benches serial number, as well as the software revisions of the operating software.

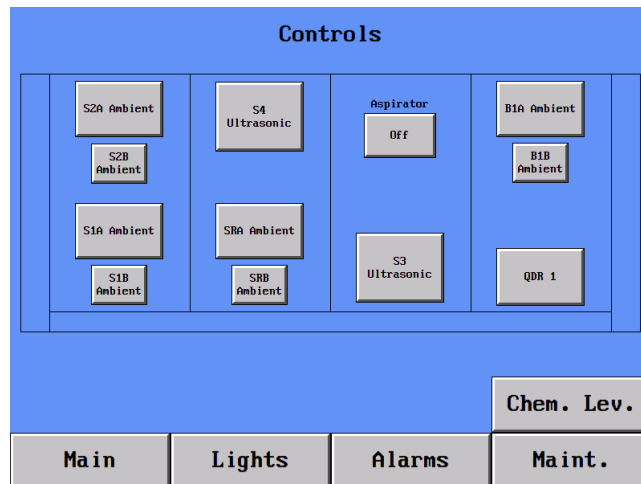
**Controls:**

This button takes you to the Control Screen.

The various other screen images displayed on the touchscreen are found throughout this document.

## 10.0 CONTROLS SCREEN

The Controls Screen is shown below:





This screen is the primary operating screen of the hood. It also graphically displays the locations of the tanks and other support equipment.

**Main:**

This button takes the user back to the Main screen. The screen contains the contact information for Air Control, Inc. the software version for the PLC and HMI, and the serial # of the hood.

**Lights:**

This button turns on an off the fume hood lights.

**Alarms:**

This button takes the user to the Active Alarm screen. The button will flash yellow to show that the bench has an active by silenced alarm.

**Maint.:**

This button takes the user to the password protected Main Maintenance screen. From this screen the user has access to all of the maintenance screens of the bench, which are used to set-up and control the components of the bench.

**Chem. Lev.:**

This button takes the user to the Chemical Canister Level screen.

**S1A Ambient:**

This button takes the user to the control screen for Ambient Bath #S1A.

**S1B Ambient:**

This button takes the user to the control screen for Ambient Bath #S1B.

**S2A Ambient:**

This button takes the user to the control screen for Ambient Bath #S2A.

**S2B Ambient:**

This button takes the user to the control screen for Ambient Bath #S2B.

**SRA Ambient:**

This button takes the user to the control screen for Ambient Bath #SRA.

**SRB Ambient:**

This button takes the user to the control screen for Ambient Bath #SRB.

**S4 Ultrasonic:**

This button takes the user to the control screen for Ultrasonic Bath #S4.

**S3 Ultrasonic:**

This button takes the user to the control screen for Ultrasonic Bath #S3.

**Aspirator:**

This button turns the aspirator on and off.

**QDR 1:**

This button takes the user to the control screen for QDR 1.

**B1A Ambient:**

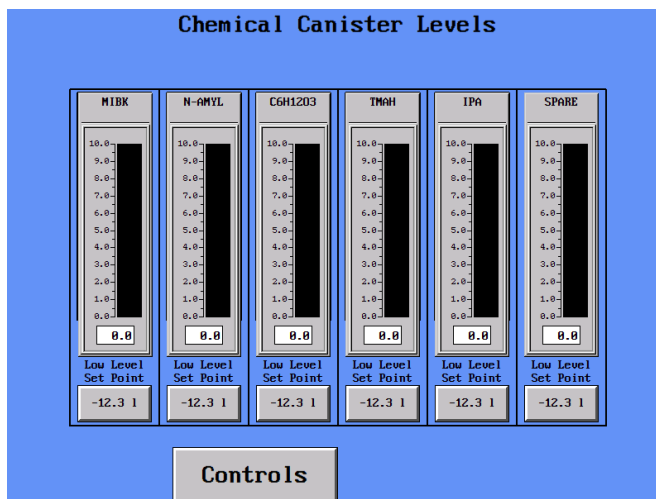
This button takes the user to the control screen for Ambient Bath #B1A.

**B1B Ambient:**

This button takes the user to the control screen for Ambient Bath #B1B.

## 11.0 CHEMICAL CANISTER LEVEL SCREEN

An example of the Chemical Canister Level screen is shown below:



This screen is where the user can set up the low level setpoint for each of the chemical canisters in the rear of the hood.

**NowPack Chemical Dispense Displays:**

These bar graphs on the right display the current estimated amount of chemical present in each of the NowPack Chemical dispense tanks that are plumbed to dispense to this ultrasonic bath. The bar graph readout is displayed at the bottom of the bar numerically, to make it easier to read the

remaining level accurately.

**Low Level Setpoint:**

This is where you can individually select the low level setpoint for each chemical canister. When this level is determined to have been reached, by sensing the appropriately low weight of the individual canister, then the low level canister alarm will be triggered for that particular canister. Each of these canister low level setpoints and alarms work independently from one another.

**Controls:**

This button takes the user back to the Main Controls screen.

## 12.0 CANISTER SCALES

The Now Pack chemical canisters are situated on top of individual scales. These scales measure the amount of chemical remaining inside each canister through a continuous monitoring of the weight of the individual canister.

### 12.1 Canister Scale Re-zeroing

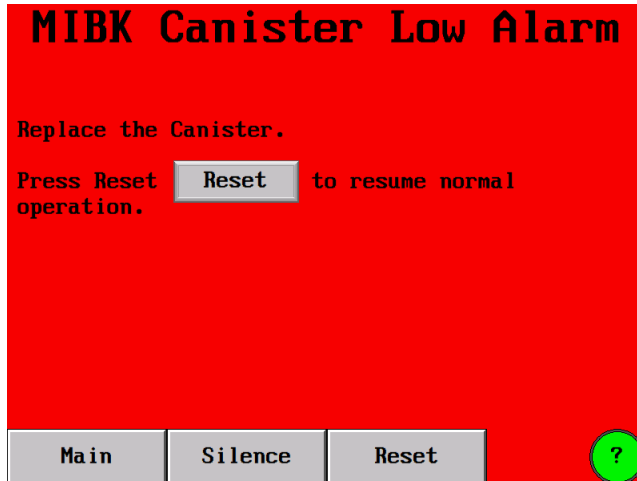
These scales will periodically need to be re-zeroed. The zeroing process is detailed below:

- a. Remove the chemical containing canister from the scale, and place an empty canister of the correct size on the scale.
- b. Insert the dispensing top for this canister into the top of the empty canister, so that its weight contributes to the load on the scale.
- c. Once the empty canister has stabilized its weight on the scale, reach up to the corresponding scale controller, and press the Zero button to zero the scale with its correct, empty canister weight on it. This zeroing button press may have to be done more than once, to allow the scale to settle.
- d. Once the scale has accepted its empty canister zero, replace the empty canister with the chemical containing canister, in order to allow the PLC readout to sense the chemical level within this canister.

## 13.0 CANISTER LOW LEVEL ALARM

When one of the chemical canisters reads the level that has been set as the low level for that particular canister, then the hood will trigger a Canister Low Level alarm. An

example of a Canister Low Level alarm screen is shown below:



**Main:**

This button takes the user back to the Main screen after the High Liquid Level in Tub alarm has been Silenced or Reset.

**Silence:**

This button Silences the High Liquid Level in Tub alarm.

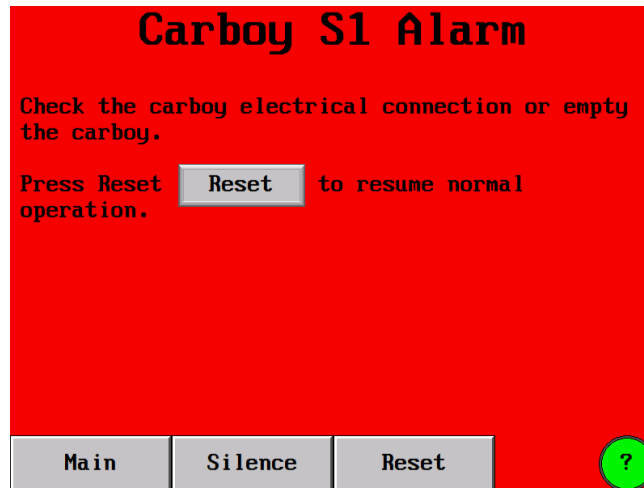
**Reset:**

This button Resets the High Liquid Level in Tub alarm.

Replace the low level canister with a full one, and press reset to clear the alarm. Press Main to return to the Operating screen.

## 14.0 CARBOY ALARM

The chemical waste carboys in this hood are monitored for full liquid level, as well as presence, as indicated by a plugged in instrumented carboy cap. When one of these carboys is either full, or goes missing from its electrical connection, then the hood will trigger a Carboy alarm. An example of a Carboy alarm screen is shown below:



**Main:**

This button takes the user back to the Main screen after the Carboy alarm has been Silenced or Reset.

**Silence:**

This button Silences the High Liquid Level in Tub alarm.

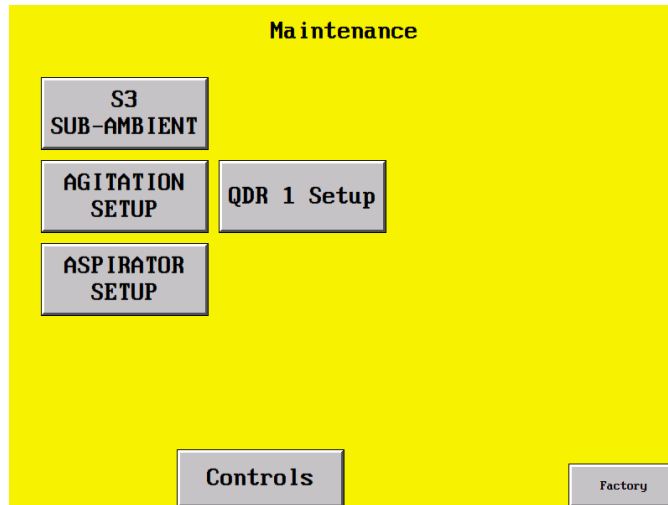
**Reset:**

This button Resets the High Liquid Level in Tub alarm.

Correct the condition that is causing the alarm, and press reset to clear the alarm. Press Main to return to the Operating screen.

## 15.0 MAIN MAINTENANCE SCREEN

The Main Maintenance screen is shown below:



This password protected screen is where the user can access the maintenance set-up for the hood. The default password for this screen is 1234.

**S3 Sub Ambient:**

This button takes the user to the S3 Sub Ambient Ultrasonic Bath setup screen. This screen will be discussed in the S3 Ultrasonic Bath section of the manual.

**Agitation Setup:**

This button takes the user to the Agitation setup screen. This screen will be discussed below.

