	STANDARD OPERATING PROCEDURE
BOISE STATE UNIVERSITY ENVIRONMENTAL HEALTH, SAFETY AND SUSTAINABILITY	**JST Acid Bench Operation**

College/Dept: College of Engineering	Building/Room: RUCH 107
Laboratory Name: Idaho Microfabrication Laboratory	Revision: A
Principal Investigator: Pete Miranda	Author: Terek Zimmerman

Before the worked detailed in this procedure may begin, the intended user must read and understand this document.

This document must be approved by the PI, the college's safety liaison, and EHSS.

Any changes to this document, however minor, must be submitted for approval by the PI, the college's safety liaison, and EHSS.

The "buddy system" will be in place whenever any work is conducted.

Intended User:	Name, Title	Signature	Date
	Name, Title	Signature	Date
Reviewed and Approved by:	Pete Miranda, Director - IML	*Pete Miranda*	5-12-20
	Name, Title	Signature	Date
	Name, Title	Signature	Date
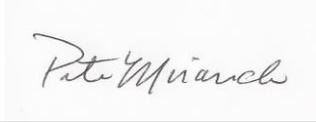
Overview

The JST Acid bench is equipped to perform a variety of cleanroom functions. The system has (2) heated quartz tanks, (1) Quick-Dump-Rinse tank, (1) ambient bath tank and a utility sink to perform a variety of operations ranging from RCA wafer cleans to wet etch processing.

Scope

This SOP reviews how to safely use the acid wet bench.

Potential Hazards

■ Chemical ☐ Thermal ☐ Hydraulic ☐ Electrical ■ Slip/Trip ☐ Biological

☐ Mechanical	☐ Radiation	☐ Pneumatic	☐ Fire	☐ Fall	■ Other

Hazard Specifics: Chemical mixtures may out-gas and should be mixed under the fume hood of the bench.

Engineering Controls (EC)

■ Fume hood	☐ Biosafety Cabinet	☐ Other Local Exhaust	■ Shielding	☐ Other

EC Specifics:

Training Requirements – except for classroom lab safety, must be completed prior to performing the procedure

■	Classroom Laboratory Safety Awareness	☐ Radiation Worker

■ Online Safety Topics (specify): Acid bench and cleanroom safety

■ Lab/Work Group Specific Training (specify): Acid bench and cleanroom safety

■ Other (specify): ASPP Training

Personal Protective Equipment (PPE)

■ Safety glasses	☐ Safety goggles	■ Face shield & safety glasses	
☐ Lab coat	■ Apron	■ Tyvek suit	☐ Tyvek sleeves
■ Gloves	■ Leg coverings	☐ Hard hat	☐ Hearing protection
☐ Respirator	■ Shoes	☐ Fall protection	■ Other

PPE Description:
- Close toed shoes and pants required at all times
- Regular cleanroom safety equipment required
- Chemical apron, Chemical Gloves and a face shield are required when handling acids.
- BUDDY RULE!!!

Equipment, Materials, Supplies, & Facility Requirements

JST Acid Bench, Glassware, Chemicals, Sample handling device

Handling, Work Area & Storage Requirements

- Handle acids with extreme care, you and your buddy's well-being is at stake.
- All waste is contained and labelled properly. Bench is wiped down with DI water after use.

Emergency Response Equipment & Supplies

■ Eyewash	☐ Fire extinguisher	■ First aid kit	■ Calcium gluconate gel (HF use)
■ Safety shower	☐ Fire blanket	■ Spill kit	☐ Emergency gas shutoffs
☐ Drench hose	☐ Other:		

Description: Emergency response equipment and supplies specific to this bench.

Decontamination & Waste Disposal

Be sure to neutralize acids after use and properly fill out a waste tag when storing hazardous waste of any kind.

Spill Response

- Follow the ASPP training protocols.
- If chemical is spilled on the floor, go to the spill kit near the furnace and contain it with the long absorbent cylinders and place the green chemical absorbent mats on the spill. Then notify lab staff.
- If spilled on a user, their buddy should rush them to the safety shower and soak them for 15 minutes. In the meantime, the buddy should call an ambulance and notify them of the location of the accident. This is posted on interior doors of the cleanroom.
- For minor spills on the acid bench, make sure to be wearing correct PPE and wipe the spill up with wipes and dispose of them in the acid waste container. Then wipe the area once again with multiple wipes saturated with DI water.

Additional Safety Information

Waste neutralization training

References

1. Acid Bench Turn On	Acid Gear PPE is required	

- To set up the acid bench, first check that the DI water is on. Walk to the side of the bench and look behind. There will be a clear water tube about 1 inch in diameter leading into the back of the bench. There is an orange valve on that line that turns water on or off to the bench. Make sure that the valve is aimed parallel to the flow of water. If it is perpendicular, turn it to parallel to turn it on.
- If the hot plate will be needed for a specific process, there is a red gas tube located on top of the bench. This line has a black valve, make sure to turn it so that it is pointing parallel to the direction of the tube. This valve should be closed after every usage, so ensure that it is turned on when needed.
- Turn on the bench using the on/off button.   Turn on the station lighting.

- If DI water is to be used for a process, make sure to run the water for at least 1 minute to clear out any water that has stagnated in the line. This will ensure that only pure DI water is used for processing.

2. Safety During Processing		

- When processing a sample, it is very important to start out with a completely dry bench. This will help identify any spills.
- If the user notices any droplets on the face of the bench, treat them with caution. All liquids on the bench should be treated as if they are extremely acidic liquids, even if the user knows that it is water.
- A buddy should be present if processing with acids, this is for both the acid and base bench, because if there is an accident, a buddy may be required to lead the user to the emergency shower/eyewash station and to call an ambulance.