**QDR 1 Setup:**

This button takes the user to the QDR 1 tank setup screen. This screen will be discussed in the QDR section of the manual.

**Aspirator Setup:**

This button takes the user to the Aspirator Setup screen. This screen will be discussed below.

**Controls:**

This button takes the user back to the Controls screen.

**Factory:**

This button is for the use of factory calibrations. It cannot be accessed by the user, as none of these calibrations are available for user adjustment.

15.1 Agitation Setup screen:

The agitation function in the heated and ambient process tanks can be setup to

automatically time out after a certain length of time on the Agitation Setup screen, which is shown below:

Agitation Setup			
S1A	S1B	B1A	B1B
Max. Time -12345 s	Max. Time -12345 s	Max. Time -12345 s	Max. Time -12345 s
S2A	S2B		
Max. Time -12345 s	Max. Time -12345 s		
SRA	SRB		
Max. Time -12345 s	Max. Time -12345 s		
Controls		Back	

**Max. Time:**

This is the length of time the agitation will run on each of the eight process tanks before shutting itself off automatically. It can be set from 1 to 9999 seconds.

**Controls:**

This button takes the user back to the Main Controls screen.

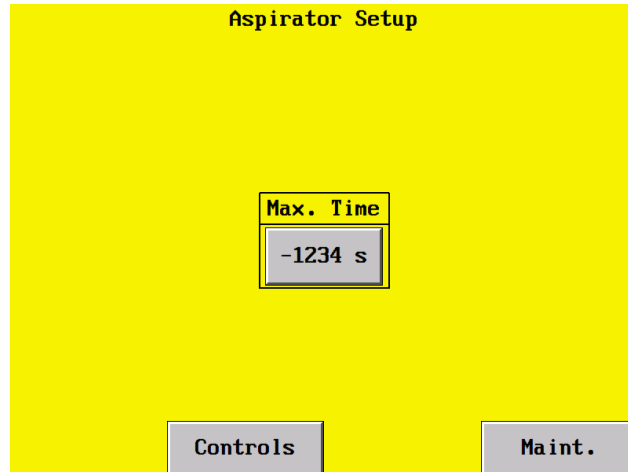
**Maint.:**

This button returns the user to the prior Main Maintenance screen.

There is a separate needle valve under the deck to adjust the amount of agitation that each process tank receives.

15.2 Aspirator Setup screen:

The aspirator can be setup to automatically time out after a certain length of time on the Aspirator Setup screen, which is shown below:



**Max. Time:**

This is the length of time the aspirator will run before shutting itself off automatically. It can be set from 1 to 9999 seconds.

**Controls:**

This button takes the user back to the Main Controls screen.

**Maint.:**

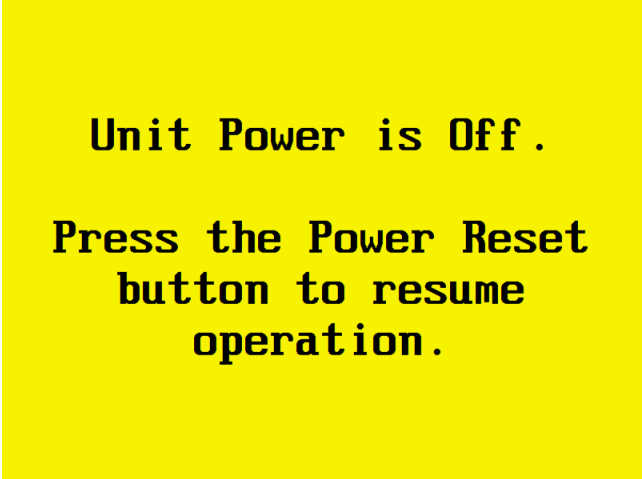
This button returns the user to the prior Main Maintenance screen.

## 16.0 EMERGENCY POWER OFF PUSHBUTTON (STOP)

The red mushroom head pushbutton in the center of the electrical panel may be depressed for electrical shutdown. Upon activation, the power will be cut to the entire unit, HMI touchscreen included. The only indication of the EPO activation is that the EPO Engaged light will come on. Twist and pull the EPO pushbutton to un-do the EPO activation. This will cause the EPO Engaged light to go out. Press the Power On button on the fume hood control panel to re-start the bench.

If the Power On button is not pressed, once the touchscreen re-activates, the following screen will remind you to press the Power On button to restore power to the bench:





Digital controllers must be "powered-up" or reset after power outages.

**17.0 LIGHTING (LED)**

This hood is equipped with standard LED lighting. The lights are activated by a button on the touchscreen Controls screen.

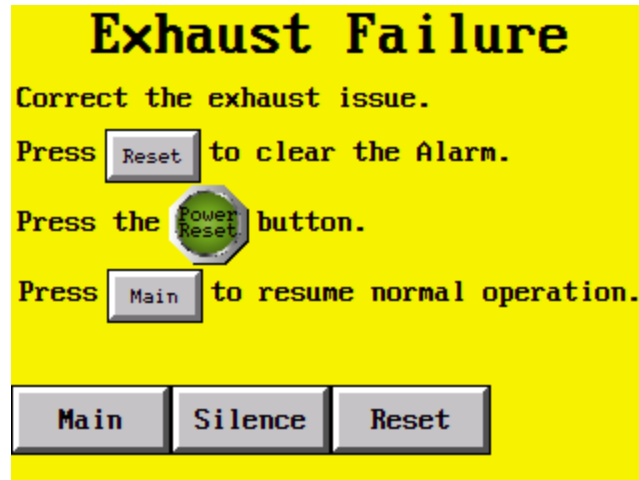
The lamps and fixture are accessed through a sealed panel on the underside of the head case.

(See the General Maintenance Section for replacement instructions.)

**18.0 EXHAUST FAILURE ALARM AND PHOTOHELIC® GAUGE**

The photo-helic® pressure gauge is located on the front head case control panel. This gauge monitors negative pressure in the fume hood's exhaust plenum. Normal reading is between 0.20 and 0.40 inch w.g., while operating the fume hood at 100-lfm face velocity.

The low-pressure set point hand on the face of the photo-helic gauge is used to initiate the exhaust failure alarm system. This system shuts down electrical power to the hood in the event of an exhaust failure or low exhaust flow. This will also cause the Exhaust Failure screen to display on the touchscreen, as shown below:



**Main:**

This button takes the user back to the Main screen after the Exhaust Failure alarm has been Silenced or Reset

**Silence:**

This button Silences the Exhaust Failure alarm.

**Reset:**

This button Resets the Exhaust Failure alarm.

The Silence button on the touch screen can silence this alarm condition; however, the condition must be corrected before the system can be reset. The low-pressure set point should typically be between 0.10 to 0.20 inches w.g.

## 19.0 EYE SHIELD

This hood is equipped with an eye shield constructed of clear C-PVC material. The eye shield should be left in a closed position while the hood is being used. Operators should look through the eye shield, not beneath it, for maximum splash protection.

**Note: Clean the eye shield with an approved plastic cleaner only. Alcohol based cleaners may damage the eye shield material.**

## 20.0 LEAK DETECTED

This hood is equipped with Leak Detection. The leak detection floats are located in the base cabinets and/or carboy drawers. In the event of a leak or spill, an alarm is shown on the HMI or indicator. The HMI alarm screen is shown below:



**Main:**

This button takes the user back to the Main screen after the Leak Detected alarm has been Silenced or Reset.

**Silence:**

This button Silences the Leak Detected alarm.

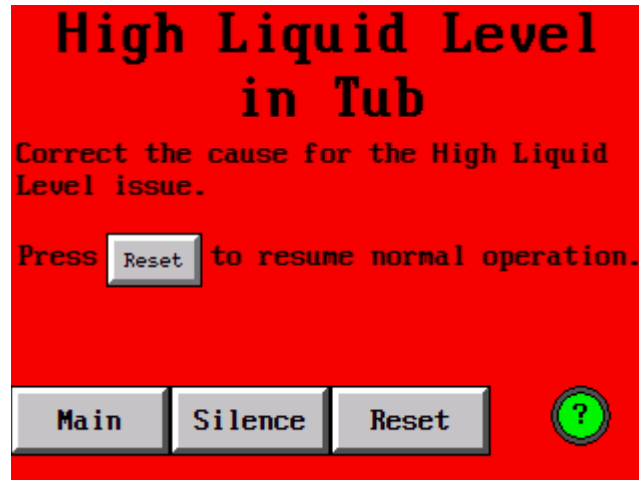
**Reset:**

This button Resets the Leak Detected alarm.

Correct the issue that caused the alarm and press reset to clear the alarm. Press Main to return to the Operating screen.

## 21.0 HIGH LIQUID LEVEL IN TUB

This hood is equipped with a liquid level sensor in the tub. The high liquid level float is located in the secondary containment tub, which is beneath the deck of the hood. In the event of excessive liquid level in the tub, an alarm is shown on the HMI or indicator. The HMI alarm screen is shown below:



**Main:**

This button takes the user back to the Main screen after the High Liquid Level in Tub alarm has been Silenced or Reset.

**Silence:**

This button Silences the High Liquid Level in Tub alarm.

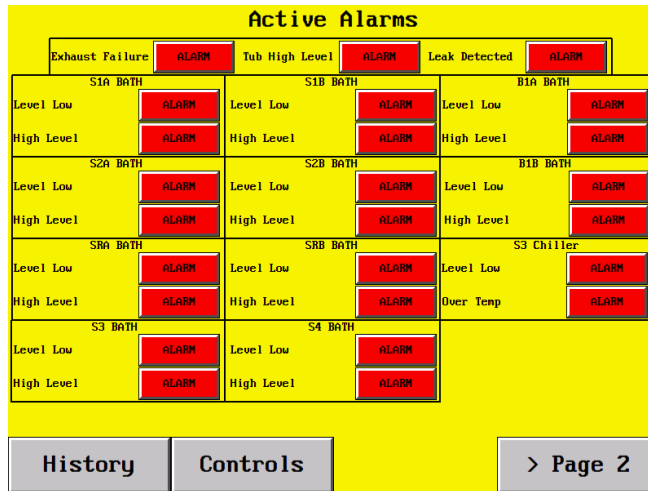
**Reset:**

This button Resets the High Liquid Level in Tub alarm.

Correct the issue that caused the alarm and press reset to clear the alarm. Press Main to return to the Operating screen.

## 22.0 ACTIVE ALARMS

The unit has a separate screen for monitoring active alarms. It is accessed through the main screen on the touchscreen controller, and is displayed below:



**History:**

This button takes the user to the built-in alarm history screen. This screen displays the alarm event time and count.

**Controls:**

This button takes the user back to the Controls screen.

**Page 2:**

This button takes the user to the second page of Active Alarm Screens.

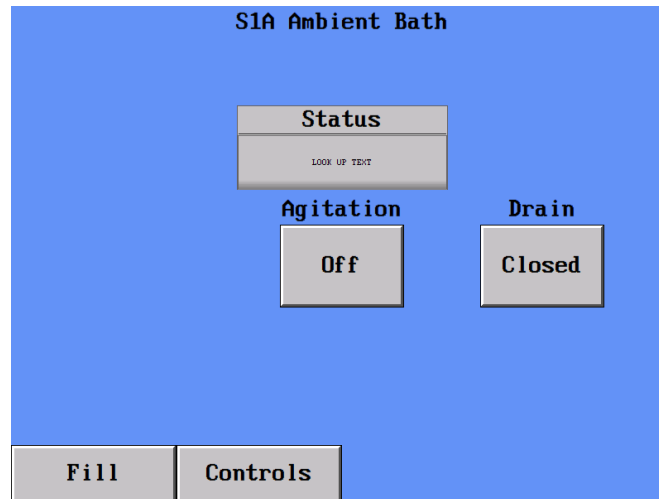
If any alarms have been silenced but are still active, this screen will display them. This screen also gives a list of alarms this hood has built into it with the exception of the EPO and Exhaust Failure alarms.

**23.0 T-923 AMBIENT BATH**

This hood is equipped with eight (8) T-923 ambient process baths. These baths have been constructed using either stainless steel (SS), which is resistant to most solvents, or natural polypropylene (PP), which is resistant to most chemicals. Refer to standard chemical resistance charts or contact Air Control for specific chemical resistance data.

**23.1 Ambient Bath Main Control Screen:**

The Ambient Baths are operated through the Ambient Bath Main Controls screen of the HMI, an example of which is shown below:



**Status:**

This status box shows the state of the ambient bath. One of the following messages will be displayed there:

**Tank High Liquid Level, Tank Low Liquid Level, Tank Over Level:**

These messages convey the various non-ready states of the liquid level in this bath.

**Tank Liquid Level OK:**

This message signifies that none of the Tank Level exceptions are present. This message conveys that the tank is completely ready to go.

**Tank Draining:**

The tank is in the process of draining.

**Agitation:**

This button turns the tank agitation on and off.

**Drain:**

This button drains the bath to its dedicated carboy in the base cabinet.

**Fill:**

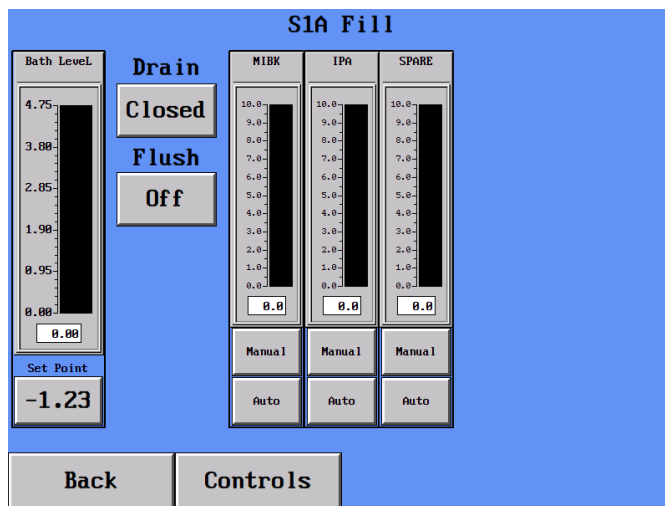
This button takes the user to this ambient tank Fill screen.

**Controls:**

This button takes the user back to the Controls screen.

23.2 Ambient Bath Fill Control Screen:

The Ambient Bath Fill screen is where you go to add chemical to one of the ambient baths. An example of this screen is shown below:



#### **Bath Level:**

This bar graph on the left displays the current estimated amount of chemical present in the bath at this time. The bar graph readout is displayed at the bottom of the bar numerically, to make it easier to read the remaining level accurately.

#### **Set Point:**

This box is where you set the amount of chemical to fill the heated tank to when the Auto button is pressed on one of the chemical fill displays on the right.

**Note: The auto fill function will raise the process tank to the level displayed on set point. E.g., if there is already 2 liters in the tank, and the Set Point is set to 4 liters, pressing one of the auto fill buttons will dispense the remaining 2 liters of tank volume required to reach the Set Point.**

#### **Drain:**

This button drains the bath to its dedicated carboy in the base cabinet.

#### **Flush:**

This button runs nitrogen through the bubbler lines in the tank to flush any remaining chemical out of the bubbler lines. This is to prevent contamination of a new chemical mixture with old chemistry remaining in the bubbler lines.

#### **NowPack Chemical Dispense Displays:**

These bar graphs on the right display the current estimated amount of chemical present in each of the NowPack Chemical dispense tanks that are plumbed to dispense to this ultrasonic bath. The bar graph readout is displayed at the bottom of the bar numerically, to make it easier to read the remaining level accurately.

**Manual:**

These buttons are used to manually add chemical to this ultrasonic bath. These buttons are momentary style, and will continue to dispense as long as they remain depressed. The amount of chemical dispensed will be tallied on the Bath Level display to the left.

**Auto:**

These buttons are used to add chemical to this ultrasonic bath in an automatic fashion. Once depressed, one of these buttons will activate the chemical dispense pump of the selected chemical, and continue filling until the Set Point on the Bath Level display is reached. A second press of this button will discontinue the automatic fill before it is completed. The amount of chemical dispensed will be tallied on the Bath Level display to the left.

**Back:**

This button returns the user to the Ultrasonic Bath Main Operation screen.

**Controls:**

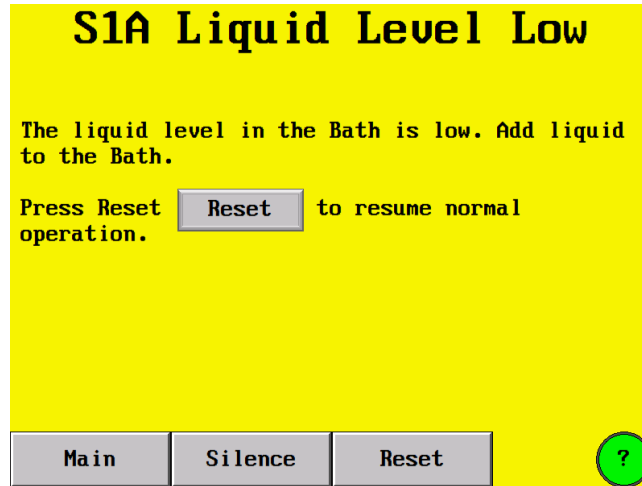
This button takes the user back to the Main Controls screen.

### 23.3 Ambient Bath Low Level Alarm

The ambient baths also have low level sensors. If the fluid level in the baths falls below the safe operating level as determined by the manufacturer, then the units will alarm. A low level condition is signaled by an alarm and a message on the Touch Screen, as shown below.

**Note: The Reset Button must be pressed to clear the alarm. This button is on the low Level alarm screen.**





**Main:**

This button takes the user back to the Main screen after the Low Level alarm has been Silenced or Reset

**Silence:**

This button Silences the Low Level alarm.

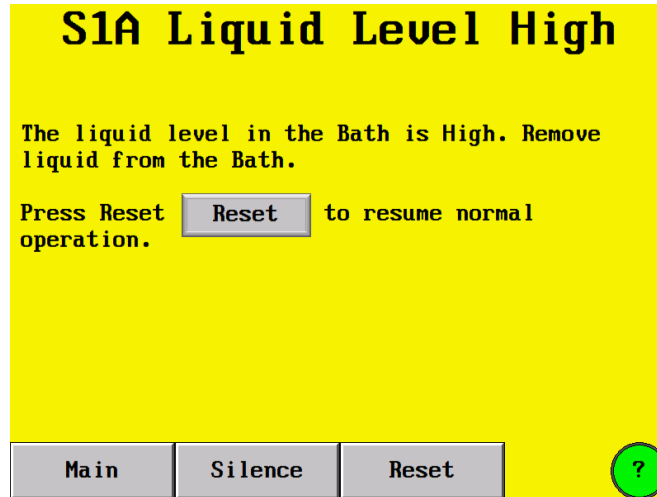
**Reset:**

This button Resets the Low Level alarm.

#### 23.4 Ambient Bath Overfill Alarm

The level sensor in the ambient baths have an overfilled condition alarm. The overfilled level is factory set to the maximum allowable bath level. An overfilled condition is signaled by an alarm and a message on the Touch Screen, as shown below.

**The Reset Button must be pressed to clear the alarm. This button is on the High Level alarm screen.**



**Main:**

This button takes the user back to the Main screen after the High Level alarm has been Silenced or Reset

**Silence:**

This button Silences the High Level alarm.

**Reset:**

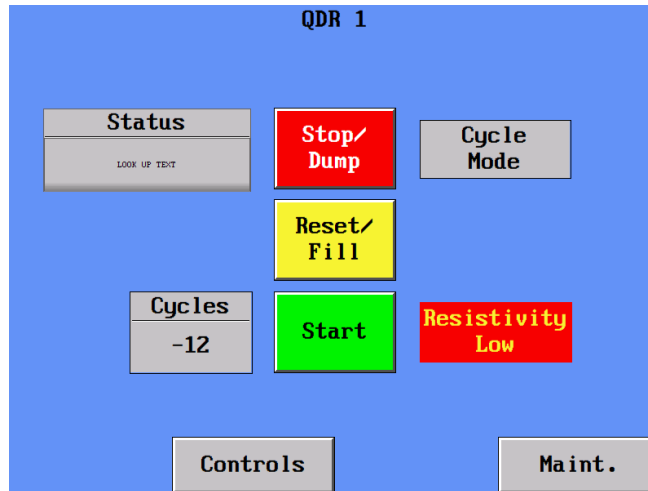
This button Resets the High Level alarm.

## 24.0 T-987 PVDF QUICK DUMP RINSER

This hood is equipped with one (1) T-987 QDR tank. This tank has been constructed using natural Polyvinylidene fluoride (PVDF) material, to prevent leeching of dyes into the process.

### 24.1 QDR Main Control Screen:

The controllers are operated through the Quick Dump Rinse (QDR) Main Control Screen of the HMI, as shown below:



## QDR:

### Status:

This status box shows the state of the QDR. One of the following messages will be displayed there:

#### Idle:

This message indicates that the QDR is empty and ready to start filling.

#### Filling:

This message indicates that the QDR is in the process of filling, heading to the Ready state.

#### Ready:

This message indicates that the QDR is filled, and is ready to start a run program.

#### Running:

The message indicates that the QDR is in the process of running a cycle.

#### Complete:

The message indicates that the QDR has completed its cycle. This state will alarm until silenced, at which point the QDR will return to Ready state.

### Cycles Display:

This display shows the number of cycles selected for operation in cycle mode. This cycle number is chosen on the QDR setup screen as detailed below.