3. Utility Sink Control		

- To operate the sink on the left side of the bench, the user should first ensure water is turned on, instructions on how to do this can be found in the bench turn on section of this SOP.
- To start the flow of DI water, there is a foot pedal located on the ground that the user can press to use the faucet.
- To control the rate of flow of the faucet, there is a knob on the side of the faucet that will increase or decrease the rate of flow. This knob should not be opened so much that the water splashes up onto the bench.
- To open the drain, there are on/off buttons on the control panel of the bench up above the shielding that are labelled 'Gooseneck Drain' this will open and close the drain as needed.

- Prior to processing, it is important to run the DI water for at least 1 minute to eliminate any stagnated water from the faucet as it will no longer be pure DI water.

4. Basic Operation of the Aspirator		

The Acid Bench aspirator uses a venturi style of flow controller to produce a vacuum for chemical extraction out of a beaker, tank or other holding/storage device. The aspirator transfers chemicals to the waste treatment system to be treated prior to release to the city sewer system. Only approved chemical waste can be aspirated so be sure you have consulted with IML staff prior to using the aspirator.

As a user of the bench you should know if your chemicals can be aspirated. If you don't contact an IML staff member and they'll let you know. Aspirator dilutes chemical waste with 10:1 DI water.

5. Basic Operation of the Hot Plate	Be Aware of Hot Surface and Sample Items	

- When using the hot plate, it is important to use glass beakers only.
- If planning to use a stirrer, insert it into the container prior to use if possible, if the chemical is already in the beaker, slowly lower part of the stirrer into the chemical while wearing chemical gear and once it is partially in, drop it. This will prevent splashing.
- Place the beaker onto the hot plate and place the tube and rod arm into the chemical. It should start a periodic bubbling if Nitrogen is on. This is how it identifies that there is liquid in the container and will allow the process to begin.
- The set rotational rate is displayed under the picture of a hot plate where it says 'SET', and the set temperature is in the center of the screen, where it says 'TEMP SET'. If these need to be changed, contact IML staff to change them, or for staff to provide a supervisor password for users to be able to change settings. To tell if the control is in operator or supervisor mode, look at the JST logo in the top left part of the screen and it will say what mode it is in right under the logo.
- Further instructions on how to interface with the MAIN CONTROL screen are shown below in the screen capture.
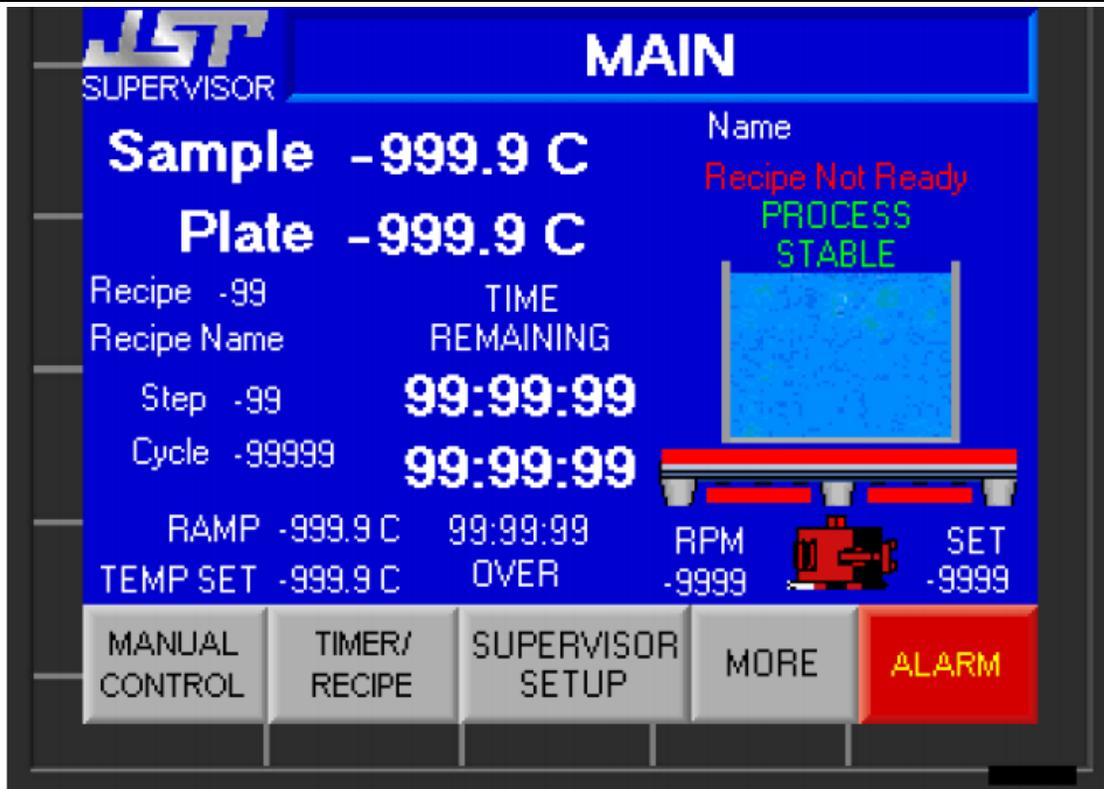
Main Screen
Security - Operator

The main screen gives an overview of the sample and/or hot plate displaying Temperatures, Liquid Level of sample, Recipe status, and Time remaining. It also gives a graphical representation of what is happening in the system. The Red line Above the hot plate is an indicator that the plate is hot (Over 45C) and can cause burns.
Sample/Plate Temp - Displays the current temperature of the sample and plate to .1 degrees Celsius .
Liquid Level - Displays if the sample liquid level is full or not full.
Time Remaining - When the timer or recipe is running it will display how much time is remaining.
Over Time - When the timer or recipe has finished running, the over timer will count up to show how much time has passed before being acknowledged.
Process Ready - Indicates when the process is ready according to the manual temperature setpoints and sample liquid level when not running a recipe.
Ramp - Displays when running in Ramp mode what the current systems moving setpoint is. This value will approach the user set setpoint at a rate relative to the Ramp rate specified.
Temp Set - Displays the manual mode temperature setpoint or the recipes current temperature setpoint.
Recipe - Displays what recipe is currently loaded up.
Step - Displays the current step of the recipe when a recipe is running.
Cycle - Displays the current cycle of the recipe when the recipe is running in cycle mode.
RPM - Displays the Stirrer motors RPM.
Hot Plate Calibrating - Indicates when the Controller is running the hot plate calibration routine.