**Reset/Fill Key:**

When first using an empty QDR, depress the Reset/Fill key to fill the tank with DI water. This step will activate the DI low flow solenoid and close the Drain valve. Both of these conditions will remain during the complete operation of the QDR.

**Ready Mode:**

Once the DI water fills to the level of the Liquid Level sensor, the DI will continue to fill the tank to the overflow level. At this point, the QDR has entered standby mode with cascade. The QDR will continue to slowly overflow the weir and the Status message will indicate Ready. The Low Flow needle valve is located below the deck near the QDR. This adjustment allows the fill rate of the Slow Fill to be adjusted to the needs of the operation.

**Start Key:**

Depress the Start key to begin the operation of the main QDR cycle. The Status message will switch to indicate Running, and the DI High Flow valve, Nitrogen Agitation, and DI Spray Bars will all turn on. All three will remain on continuously for the QDR cycle. The flow needle valves for each of these processes are located below the deck near the QDR. Adjustment of these needle valves will allow changes to the flow rate for the DI High Flow valve, Nitrogen Agitation, and DI Spray Bars. This allows the flow rates of each of these three processes to be adjusted separately, to tailor them to the needs of the operation.

The Start key also begins the Start Delay timer. The Start Delay is the time in the cycle when the DI water stays at the top of the weir overflow. When the Start Delay timer reaches zero, the QDR drain valve will open and drain the QDR. The Drain Time timer determines the time the QDR drain valve remains open. The DI Low & High Flow valves, Nitrogen Agitation, and Spray Bars will all stay on throughout this cycle.

Once the Drain Time timer reaches zero, the QDR drain valve will close, and the QDR will fill back up. The DI High & Low Flow valves, Nitrogen Agitation, and Spray Bars will all stay on throughout this cycle.

Once the DI water reaches the overflow level, the cycle will restart and continue until the Cycle count is 0. When the Cycle count is 0, the DI High Flow valve, Nitrogen Agitation, and Spray Bars will all turn off and the QDR alarm will sound the completion of the cycle. The yellow reset button will also flash upon completion of the cycle. Press the Reset key to silence the alarm and place the QDR in Ready mode. The QDR will continue to slowly overflow the weir. The Status message will indicate Ready and the QDR is ready to Start a

new cycle.

**Stop/Dump Key:**

At any time during or at the end of the QDR operation, depressing the Stop/Dump key will stop the cycle, open the QDR drain valve, and shut off all the fills and agitations of the tank. This Stop/Dump Key shuts off the QDR and returns it to the off state.

**Cycle Mode Display:**

This display shows if the QDR is set to Cycle mode or Resistivity mode. This setting is chosen on the QDR setup screen as detailed below.

**Resistivity Display:**

This display shows if the QDR resistivity is low, indicating a still dirty process, or high, indicating a process that has cycled to the cleanliness specification set on the resistivity monitor.

**Controls:**

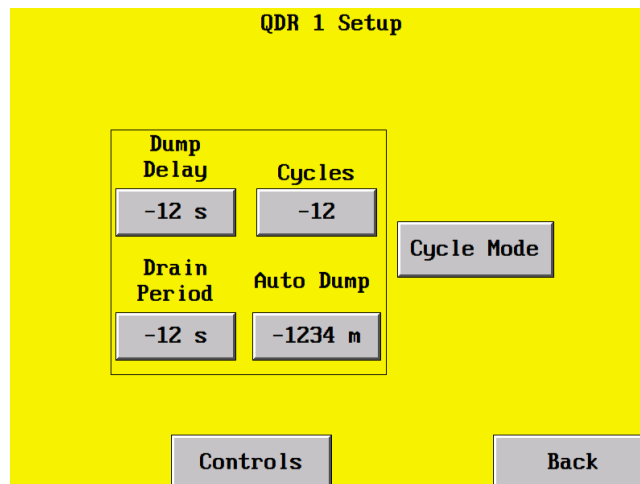
This button returns the user to the Controls screen.

**Maint.:**

This button takes the user to the password protected Maintenance screen.

24.2 QDR Setup Screen:

The parameters of the QDR process can be changed in the QDR Setup screen of the HMI, as shown below:



## **QDR Cycle mode parameters:**

### **Dump Delay:**

The Dump Delay is used to set a delay before the QDR dumps. This is the time the QDR holds the DI water at the full level before dumping.

Minimum: 1 seconds.

Maximum: 99 seconds.

Default: 10 seconds.

### **Cycles:**

The Cycles counter is set to the number of rinse cycles required by the process.

Minimum: 1 cycle.

Maximum: 99 cycles.

Default: 3 cycles.

### **Drain Period:**

The Drain Period is the amount of time the QDR dump valve stays open to allow the DI water to drain completely. If any DI water remains in the tank, increase the time. The increased Drain Period can also allow the Spray Bars to rinse the wafers longer is desired.

Minimum: 1 seconds.

Maximum: 99 seconds.

Default: 5 seconds.

### **Auto Dump:**

The Auto Dump timer will allow the QDR refresh the DI water during long periods of Ready operation. If the QDR has been left in Ready mode for the entire duration of the Auto Dump timer, the drain valve will open, and the QDR will execute a single cycle to refresh the DI water within the tank. This is to prevent the possibility of heavy particles accumulating in the QDR tank during long standby sessions.

Minimum: 1 minute.

Maximum: 1440 minutes.

Default: 180 minutes.

### **Cycle Mode:**

This button is used to choose between cycle mode and resistivity mode operation.

### **Resistivity Mode:**

This unit is equipped with a resistivity monitor. This monitor can be used to cycle the QDR until a cleanliness specification has been met.

**(Please consult the included resistivity monitor manual for proper setup and operation of the Thornton resistivity monitor and probe)**

**Controls:**

This button returns the user to the Controls screen.

**Maint.:**

This button returns the user to the prior maintenance screen.

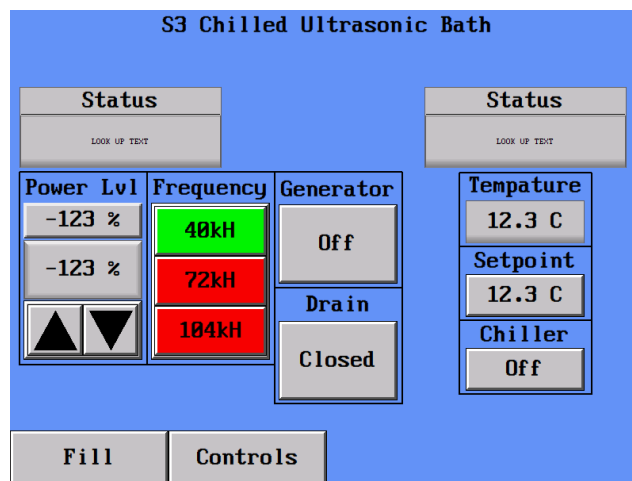
The QDR's Spray Bar valve, Slow Flow valve and Fast Flow valve flow rates are factory set. There are flow adjustment needle valves for this system beneath the work surface, should additional adjustment be required.

## 25.0 CHILLED ULTRASONIC BATH

This station is equipped with one (1) Chilled Ultrasonic Bath. This system has been constructed of stainless steel (SS), and is suitable for use with most solvents. Refer to standard chemical resistance charts or contact Air Control for specific chemical resistance data. These tanks are fitted with chemical fill lines plumbed from the chemical tanks in the rear.

### 25.1 Chilled Ultrasonic Bath Main Control Screen:

The Chilled Ultrasonic Bath is operated through the Chilled Ultrasonic Bath Main Control screen of the HMI, an example of which is shown below:



**(Left) Status:**

The Status box on the left shows the state of the Chilled Ultrasonic Bath. One of the following messages will be displayed there:

**Power is off:**

The power to the ultrasonic generator is off.

**Ready:**

The bath is ready to run the ultrasonic generator.

**Liquid Level is Low:**

The liquid level in the bath is too low. Add liquid to the bath to bring the level to the operating level.

**Draining:**

The bath is draining.

**Power Lvl.:**

This is where you can adjust the power level of the ultrasonic generator. The upper box is the readout of the power level, the lower box is where you can set the level in 10% increments. You can set levels from 20 to 100% using the up and down arrows shown.

**Frequency:**

This is where you choose which of the three possible ultrasonic generator frequencies to use. Your selection will highlight in green, while the other two frequencies will remain in red.

**Generator:**

This button turns the ultrasonic generator on or off.

**Drain:**

This button drains the bath to its dedicated carboy in the base cabinet.

**(Right) Status:**

The Status box on the right shows the state of the Chiller that is associated with the Chilled Ultrasonic Bath. One of the following messages will be displayed there:

**Ready:**

The Chiller is ready to run.

**Chiller is off:**

The power to the Chiller is off.



**Compressor is off:**

The Chiller compressor is not functioning.

**Pump is off:**

The Chiller circulation pump is not functioning.

**Over Temperature:**

The Chiller is in an overtemperature fault state.

**Liquid Low:**

The liquid level in the bath is too low. Add liquid to the bath to bring the level to the operating level.

**Running:**

The Chiller is on, and fully functional.

**Temperature.:**

This is where you readout the current temperature of the chilled loop.

**Set Point:**

This is where you choose the temperature to set the chilled loop to. This can be set in a range from 12 degrees C to 22 degrees C.

**Chiller:**

This button turns the Chiller on or off.

**Fill:**

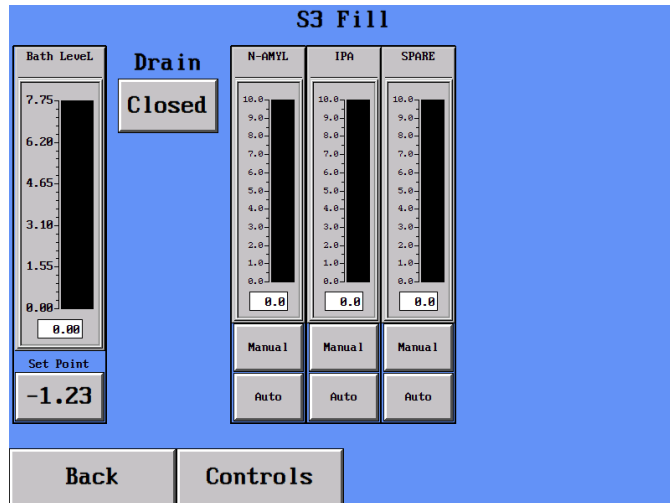
This button takes the user to the ultrasonic tanks Fill screen.

**Controls:**

This button takes the user back to the Controls screen.

## 25.2 Chilled Ultrasonic Bath Fill Control Screen:

The Chilled Ultrasonic Bath Fill screen is where you go to add chemical to the chilled ultrasonic bath. An example of this screen is shown below:



**Bath Level:**

This bar graph on the left displays the current estimated amount of chemical present in the bath at this time. The bar graph readout is displayed at the bottom of the bar numerically, to make it easier to read the remaining level accurately.

**Set Point:**

This box is where you set the amount of chemical to fill the ultrasonic tank to when the Auto button is pressed on one of the chemical fill displays on the right.

**Note: The auto fill function will raise the process tank to the level displayed on set point. E.g., if there is already 2 liters in the tank, and the Set Point is set to 4 liters, pressing one of the auto fill buttons will dispense the remaining 2 liters of tank volume required to reach the Set Point.**

**Drain:**

This button drains the bath to its dedicated carboy in the base cabinet.

**NowPack Chemical Dispense Displays:**

These bar graphs on the right display the current estimated amount of chemical present in each of the NowPack Chemical dispense tanks that are plumbed to dispense to this ultrasonic bath. The bar graph readout is displayed at the bottom of the bar numerically, to make it easier to read the remaining level accurately.

**Manual:**

These buttons are used to manually add chemical to this ultrasonic

bath. These buttons are momentary style, and will continue to dispense as long as they remain depressed. The amount of chemical dispensed will be tallied on the Bath Level display to the left.

**Auto:**

These buttons are used to add chemical to this ultrasonic bath in an automatic fashion. Once depressed, one of these buttons will activate the chemical dispense pump of the selected chemical, and continue filling until the Set Point on the Bath Level display is reached. A second press of this button will discontinue the automatic fill before it is completed. The amount of chemical dispensed will be tallied on the Bath Level display to the left.

**Back:**

This button returns the user to the Ultrasonic Bath Main Operation screen.

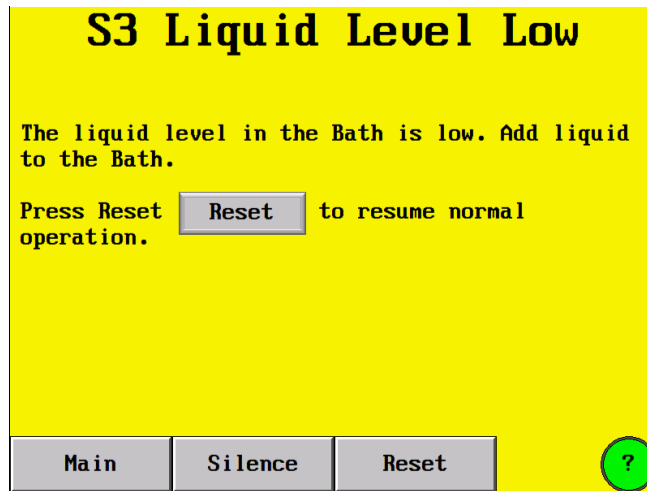
**Controls:**

This button takes the user back to the Main Controls screen.

### 25.3 Chilled Ultrasonic Bath Low Level Alarm

The chilled ultrasonic bath also has a low level sensor. If the fluid level in the bath falls below the safe operating level as determined by the manufacturer, then the unit will alarm. A low level condition is signaled by an alarm and a message on the Touch Screen, as shown below.

**Note: The Reset Button must be pressed to clear the alarm. This button is on the low Level alarm screen.**



**Main:**

This button takes the user back to the Main screen after the Low Level alarm has been Silenced or Reset

**Silence:**

This button Silences the Low Level alarm.

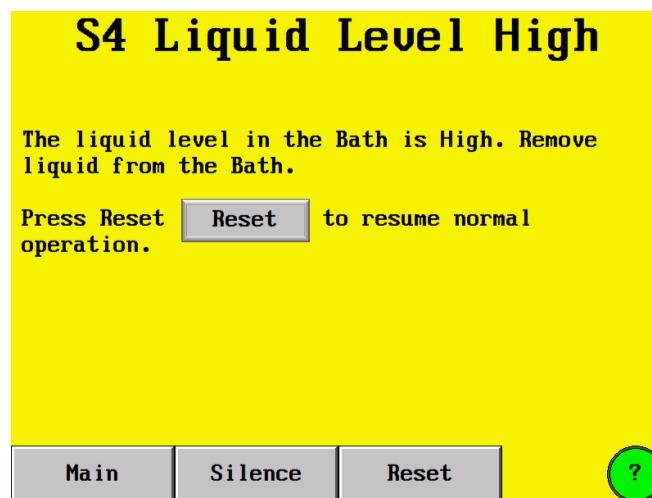
**Reset:**

This button Resets the Low Level alarm.

#### 25.4 Chilled Ultrasonic Bath Overfill Alarm

The level sensor in the chilled ultrasonic bath also has an overfilled condition alarm. The overfilled level is factory set to the maximum allowable bath level. An overfilled condition is signaled by an alarm and a message on the Touch Screen, as shown below.

**The Reset Button must be pressed to clear the alarm. This button is on the High Level alarm screen.**



**Main:**

This button takes the user back to the Main screen after the High Level alarm has been Silenced or Reset

**Silence:**

This button Silences the High Level alarm.

**Reset:**

This button Resets the High Level alarm.

## 25.5 Chiller Maintenance Screen

The chilled ultrasonic bath chiller has parameters that can be set within the password protected Chiller Setup screen, as shown below:

The screenshot shows a yellow background with the title "S3 Chilled Setup". The parameters are arranged in a grid-like structure:

S3 Chilled Setup		
Proportion (Gain)	Offset	Tempature
-1234	-12.3 C	12.3 C
Integral (Reset)		Setpoint
-1234 s		12.3 C
Derivative (Rate)	Time Base (sec.)	Chiller
-1234 s	-12.34	Off
Controls		Back

### **Left Side:**

The four buttons on the left side control the PID loop for the chiller.

(Read the chiller manual for more details on this PID loop programming).

### **Offset:**

This is where you set the offset that will sync the temperature sensor inside the chiller with the temperature sensor in the ultrasonic tank.

### **Temperature:**

This reads out the temperature of the chiller.

### **Setpoint:**

This is where you set the desired temperature of the chiller loop.

### **Chiller:**

This button Turns the chiller on and off.

### **Controls:**

This button takes the user back to the Main Controls screen.

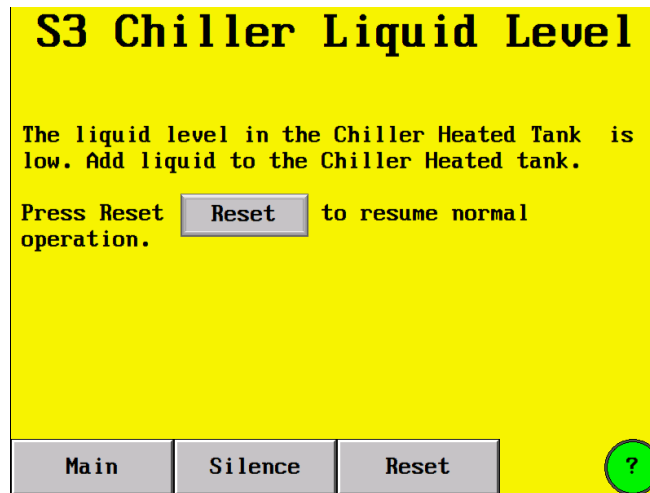
### **Back:**

This button returns the user to the Maintenance main screen.

## 25.6 Chiller Liquid Low Level Alarm

The chiller is equipped with a low liquid level sensor. If the fluid level in the chiller falls below the safe operating level as determined by the manufacturer, then the unit will alarm. A low level condition is signaled by an alarm and a message on the Touch Screen, as shown below.

**Note: The Reset Button must be pressed to clear the alarm. This button is on the low Level alarm screen.**



### **Main:**

This button takes the user back to the Main screen after the Low Level alarm has been Silenced or Reset

### **Silence:**

This button Silences the Low Level alarm.

### **Reset:**

This button Resets the Low Level alarm.

## 25.7 Chiller Overtemp Alarm

The chiller is also equipped with an overtemperature sensor. In the event that the chiller experiences an overtemp event, it will be signaled by an alarm and a message on the Touch Screen, as shown below.

**The Reset Button must be pressed to clear the alarm. This button is on the High Level alarm screen.**



**Main:**

This button takes the user back to the Main screen after the High Level alarm has been Silenced or Reset

**Silence:**

This button Silences the High Level alarm.

**Reset:**

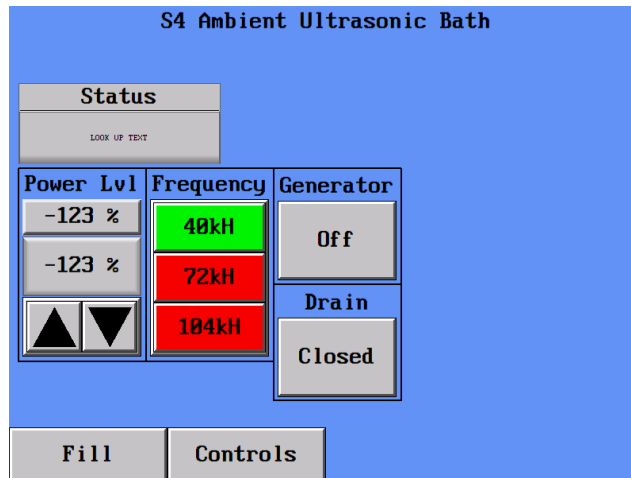
This button Resets the High Level alarm.

## 26.0 AMBIENT ULTRASONIC BATH

This station is equipped with one (1) Ambient Ultrasonic Bath. This system has been constructed of stainless steel (SS), and is suitable for use with most solvents. Refer to standard chemical resistance charts or contact Air Control for specific chemical resistance data. These tanks are fitted with chemical fill lines plumbed from the chemical tanks in the rear.

### 26.1 Ultrasonic Bath Main Control Screen:

The Ultrasonic Bath is operated through the Ultrasonic Bath Main Control screen of the HMI, an example of which is shown below:



**Status:**

The Status box shows the state of the Ultrasonic Bath. One of the following messages will be displayed there:

**Power is off:**

The power to the ultrasonic generator is off.

**Ready:**

The bath is ready to run the ultrasonic generator.

**Liquid Level is Low:**

The liquid level in the bath is too low. Add liquid to the bath to bring the level to the operating level.

**Draining:**

The bath is draining.

**Power Lvl.:**

This is where you can adjust the power level of the ultrasonic generator. The upper box is the readout of the power level, the lower box is where you can set the level in 10% increments. You can set levels from 20 to 100% using the up and down arrows shown.

**Frequency:**

This is where you choose which of the three possible ultrasonic generator frequencies to use. Your selection will highlight in green, while the other two frequencies will remain in red.

**Generator:**

This button turns the ultrasonic generator on or off.