Manual Control - Takes the user to the Manual Control screen.
Timer/Recipe / Supervisor Setup - Takes the user the corresponding screen.
More - Toggles Pushbuttons and to Login and Logoff Pushbuttons.
Login - Enables a keypad entry to enter the supervisor password.
Logout - Pushbutton to set the user to operator.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

- To turn the stirrer or heater on, select the corresponding box on the left side of the screen and the box should turn green. To monitor RPM, look at the bottom left 'RPM' label of the hot plate diagram. The temperature of the sample and the temperature of the hot plate will be listed in large white lettering on the top left part of the screen.

Five functions keys on the faceplate are provided for: Heater On/Off, Recipe Start, Recipe Reset, Stirrer On/Off and Alarm Acknowledge.

- When the Heater on/off is pressed the Heater will turn on and drive the plate/sample temperature towards the set point. When the Heater On/off is pressed a second time the Heater will turn off.
- When the Recipe Start button is pressed the recipe will start. This will turn control of the heater and the stirrer over to the recipe parameters. The Stirrer and heater will run according to the parameters set in the Recipe.
- When Recipe Reset button is pressed it will Pause the bath recipe. The recipe can be restarted by pressing the Start button. To reset the recipe, press the Stop/Reset button once more.
- When the Stirrer button is pressed Stirrer will turn on and drive toward the RPM Set point. When the stirrer button is pressed again the stirrer will turn off.
- When the Alarm Acknowledge/Go to Alarm Screen button is pressed the audio alarm is silenced and the page displayed will be the alarm screen.

A maximum amount of time can be set for the heater to be on. This can be set so that the hot plate is not inadvertently left on overnight. Current setting is 4 hours, if you need to heat something longer than 4 hours please let an IML staff member now and this setting can be changed or turned off.

A maximum temperature delta can be specified between the plate and the sample temperature. This can be set so that the user does not inadvertently set up a process that causes damage to equipment from too high of a temperature gradient.

The controller can be setup for 20 different recipes each with 20 steps in each recipe. The recipe parameters are: Heating Mode, Temp Set point, Ramp On/Off, Ramp Rate, Stirring RPM, Timer, Cycle mode, and number of cycles.

The recipe modes are: Sample/Plate, Cycle Off/On/Continuous, Ramp Off/On

- Sample mode will apply temperature set points and the ramp to the sample probe. Plate mode will apply the temperature set points and the ramp to the probe inside the plate.
- Cycle Mode will allow the recipe to be repeated. When in mode "On" the recipe will be repeated the number of times specified in Recipe parameters. When in Continuous mode the recipe will be continued indefinitely and in order to stop the recipe will need to be aborted.
- Ramp Mode will allow for controlling the rate the temperature is increased or decreased as it approaches the set point. When "On" the controller will set a floating set point that will be updated every minute that will move towards the temperature set point defined by the user at a rate specified.

Manual settings can be set for Temperature settings, Ramp mode and rates, Heating mode that will go into effect whenever a Recipe is not being run.

There are alarms for high and low temperatures, High limit trip, Sample liquid level low, Stirrer out of range, and recipe abort.

- The high and low temperature will alarm if the temperature falls outside the alarm limits after reaching the desired set point.
- High limit will alarm whenever the high limit relay is tripped.
- Sample liquid level low will alarm whenever the heater or stirrer is active and the liquid level falls below the liquid level sensor when using sample mode.
- The stirrer out of range will alarm whenever the RPM falls outside the alarm limits after reaching the desired RPM set point.

- The recipe abort will alarm if the recipe is stopped before it has finished.

Heater Controller Screen Shots and Descriptions
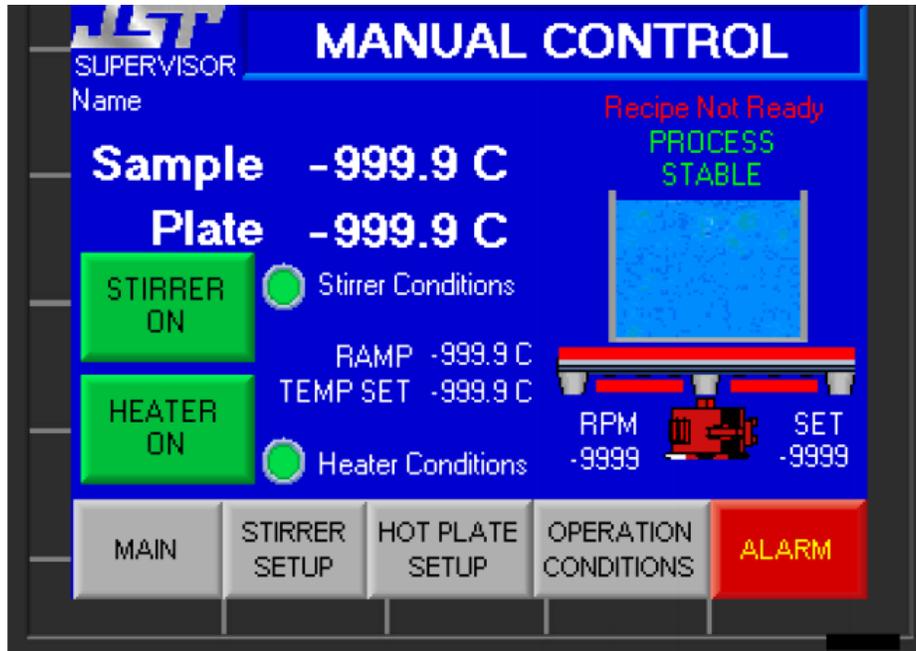
Manual Control Screen
Security - Operator

The Manual Control screen controls the hot plates heater and stirrer motor. It also gives a graphical representation of what is happening in the system. The Red line Above the hot plate is an indicator that the plate is hot (Over 45C) and can cause burns.