**Drain:**

This button drains the bath to its dedicated carboy in the base cabinet.

**Fill:**

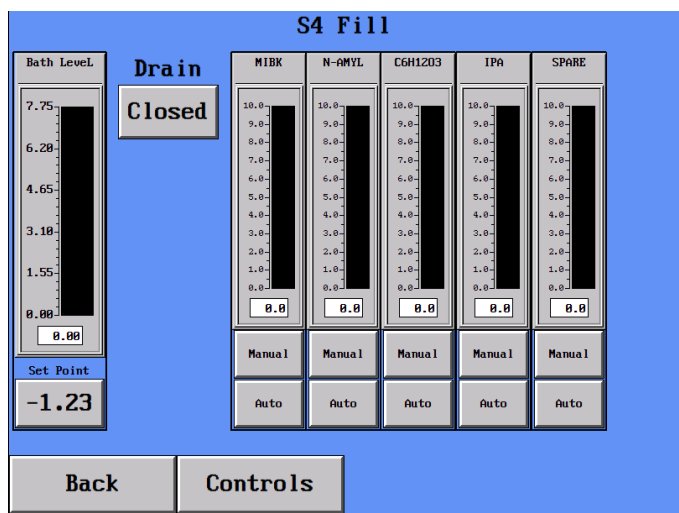
This button takes the user to the ultrasonic tanks Fill screen.

**Controls:**

This button takes the user back to the Controls screen.

26.2 Ultrasonic Bath Fill Control Screen:

The Ultrasonic Bath Fill screen is where you go to add chemical to the ultrasonic bath. An example of this screen is shown below:



**Bath Level:**

This bar graph on the left displays the current estimated amount of chemical present in the bath at this time. The bar graph readout is displayed at the bottom of the bar numerically, to make it easier to read the remaining level accurately.

**Set Point:**

This box is where you set the amount of chemical to fill the ultrasonic tank to when the Auto button is pressed on one of the chemical fill displays on the right.

**Note: The auto fill function will raise the process tank to the level displayed on set point. E.g., if there is already 2 liters in the tank, and the Set Point is set to 4 liters, pressing one of the auto fill**

**buttons will dispense the remaining 2 liters of tank volume required to reach the Set Point.**

**Drain:**

This button drains the bath to its dedicated carboy in the base cabinet.

**NowPack Chemical Dispense Displays:**

These bar graphs on the right display the current estimated amount of chemical present in each of the NowPack Chemical dispense tanks that are plumbed to dispense to this ultrasonic bath. The bar graph readout is displayed at the bottom of the bar numerically, to make it easier to read the remaining level accurately.

**Manual:**

These buttons are used to manually add chemical to this ultrasonic bath. These buttons are momentary style, and will continue to dispense as long as they remain depressed. The amount of chemical dispensed will be tallied on the Bath Level display to the left.

**Auto:**

These buttons are used to add chemical to this ultrasonic bath in an automatic fashion. Once depressed, one of these buttons will activate the chemical dispense pump of the selected chemical, and continue filling until the Set Point on the Bath Level display is reached. A second press of this button will discontinue the automatic fill before it is completed. The amount of chemical dispensed will be tallied on the Bath Level display to the left.

**Back:**

This button returns the user to the Ultrasonic Bath Main Operation screen.

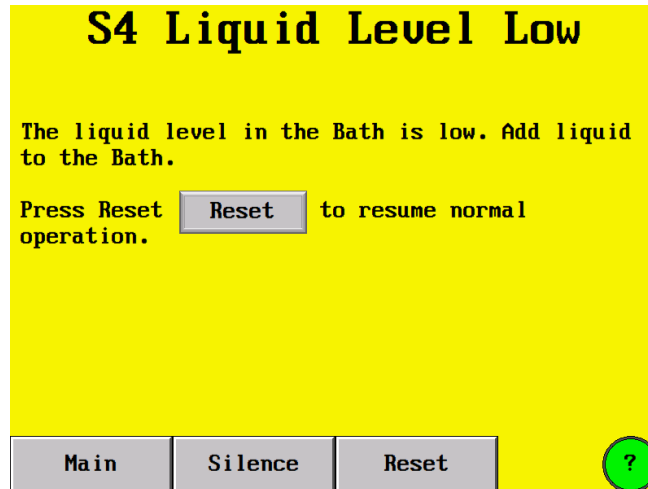
**Controls:**

This button takes the user back to the Main Controls screen.

### 26.3 Ultrasonic Bath Low Level Alarm

The ultrasonic bath also has a low level sensor. If the fluid level in the baths falls below the safe operating level as determined by the manufacturer, then the unit will alarm. A low level condition is signaled by an alarm and a message on the Touch Screen, as shown below.

**Note: The Reset Button must be pressed to clear the alarm. This button is on the low Level alarm screen.**



**Main:**

This button takes the user back to the Main screen after the Low Level alarm has been Silenced or Reset

**Silence:**

This button Silences the Low Level alarm.

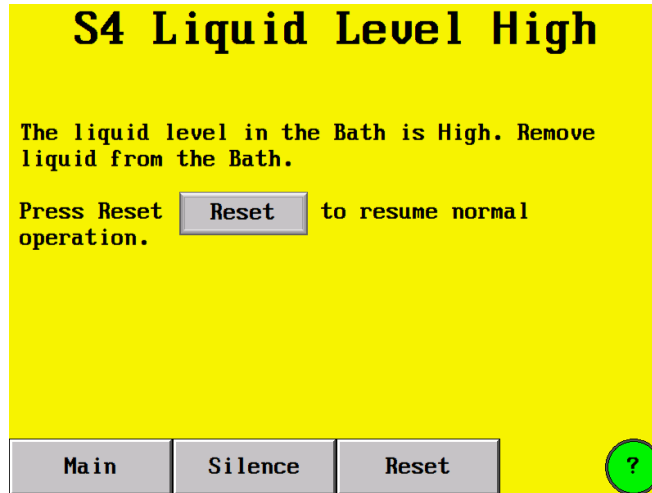
**Reset:**

This button Resets the Low Level alarm.

#### 26.4 Ultrasonic Bath Overfill Alarm

The level sensor in the ultrasonic bath also has an overfilled condition alarm. The overfilled level is factory set to the maximum allowable bath level. An overfilled condition is signaled by an alarm and a message on the Touch Screen, as shown below.

**The Reset Button must be pressed to clear the alarm. This button is on the High Level alarm screen.**



**Main:**

This button takes the user back to the Main screen after the High Level alarm has been Silenced or Reset

**Silence:**

This button Silences the High Level alarm.

**Reset:**

This button Resets the High Level alarm.

## 27.0 NITROGEN BLOW OFF GUNS

This hood is equipped with two (2) nitrogen blow-off guns. These guns on either side of the work deck are mounted on coiled hoses, which extend to allow access to the entire work surface. Each gun has a PTFE membrane filter in its screw off tip. This filter should be changed on a preventative maintenance schedule.

## 28.0 DI SPRAY GUNS

This hood is equipped with two (2) DI spray guns. These guns on either side of the work deck are mounted on coiled hoses, which extend to allow access to the entire work surface. The guns are plumbed to the DI loop system to maintain DI water quality.

## 29.0 WAFER HANDLING VACUUM WAND

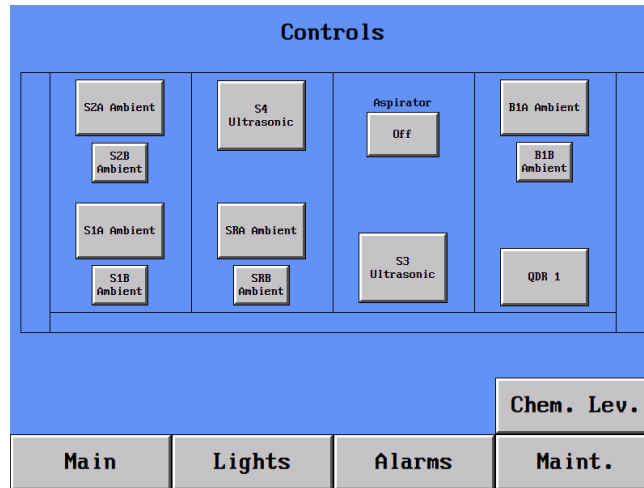
This hood is equipped with two (2) wafer handling wands. These wands on either side of the work deck are mounted on coiled hoses, which extend to allow access to the entire work surface.

These vacuum wands are operated by a button on the handle of the wand. Pressing this button down will activate the vacuum, and allow the wand to pick up silicon wafers safely. Releasing this button will stop the vacuum, allowing the placement of the silicon wafer where desired.

These wands are plumbed to the facility vacuum feed through a connection in the bottom of the hood.

### 30.0 LIQUID ASPIRATOR

This hood is equipped with one (1) liquid aspirator wand, mounted on the left side of the deck. This aspirator is turned on and off by a button on the Main Controls Screen, as shown below:



The aspirator setup screen is discussed in the Main Controls Screen section of the manual.

### 31.0 RECIRCULATING DI LOOP SYSTEM

This hood is equipped with a continuous flow DI Loop System. This system circulates DI water from a facility-supplied source to a restricted or low pressure DI return line.

Each component in the hood requiring DI water is connected to the DI supply manifold and to the DI return manifold. When components are in use DI return flow is minimal. When components are idle, DI return flow is continuous thus preventing stagnation and bacteria growth.

The DI plumbing consist of Teflon PFA tubing (.062 wall) connected to "flare" style fittings. This is an excellent combination for leak resistance and high purity.

## 32.0 CIRCUIT BREAKERS

The unit is equipped with five (5) circuit breakers which are located inside the rear electrical cabinet of the bench. These breakers protect the wiring in the fume hood from overcurrent situations. In the event of a tripped circuit breaker, please contact your facilities manager to determine the cause. Merely resetting the circuit breaker without determining the root cause may just cause the breaker to trip again once the tripping activity is repeated.

**Note: Feel free to contact Air Control for assistance in troubleshooting circuit breaker events.**

## 33.0 CONTROL INTERFACE CONNECTOR

The hood is equipped with a control interface connector, located in the center of the hood control panels. This connector is sealed within a fume-tight cover and contains the Ethernet connector to connect a laptop to the fume hood controls. This connection is for programming and testing of the bench electronic controls by qualified personnel.

There is a second control interface connector, located on the back of the hood. This connector is also sealed within a fume-tight cover and contains the Ethernet connector to connect the hood to the internet. This connector is only for interfacing with the Air Control factory in North Carolina, U.S.A. Using this connector, connected to the internet, Air Control personnel can provide remote troubleshooting assistance.

## 34.0 CARBON DIOXIDE FIRE SUPPRESSION SYSTEM

This hood is equipped with a fire detection and suppression system. This system is designed to detect, contain and extinguish fire within the fume hood.