Supervisor/Operator - Display in the upper left corner to show who is logged in. The supervisor can program setpoints and have access to certain screens.

Sample/Plate - Displays the current temperature of the sample and plate to .1 degrees Celsius .

Liquid Level - Displays if the bath liquid level is full or not full.

Stirrer Off/On - Pushbutton to control the Stirrer motor. If the Stirrer is off it will display off and be gray, if the stirrer is on it will display on and be green. The stirrer in the graphical display will turn green to indicate the pump is on. The Stirrer motor will be blue when being controlled by the recipe, and will be red when in an error state.

Stirrer Conditions - Display to show if the stirrer can run or not. If the conditions are green it can run, if they are red then an interlock will prevent the stirrer from being enabled.

Heater Off/On - Pushbutton to control the heater. If the heater is off it will display off and be gray, if the heater is on it will display on and be green. The red blocks on the bottom of the plate in the graphical display will turn red to indicate when the heater elements are actually heating.

Heater Conditions - Display to show if the heater can run or not. If the conditions are green it can run, if they are red then an interlock will prevent the heater from being enabled.

Temp Set - Displays the temperature the bath is set to operate at.

Ramp - Displays when running in Ramp mode what the current systems moving setpoint is. This value will approach the user set setpoint at a rate relative to the Ramp rate specified.

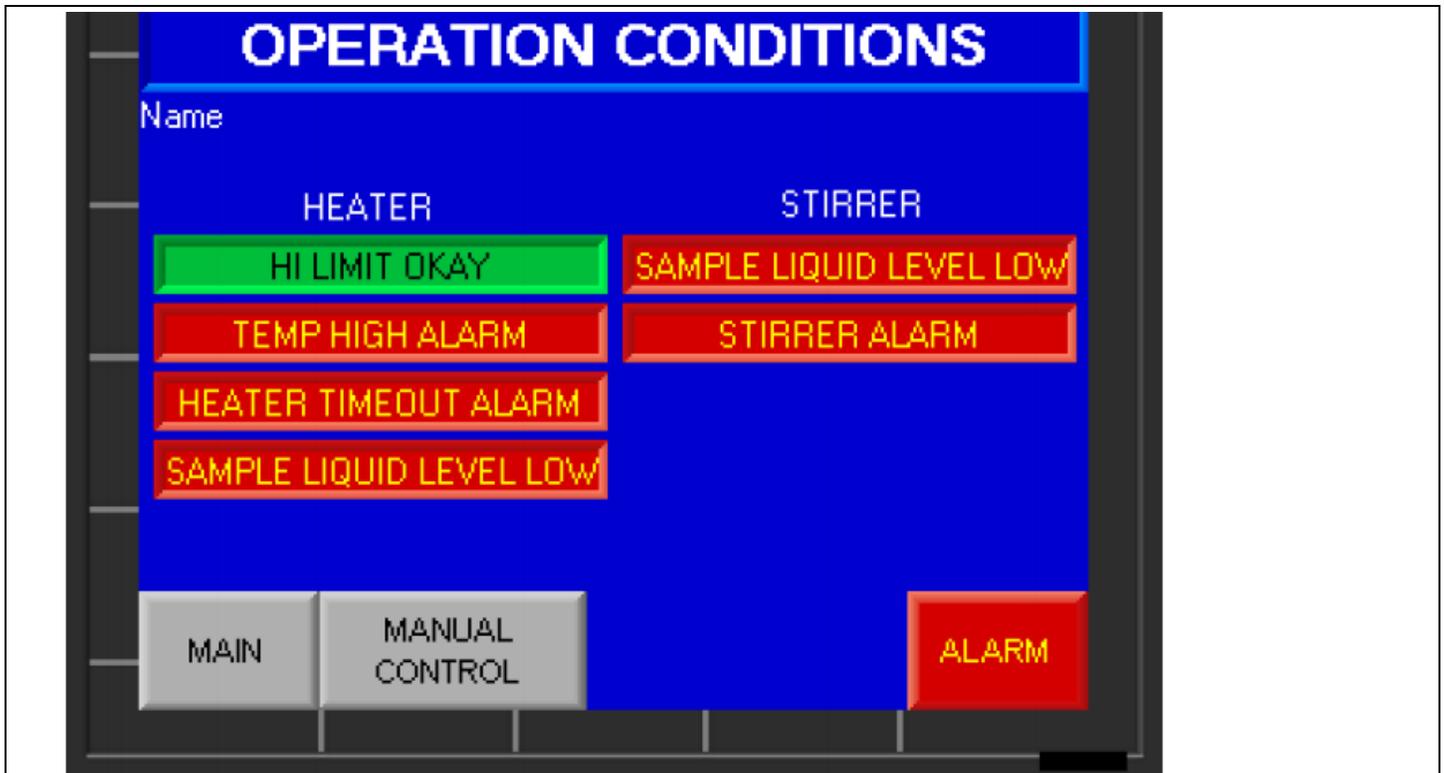Temp Set - Displays the manual mode temperature setpoint or the recipes temperature current setpoint.

RPM - Displays the Stirrer motors RPM.

Hot Plate Calibrating - Indicates when the Controller is running the hot plate calibration routine.

Main, Operation Conditions - Takes the user to the corresponding screen.

Hot Plate/Stirrer Setup - Takes the user to the corresponding screen. These buttons are only available to the supervisor.

Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

OPERATION CONDITIONS

Name

HEATER

| HI LIMIT OKAY |
| TEMP HIGH ALARM |
| HEATER TIMEOUT ALARM |
| SAMPLE LIQUID LEVEL LOW |

STIRRER

| SAMPLE LIQUID LEVEL LOW |
| STIRRER ALARM |

| MAIN | MANUAL CONTROL | | ALARM |

Operation Conditions Screen
Security - Operator

The Operation Conditions screen displays what conditions are met in order to run the corresponding function. If the display is green, the condition is in a runable state. If the display is red, the condition is not in a runable state and it can not run the function.

Main - Takes the user to the Main screen.
Manual Control - Takes the user to the Manual Control screen.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.
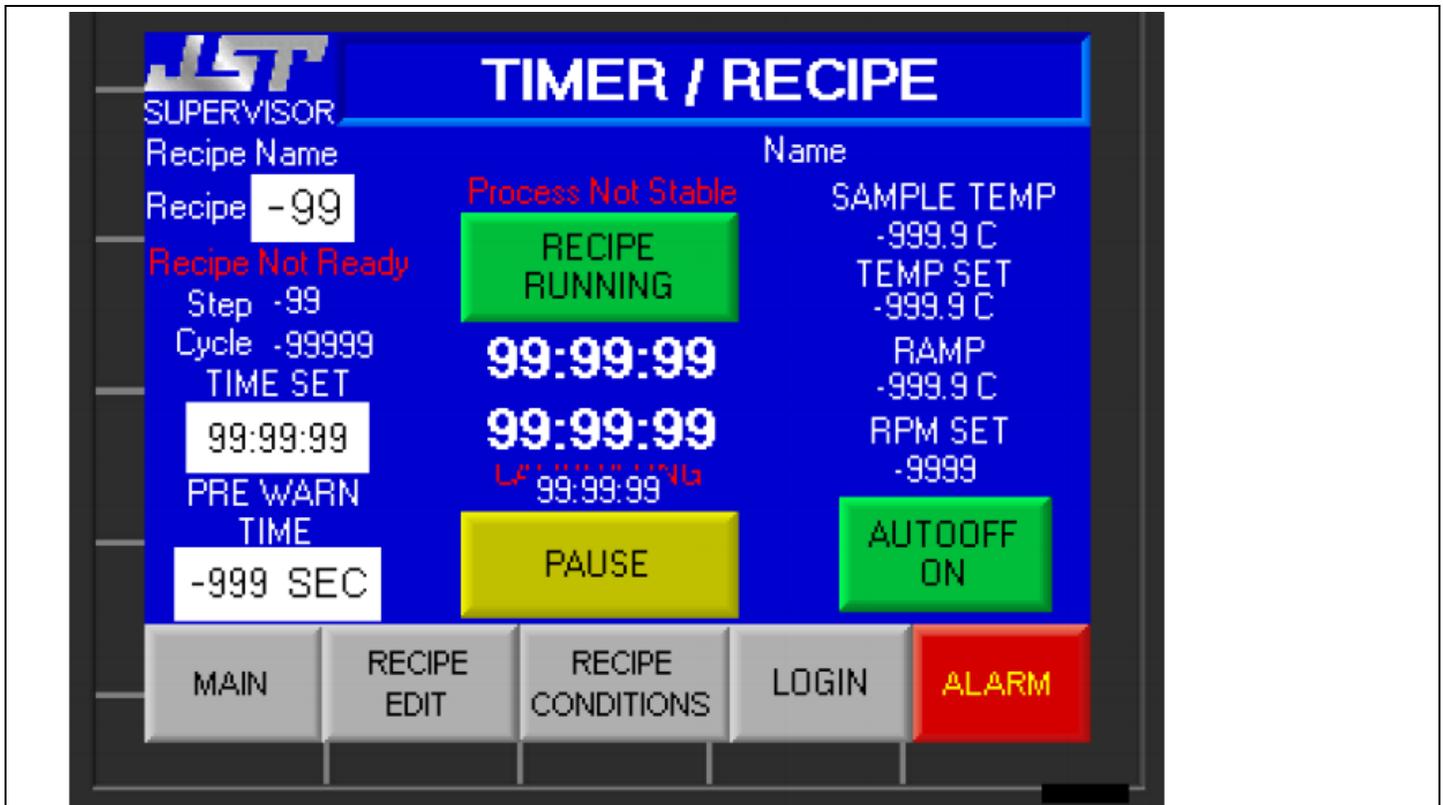
Timer/Recipe Screen
Security - Operator