The carbon dioxide system is designed to discharge with the fume hoods exhaust system in operation. The volume of carbon dioxide supplied is sufficient to overcome the exhaust flow. Maintaining exhaust flow is critical to prevent smoke damage to surrounding equipment.

The fire system discharges automatically upon fire detection by dual IR sensors. These sensors are installed in acid resistant waterproof housings to ensure safe and effective operation. Sensors installed above the work area and in the tub provide constant monitoring. The base cabinet storage area is not monitored.

In addition to automatic fire detection, this system allows for manual discharge via a

front panel mounted manual pull station.

The system uses a maintenance switch box to allow work to be performed on the system safely and without accidental discharge.

**Note: The manual pull station sounds the fire alarm but also signals for the delayed release of carbon dioxide (20 second delay)**

The fire system control panel is the Kidde Aegis (See Additional Kidde Aegis Panel Info.) This panel is installed in the rear electrical enclosure of the hood. The Aegis is the controller of the bench fire suppression system. LEDs on the front of the control panel signal the current status of the system. Alarm and system reset switches are also located on the front of the control panel.

The carbon dioxide supply for the system is contained in a remotely located cylinder. The cylinder is plumbed and wired directly into the fume hood. It should be noted that until a discharge condition occurs carbon dioxide would not be present in the plumbing lines. Upon discharge the valve on the carbon dioxide cylinder opens allowing carbon dioxide to flow through the normally open nozzles in the fume hood.

**Notes:**

**1) Carbon dioxide cylinders should be checked periodically and refilled after each discharge.**

**2) The discharge of carbon dioxide is controlled by an automatic valve, additional manual or automatic valves are not permitted in the system.**

(Please consult the manufacturers manual for further information about this system.)

### 35.0 SERVICE CONNECTIONS

NITROGEN:	1/2" FNPT, SS (70 PSI)
CDA:	1/2" FNPT, SS (80 PSI)
DI SUPPLY:	1/2" TEFLON FLARE (65 PSI MAX)
DI RETURN:	1/4" TEFLON FLARE
POTABLE WATER:	1/2" FNPT, SS (70 PSI)
VACUUM:	1/2" FNPT, SS (24 IN. HG.)
TRADE WASTE/TUB DRAIN:	1 1/2" NPT, SS
EXHAUST:	12" SS FLANGED COLLAR (950 CFM AT .5 S.P. 100 LFM FACE VELOCITY, 18" OPENING)
ELECTRICAL:	PDB-1: 230 VAC, 1 Phase, 50 Hz, 25 FLA



## 36.0 ELECTRICAL REQUIRMENTS

Rated environmental conditions:

- Indoor use only.
- Use in altitudes up to 2,000 m
- Use environmental temperatures from 5°C to 40°C
- Use relative humidity from 80%RH @ 31°C; 50%RH @ 40°C
- Use Overvoltage Category II
- Pollution Degree 2

Protective Earthing:

Protective Earth Grounding (PE) is provided to the equipment by bonding a PE ground to the Grounding Terminal within the Main junction box located on the top of



the equipment. It is marked with the Ground Terminal Symbol.

**Note: Protection provided by the equipment may be impaired if used in a manner not specified in the instructions**

The electrical installer shall provide a disconnect switch(s) that meet IEC 60947-1 and IEC 60947-3, and does not interrupt the PROTECTIVE EARTH CONDUCTOR, or the electrical installer shall provide circuit breaker(s) used as a disconnect device(s) as required by local electrical regulation. This device shall be located where easily located and shall be marked as the disconnect device for the circuit(s) for the equipment.

### 37.0 PARTS LIST

Item	Qty	Part Number	Description	Manufacturer
1	1		1 1/2" npt 316 ss tee	
2	1		1 1/2" npt 316 ss half coupling	
3	1		1 1/2" x 1/2" npt 316 ss bushing	
4	3		1 1/2" x close 316 ss nipple	
5	8		1/2" npt 316 ss coupling	
6	3		1/2" socket 316 ss coupling	
7	2		1/2" x close 316 ss nipple	
8	2		1 1/2" npt 316 ss 45 deg ell	
9	6	C60-NI-BR-420	Intrinsically Safe Platform Scales	
10	8	R55M-2GP	0-100 PSI REGULATOR W/ GAUGE & MOUNTING NUT	MASTER PNEUMATICS
11	2	R55M-2L30GP	0-30 PSI REGULATOR W/ GAUGE & MOUNTING NUT	MASTER PNEUMATICS
12	1	R55M-L15GP	0-15 PSI REGULATOR W/ GAUGE & MOUNTING NUT	MASTER PNEUMATICS
13	8	1/8F6502	NATURAL POLYPRO FLAT SPRAY NOZZLE	BEX
14	2		7" x 7" x 10" dp unheated, 40-72-104 Multisonic generator, 230 vac 50 hz Australian Plug	Blackstone/Ney
15	3	EX500-AP050-S	Straight M12, 5M power cable	SMC
16	3	EX9-AC020EN-PSRJ	RJ45 Ethernet/IP cable for valve manifold	SMC
17	2	LLC3A-02-S0011	2 Position PFA valve manifold	SMC
18	2	LLC3A-03-S1100	3 Position PFA valve manifold	SMC
19	2	LLC3A-04-S0011	4 position PFA valve manifold	SMC
20	2	LLC3A-04-S1100	4 position PFA valve manifold	SMC
21	26	LVC30A-S07-4	PFA pneumatic valve w/ integral fitting	SMC
22	1		SY3000 Manifold/Valve assy. Refer to SMC worksheet 2a	SMC
23	1		SY3000 Manifold/Valve assy. Refer to SMC worksheet 2b	SMC
24	1		SY3000 Manifold/Valve assy. Refer to SMC worksheet 2c	SMC
25	5	57WSAN	10L PE tighthead plastic container	N/A
26	5	57WCAR	70mm PE cap	Reike
27	8	96-10-500-50	Black powder coated lift off hinge	Southco
28	8	96-10-570	ADJ. LIFT OFF HINGE	SOUTHCO
29	4	C6-26	110 DEG DETENT PLASTIC HINGE	SOUTHCO
30	14	E3-56-75	TOOL OPERATED PANEL LATCH	SOUTHCO
31	2	L-270	270MM SS LID STAY	SUGATSUNE
32	4	MC-JM49	Magnetic door catch counterplate	SUGATSUNE

33	4	MC-JM50BL	Magnetic door catch	SUGATSUNE
34	1	RMA8-SSV	10-100 SCFH FLOW METER	DWYER
35	6	450T-0820Z-17N-17PC	1/2"-13 LEVELING FEET W/ NYLON PAD	GABRIEL GLIDES
36	3	2ZY76	Polypropylene/SS low level float switch	Madison
37	1	252905	1/2" npt polypro 3 wall ball valve	Asahi
38	1	NSHD10008	Polypropylene quick connect body w/ epdm "o" rings	Colder Products
39	1	NSHD240008	polypropylene quick connect stem w/ epdm "o" rings	Colder Products
40	1	M3326-NPT-NO	Polypropylene submini vertical float sw. NO	Madison
41	5	M8000	Polypropylene mini vertical float switch	Madison
42	5	FC8-8N-1	1/2" pfa flare female connector	Fit Line
43	2	FE8-8N-1	1/2" pfa flare female ell	Fit Line
44	4	MBT88-4N-1	1/2" x 1/4" pfa flare branch tee	Fit Line
45	3	MBT88-8N-1	1/2" pfa flare branch tee	Fit Line
46	4	MC4-4N-1	1/2" pfa flare male connector	Fit Line
47	12	MC6-4N-1	3/8" x 1/4" pfa flare male connector	Fit Line
48	12	MC8-8N-1	1/2" pfa flare male connector	Fit Line
49	1	MCPM4-4N-1	1/4" pfa flare panel mount male connector	Fit Line
50	1	MCPM8-8N-1	1/2" FLARE PFA panel mount male connector	Fit Line
51	2	ME8-8N-1	1/2" pfa flare male elbow	Fit Line
52	1	SU84N-1	1/2" X 1/4" PFA FLARE UNION	Fit Line
53	2	UT4N-1	1/4" pfa flare union tee	Fit Line
54	6	UT8N-1	1/2" pfa flare union tee	Fit Line
55	2	MCVM-F44	1/4" pfa flare check valve	Furon
56	6	MCVM-F66-3	Check Valve 3/8" Flare Ports, 3/8" Orifice, PFA Nuts	Furon
57	4	QV2-144-NC	1/4" npt pfa pneumatic valve	Furon
58	4	QV2-188-NC	1/2" npt pfa pneumatic valve	Furon
59	2	VWSET-E	vacuum wand set	H-Square
60	1	AC-POL-01EPEPD	1" stroke, polypro pneumatic cylinder	IPS
61	1	DDV-02-08-K-T	2:1 Teflon dilution drain valve	IPS
62	2	DI-POL88P-C	1/2" polypro pneumatic valve	IPS
63	1	KL-A-1866-02	Teflon aspirator kit	IPS
64	10	TP-2W8P-C	1/2" ptfе pneumatic drain valve	IPS
65	9	WV-POL- 44P-NC-EP	1/4" polypro pneumatic valve	IPS
66	1	WHRV2223212	1/2 hp recirculator (24vdc control relay) w/ 230 vac 50 htz Australian electricals	Kinetics
67	1		Co2 fire system	Mark Systems
68	9	NG-250-PPR	1/4" pp needle valve	Marquest Scientific
69	5	NG-250-PVD	1/4" pvdf needle valve	Marquest Scientific
70	3	NG-500-PVD	1/2" pvdf needle valve	Marquest Scientific
71	2	13875A12	11 3/4" stainless steel full extension slide	Accuride
72	4	1071A51	SS lift off bullet hinges	Guden