The Timer/Recipe screen can run 20 different recipes as well as just run in timer mode.
Supervisor/Operator - Display in the upper left corner to show who is logged in. The supervisor can program setpoints and have access to certain screens.
Recipe Select - Numeric entry to select which Recipe to run. Selecting Recipe 0 will set controller to run in Timer mode.
Recipe Name - Display shows the name of the current recipe loaded.
Time Set (left side) - Numeric entry to program how long the timer will run in Timer mode.
Pre Warn Time (left side) - Numeric entry to program a time when an audio will sound to indicate that the timer is almost finished. When the time remaining on the timer is below the pre warn time, the audio will pulse for .25 seconds on, 1 second off.
Timer-Recipe Start/Timer-Recipe Unpause from Paused State - Pushbutton to start the timer/recipe. When the timer/recipe is not running it will display "Timer Off" or "Recipe Off" and be gray, when the timer/recipe is running it will display "Timer Running" or "Recipe Running", and turn green. When Timer is paused it will display "Timer Continue" or "Recipe Continue" and turn yellow.
Time Remaining - When the timer/recipe is running it will display how much time is remaining of the current step.
Over Time - When the timer/recipe has finished timing, the over timer will count up to show how much time has passed before being acknowledged.
Timer-Recipe Pause/Timer-Recipe Reset from Paused State/Timer-Recipe Acknowledge - Pushbutton Control to pause timer/recipe, reset timer/recipe, and acknowledge when timer/recipe is done.. When timer/recipe is running it will display "Pause" and be gray. When timer/recipe is paused it will display "Reset" and turn red. When timer/recipe is finished it will display "Timer Complete Ack" or "Recipe Complete ACK" and turn yellow. When timer/recipe is not running button will be hidden.
Process Ready - Indicates when the process is ready according to the manual temperature setpoints and sample liquid level when not running a recipe.
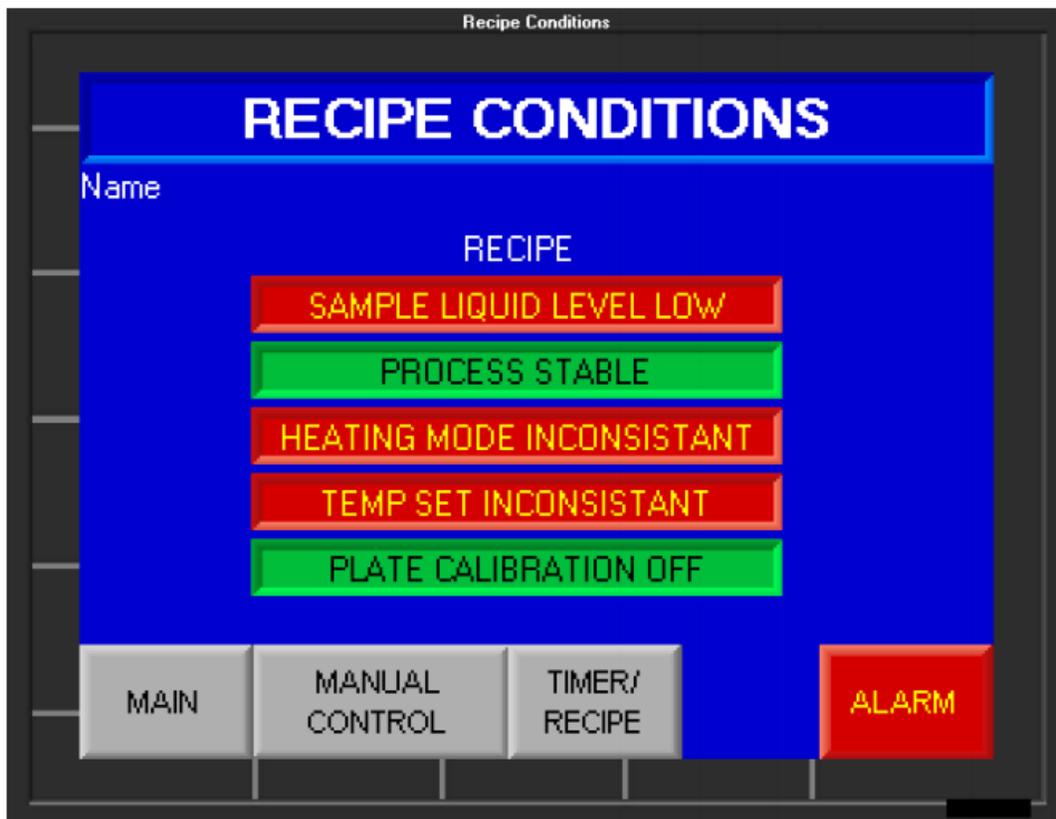Step - Displays the current step of the recipe when a recipe is running.
Cycle - Displays the current cycle of the recipe when the recipe is running in cycle mode.
Temp/Temp Set/RPM Set - Display the current temperature of the sample or plate depending on heating mode and the current setpoints of the sample or plate and the Stirrer motor.
Main/Recipe Edit/Recipe Conditions - Takes the user to the corresponding screen.
Login - Enables a keypad entry to enter the supervisor password.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

RECIPE CONDITIONS

Name

RECIPE

| SAMPLE LIQUID LEVEL LOW |
| PROCESS STABLE |
| HEATING MODE INCONSISTANT |
| TEMP SET INCONSISTANT |
| PLATE CALIBRATION OFF |

| MAIN | MANUAL CONTROL | TIMER/ RECIPE | | ALARM |

Recipe Conditions Screen
Security - Operator

The Recipe Conditions screen displays what conditions are met in order to start a Recipe. If the display is green, the paramter is in a runable state. If the display is red, the parameter is not in a runable state and the recipe will not be allowed to start.

Main - Takes the user to the Main screen.
Manual Control/ Timer/Recipe - Takes the user to the corresponding screen.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.
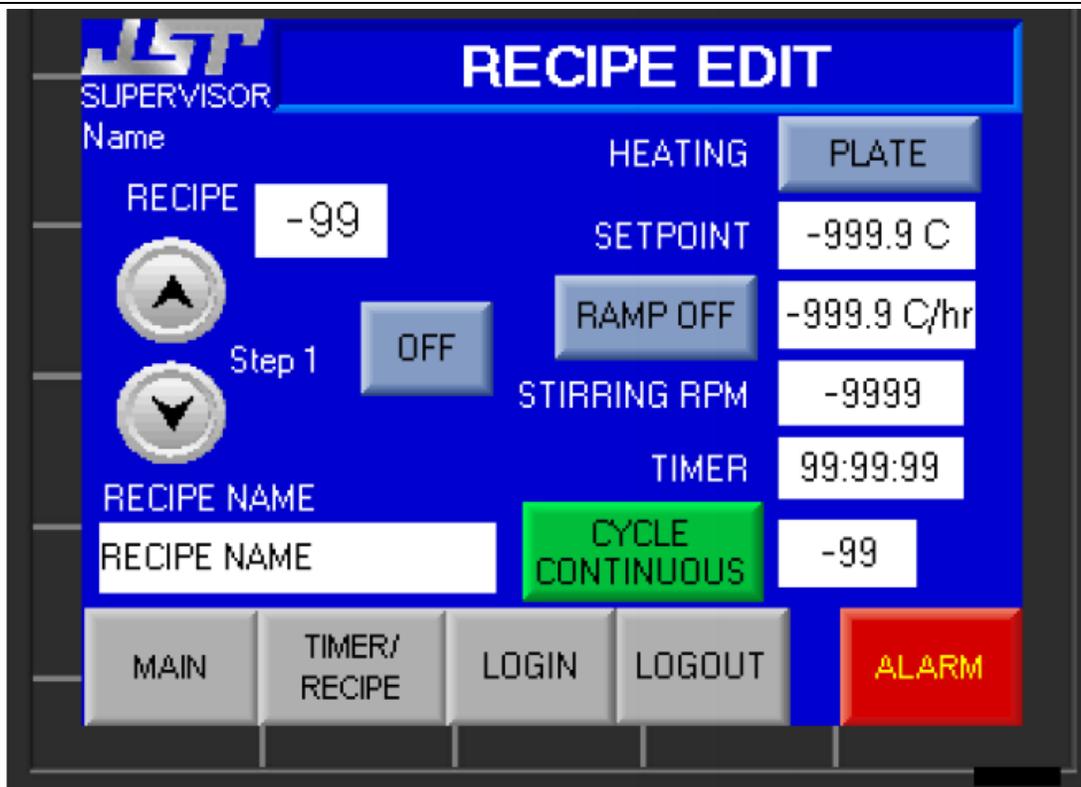
Recipe Edit Screen
Security - Operator