73	10	3006T51	S.S. CONDUIT CLAMP	N/A
74	8	78155T61	2" swivel caster	N/A
75	2	62005K313	1/4" inline metering valve	SMC
76	3	KT-LED18.5T8-48GC-840-D	4' T8 LED tube 4000K color	Keystone
77	5	SS-QC8-B-8PMKZ	1/2" MALE SS QUICK CONNECT BODY W/ KALREZ O-RINGS	SWAGELOK
78	5	SS-QC8-D-8PMKR	1/2" MALE SS QUICK CONNECT STEM W/ KALREZ O-RINGS	SWAGELOK
79	2	421-42-11	PFA N2 GUN	Entegris
80	6	PL10KFZZB2A-xx-xx-xx	Dispense Head for (6 keyed different chemicals)	Entegris
81	2	SS-1210-1-12	3/4" ss male connector	Swagelok
82	2	SS-1210-3	3/4" ss union tee	Swagelok
83	2	SS-1210-6-8	3/4" x 1/2" ss reducing union	Swagelok
84	2	SS-1210-7-12	3/4" FEMALE CONNECTOR	Swagelok
85	1	SS-1210-9	3/4" ss union ell	Swagelok
86	2	SS-1210-9-3-12-8	3/4" x 1/2" ss reducing union tee	Swagelok
87	3	SS-1210-9-3-12-8	3/4" x 1/2" ss reducing union tee	Swagelok
88	2	SS-12-CP	3/4" ss pipe cap	Swagelok
89	9	SS-810-1-8	1/2" MALE CONNECTOR	Swagelok
90	1	SS-810-2-8	1/2" ss male ell	Swagelok
91	2	SS-810-3	1/2" UNION TEE	Swagelok
92	5	SS-810-3-8TTM	1/2" BRANCH TEE	Swagelok
93	1	SS-810-61	1/2" BULKHEAD UNION	Swagelok
94	2	SS-810-9	1/2" SS UNION ELL	Swagelok
95	3	SS-8-CP	1/2" PIPE CAP	Swagelok
96	30	SS-T8-S-065-20	1/2" x .049 or .065 316 ss tubing/ straight stick	Swagelok
97	1		1/2" X20' PTFE convoluted tubing	TEF-CAP
98	6	3/8" Coils	3/8" coiled FEP tubing	
99	1	PD01P-HPS-KTT-A	1/4" Teflon fitted polypropylene clamped AODD pump	ARO
100	5	P.025/SSPPP/TNL/TF/STF	1/4" 316 ss double diaphragm pump (Teflon fitted)	Wilden
101	6	134.81.617	1" ss pull knob	Hafele
102	3		4' T8 Resistguard UV sleeves	White Knight
103	1	RMA6-SSV	0-50 scfh flow meter	DWYER
104	2	1/4" coils	1/4" coiled FEP tubing	
105	6		MKE-5 scale indicator, 4-20 mA output w/ 20ft cable	Arlyn Scales
106	2	SU201M-K10	10 AMP, 1 POLE, K CURVE, SU200 M, UL489, MINIATURE CIRCUIT BREAKER, PRO M COMPACT	ABB

107	2	SU201M-K2	2 AMP, 1 POLE, K CURVE, SU200 M, UL489, MINIATURE CIRCUIT BREAKER, PRO M COMPACT	ABB
108	1	SU201M-K5	5 AMP, 1 POLE, K CURVE, SU200 M, UL489, MINIATURE CIRCUIT BREAKER, PRO M COMPACT	ABB
109	13	1SVR405601R1000	24 VDC, PLUGGABLE PCB RELAY CR-P, 250V, 8A, w/DIODE AND LED - GREEN	ABB
110	13	1SVR405650R1000	STANDARD SOCKET CR-P	ABB
111	13	1SVR405654R1000	DIODE AND LED	ABB
112	1	RTE-P1AF20	Timer, 10 A, 100 to 240 VAC, 0.1 Sec. to 600 hr, 10, Pin, 2 Form C, DPDT	IDEC CORPORATION
113	1	SR2P-05	Relay Socket 2 Pole DIN rail mount for RR2P relays dual tier	IDEC CORPORATION
114	1	1SFA611102R1102	MP3-11G, MOMENTARY, GREEN, ILLUMINATED EXTENDED PUSH BUTTON, BLACK PLASTIC BEZEL	ABB
115	1	1SFA611605R1100	MCBH-00, 3-POSITION HOLDER	ABB
116	1	1SFA611610R1001	MCB-10, SINGLE CONTACT BLOCK, NO	ABB
117	1	1SFA611621R1012	MLBL-01G, GREEN LED, 24 VAC/DC	ABB
118	2	HW9Z-KG3	Shroud, For 22mm E-Stop; 40mm button max	IDEC
119	8	C01620D00311012	Circular DIN Connectors 3+PE FEM STRT BLK SCW SILV INT ST RELF	Amphenol Industrial
120	8	C01620H00311012	Circular DIN Connectors 3+PE MALE STRT BLK SCW SILV INT ST RELF	Amphenol Industrial
121	1	SE-SL3001	Basic industrial VPN router, wired Internet connectivity, (5) Ethernet Gigabit (RJ45) port(s), iOS/Android with mobile VPN, 12-24 VDC required.	STRIDE
122	1	SE2-SW8U	industrial unmanaged Ethernet switch, 8 ports, (8) Ethernet 10/100Base-T (RJ45) port(s), -10 to +60 deg C, metal housing, IP30, 35mm DIN rail mount.	STRIDE
123	1	SC-E1-220VAC	IEC contactor, 32A, (3) N.O. power contact(s), 240 VAC (60Hz)/220 VAC (50Hz) coil voltage	FUJI
124	2	E22LLB2B	22 mm, twist-to-release, emergency stop, 1 N.C. contact(s), plastic base, plastic bezel, Operator: red, mushroom, 40 mm, round, plastic	EATON
125	2	E22B2	Cutler-Hammer contact block, replacement, (1) N.O. contact(s). For use with 22mm devices.	EATON

126	1	EA9-T8CL	EA9 series touch screen HMI, 8in color TFT LCD, 800 x 600 pixel, SVGA, LED backlight, supports (3) serial, (1) Ethernet and (2) USB ports,	AUTOMATION DIRECT
127	1	P2-01DCAC	AC/DC base power supply, 12-24 VDC/24 VAC nominal input.	AUTOMATION DIRECT
128	1	P2-8AD4DA-2	Input: 8-channel, voltage, 0-5 VDC and 0-10 VDC, Output: 4-channel, voltage, 0-5 VDC and 0-10 VDC.	AUTOMATION DIRECT
129	3	P2-08AD-1	Analog input module, 8-channel, current, 16-bit, input current signal range(s) of 0-20 mA, external 24 VDC required.	AUTOMATION DIRECT
130	1	P2-08THM	temperature input module, thermocouple, 8-channel, 16-bit resolution, input thermocouple type(s): J, E, K, R, S, T, B, N, C.	AUTOMATION DIRECT
131	1	P2-11B	I/O base, 11-slot, DIN rail or flush mount. Requires P2-01AC or P2-01DCAC power supply. Holds power supply, CPU and (11) I/O modules.	AUTOMATION DIRECT
132	2	P2-16NE3	Discrete input module, 16-point, 24 VAC/VDC, sinking/sourcing, 2 isolated common(s), 8 point(s) per common	AUTOMATION DIRECT
133	2	P2-16TR	Relay output module, 16-point, 6-24 VDC/6-240 VAC, (16) Form A, 2 isolated common(s), 8 point(s) per common, 1A/point, 8A/common.	AUTOMATION DIRECT
134	8	ZL-P2-CBL18-1P	PLC I/O cable, 18-position terminal block to pigtail, 3.2ft/1m cable length.	AUTOMATION DIRECT
135	1	P2-550	CPU, up to 50 MB ladder memory, microSD card slot, (2) Ethernet (RJ45), (1) RS-232 (RJ12), (1) RS-485 and (1) microB-USB port	AUTOMATION DIRECT
136	2	P2-FILL	Productivity2000 filler module.	AUTOMATION DIRECT
137	1	PSL-24-060	Switching power supply, 24 VDC (adjustable) output, 2.5A, 60W, 120/240 VAC or 125-375 VDC nominal input,, DIN rail, NEC Class 2.	RHINO
138	1	PB1043	Edison distribution block, UL Recognized, 3 pole, openings: 1 line side / 4 load side, 200kA SCCR	EDISON
139	10	DCTG0001BPT011	MODEL DCT DIGITALLY COMPENSATED PRESSURE TRANSDUCER, 4-20mA	AMETEK
140	1	3001MR	0-1" w.c Series 3000MR/3000MRS Photohelic Switch/Gage	DWYER
141	1	1910-00	Compact Low Differential Pressure Switch	DWYER

142	1	CH-V09-525-Q	Medium Loud Chime Tone; Single Shot Rate; Panel Mount with Volume Control Case and Quick Connect Blades Termination	FLOYD BELL
143	1	74110	AUSTRALIA / NEW ZEALAND 10 AMPERE-250 VOLTS OUTLET (AS/NZS 3112) TYPE I (AU1-10R), SINGLE	INTERNATIONAL CONFIG
144	1	74210	AUSTRALIA / NEW ZEALAND 10 AMPERE-250 VOLTS OUTLET (AS/NZS 3112) TYPE I (AU1-10R), DUPLEX	INTERNATIONAL CONFIG
145	2	CSMN15MF-15	Deluxe Molded D-Sub Cable, DB15 Male / Female, 15.0 ft	L-COM
146	8	TRD695ABLK-10	Premium Cat6a Cable, RJ45 / RJ45, Black 10.0 ft	L-COM
147	2	WPBHC6110	Cat 6 IP67 RJ45 to 110 Bulkhead Panel Mount Coupler, Shielded, Feed-Thru, PoE+ with Dust Cap	L-COM
148	1	30280774	THORNTON RESISTIVITY MONITOR, 2 CHANNEL	METTLER-TOLEDO
149	1	58031217	THORNTON RESISTIVITY PROBE, 20 FT LEADS, TINNED WIRE	METTLER-TOLEDO
150	1	206060-1	Standard Circular Connector PLUG 4 POSITION shell size 11	TE Connectivity
151	2	1-206062-6	Standard Circular Connector STD CABLE CLAMP 11	TE Connectivity
152	1	206429-1	Standard Circular Connector PLUG 4 POSITION shell size 11	TE Connectivity
153	1	206430-1	Standard Circular Connector RECEPTACLE 4 PIN shell size 11	TE Connectivity
154	1	211766-1	Standard Circular Connector Socket (Female) PLUG 9 POSITION shell size 17	TE Connectivity
155	1	206070-8	Standard Circular Connector STD CABLE CLAMP 17	TE Connectivity
156	1	211768-1	Standard Circular Connector Pin (Male) PLUG 9 POSITION shell size 17	TE Connectivity
157	2	206070-8	Standard Circular Connector STD CABLE CLAMP 17	TE Connectivity
158	1	211769-1	Standard Circular Connector RECEPTACLE 9 PIN shell size 17	TE Connectivity
159	5	KFD2-SR2-EX2.W	Isolator, Barrier, NAMUR, 24VDC, DIN Rail, 20-30VDC, Relay Output	PEPPERL + FUCHS
160	1	TC-15	THERMOCOUPLE, J TYPE, 15 FT LEADS	PROCESS TECHNOLOGY
161	2	3113-4-00-57610	RED, LED, Pilot Light, 28 VDC, 3W	SOLICO
162	1	3116-4-00-57610	RED, LED, Pilot Light, 250 VAC, 3W	Wamco

### 38.0 UNIT PRINTS

(Separate Documents)

### 39.0 QUALITY CONTROL

(Separate Documents)

### 40.0 COMPONENT MANUALS

(Separate Documents)