The Recipe Edit screen can store 20 different recipes(1-20).
Supervisor/Operator - Display in the upper left corner to show who is logged in. The supervisor can program setpoints and have access to certain screens.

Recipe Select - Numeric entry to select which Recipe to edit.
Recipe Name - Each recipe can be named by the user consisting up to 12 characters.
Toggle buttons - These will increment the Step to be edited of the loaded recipe. Each recipe has 20 usable steps.
Off/On Pushbutton - Turns the recipe step On and Off
Heating Pushbutton - Changes the mode of the recipe to be sample or plate heating.
Ramp Pushbutton - Changes the mode of the step to use the ramping function.
Cycle Pushbutton - Changes the cycle mode from Off, On , and Continuous.

Setpoint - Numeric entry to specify the Temperature setpoint for specific step.
Ramp Entry - Numeric entry to specify the Ramp Rate for specific step.
Stirrer RPM - Numeric entry to specify the Stirring RPM for specific step. Setting to 0 will turn the stirrer off.
Timer - Numeric entry to specify the Timer Duration for specific step.
Cycle - Numeric entry to specify the Number of cycles to execute the recipe in Cycle On mode.

Main - Takes the user to the Main screen.
Timer/Recipe / Supervisor Setup - Takes the user the corresponding screen.
Login - Enables a keypad entry to enter the supervisor password.
Logout - Pushbutton to set the user to operator.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

6. Basic Operation of the QDR		

- Prior to using the QDR, make sure that the Nitrogen gas is on or the QDR will not know when it is full. Also, be sure to click the 'Recipe Start' button to clear out any stagnated DI water to ensure that the sample is not contaminated in any way.
- If just needing to run a rinsing cycle, the recipe that is loaded is very effective. Just place the sample into the bath and click 'Recipe Start'. If a custom recipe is needed, ask IML staff for assistance.
- If just a water bath is needed, the 'Fill On/Off' button will fill it. When it is full, it will overflow momentarily before shutting the fill operation off automatically.
- At the end of the programmed QDR recipe ad after a fill operation, the QDR may need to be drained. To do this press the 'Drain On/Off' button. Once drained, make sure to click this button again. The QDR will not begin any processes if the drain is open.
- After a recipe, an alarm will sound to let the user know it is complete. When it does, click the yellow 'Complete Ack' box on the screen, this will stop the alarm.
- Once again, if any water droplets make it out of the QDR, make sure to take all precautions when cleaning it up. Treat the droplets as if they are highly acidic even if they are not.

Five functions keys on the faceplate are provided for: Start/Continue Recipe, Stop/Pause/Reset Recipe, Fill, Drain, and Alarm Acknowledge/Go to Alarm Screen

- When the Start button is pressed the recipe will start

- When the Stop/Pause/Reset button is pressed it will Pause the bath recipe. The Recipe can be restarted by pressing the Start button. To reset the recipe press, the Stop/Reset button once more.

- When the Fill button is pressed DI Water will fill the bath to the full liquid level Sensor.

- The Drain function provides a timed and temperature interlocked drain cycle. In the setup parameters, IML staff member may program the temperature above that the drain function will not work. Also, the length of the drain period after an empty liquid level may be programmed. The drain button may be used to start the drain cycle and also stop it. If the cycle is not manually stopped before the timer elapses, the timer will automatically stop the Drain. The drain temperature and time setting are programmed by IMl staff if you feel the need for these to be change please contact a staff member.

- When the Alarm Acknowledge/Go to Alarm Screen button is pressed the audio alarm is silenced and the page displayed will be the alarm screen.

An auto-dump time can be programmed to drain the bath and then refill with DI Water when the auto-dump time counts down. When this set point is 0 it will not run.

The DI Water Spray button controls the bath top sprays.

The recipe parameters are: Mode, Cycles, Cascade/Spray time, Drain time, Spray on/off, Resistivity monitor on/off, and End of cycle on/off.

A Resistivity meter remote input can be integrated into the control scheme to rinse product to a resistivity set point. The input can be set for Normally Open or Normally closed. The setting is located on the global setting Screen which is only accessible by the supervisor.
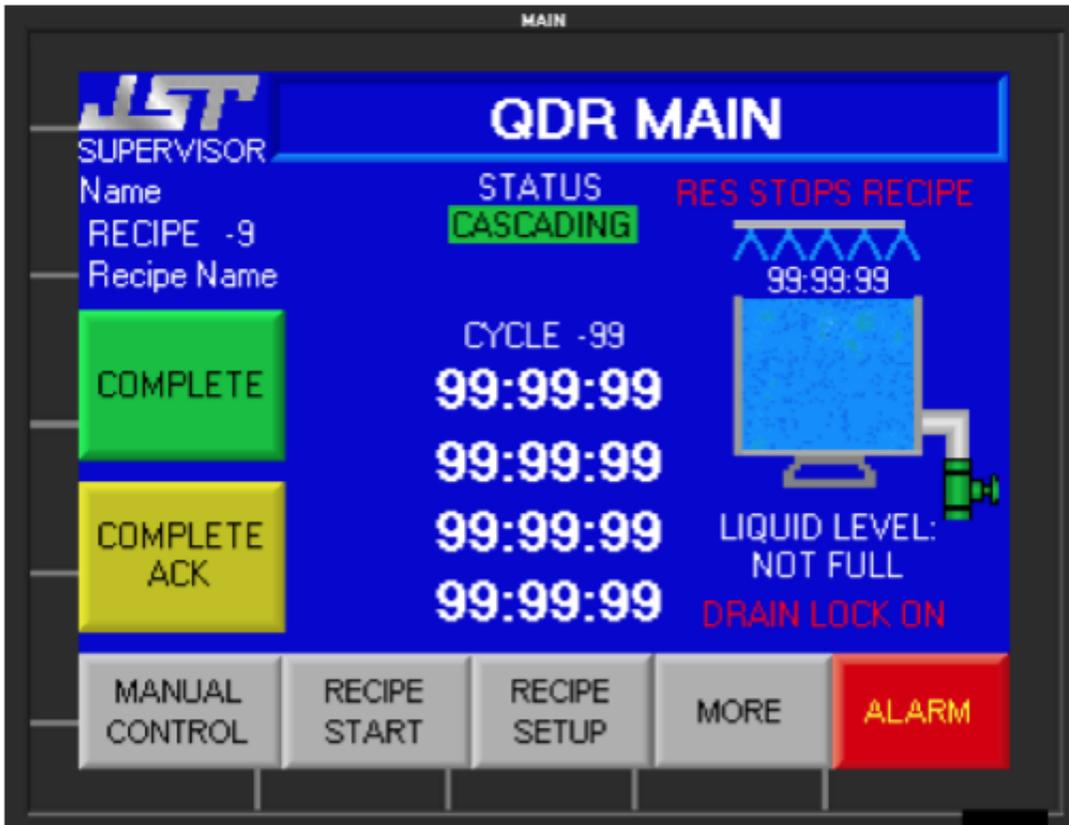
The recipe modes are: QDR, Overflow, and Spray.
- QDR mode will fill the bath to full liquid level, cascade for the programmed time, drain for the programmed time, and repeat for the number of cycles programmed. When the cycles are complete the bath will fill with DI Water or run a drain cycle depending on the end of cycle setting and give an audio alarm to indicate the recipe is complete. If the spray is selected to be on they will be active during the filling and draining steps.

- Overflow mode will cascade DI Water for the programmed time and then give an audio alarm to indicate the recipe is complete. It will leave the bath full for the next cycle.
- Spray mode will open the drain and turn the sprays on for the programmed amount of time and then give an audio alarm to indicate the recipe is complete.

There are alarms for the QDR fill timeout and recipe abort. The QDR fill timeout will alarm if the bath does not fill/finish cascading in the programmed amount of time. The recipe abort will alarm if the recipe is stopped before it has finished.

There is a nitrogen blanket for the top of the bath. To utilize the Nitrogen blanket there is a push button switch in the head casing that controls the nitrogen blanket.

QDR Controller Screen Shots and Descriptions

MAIN

QDR MAIN

SUPERVISOR
Name
RECIPE -9
Recipe Name

STATUS
CASCADING

RES STOPS RECIPE

99:99:99

COMPLETE

COMPLETE
ACK

CYCLE -99
99:99:99
99:99:99
99:99:99
99:99:99

LIQUID LEVEL:
NOT FULL
DRAIN LOCK ON

MANUAL CONTROL | RECIPE START | RECIPE SETUP | MORE | ALARM

QDR Main Screen
Security - Operator
The main screen gives an overview of the bath, displaying Liquid Level, and Recipe Status. It also gives a graphical representation of what is happening in the system.

Supervisor/Operator - Display in the upper left corner to show who is logged in. The supervisor can program setpoints and have access to recipe setup and password setup screens.

Status - Displays what state the recipe is in. The four times below will be display the start cascade time remaining, the recipe cascade time remaining, drain time remaining, or spray time remaining. These times are only visible only if the corresponding function is active. The cycle status above will display the current cycle number of the current recipe running. It will be hidden when not running a QDR recipe.

Recipe/Recipe Name - Display shows the number & name of the current recipe loaded.

"Res Stops Recipe" - An indicator that will display whenever a resistivity controller stops the recipe. Resisitivity control must be turned on in the recipe setup for this function to be active.

"Drain Lock On" - An indicator that will display whenever the drain has been manually turned on from the manual control screen.

Fill past full timer - This timer located above the tanks graphical representation will display time remaining for the fill past full parameter. This parameter is set in the global settings screen.

Liquid Level - Displays if the bath liquid level is full or not full.

Recipe Start/Recipe Unpause from Paused State - Pushbutton to start the Recipe. When the Recipe is not running it will display "Start" and be gray, when the Recipe is running it will display the current step in the recipe, and turn green. When a Recipe is paused it will be green and will display the current recipe state but will not unpause the recipe when depressed.

Recipe Pause/Recipe Reset from Paused State/Recipe Acknowledge - Pushbutton Control to pause recipe, reset recipe, and acknowledge when recipe is done.. When recipe is running it will display "Pause" and be gray. When recipe is paused it will display "Reset" and turn red. When recipe is finished it will display "Complete Ack" and turn yellow. When recipe is not running button will be hidden.

Recipe Setup - Takes the user to the Recipe Setup screen. Only the supervisor has access to this screen.
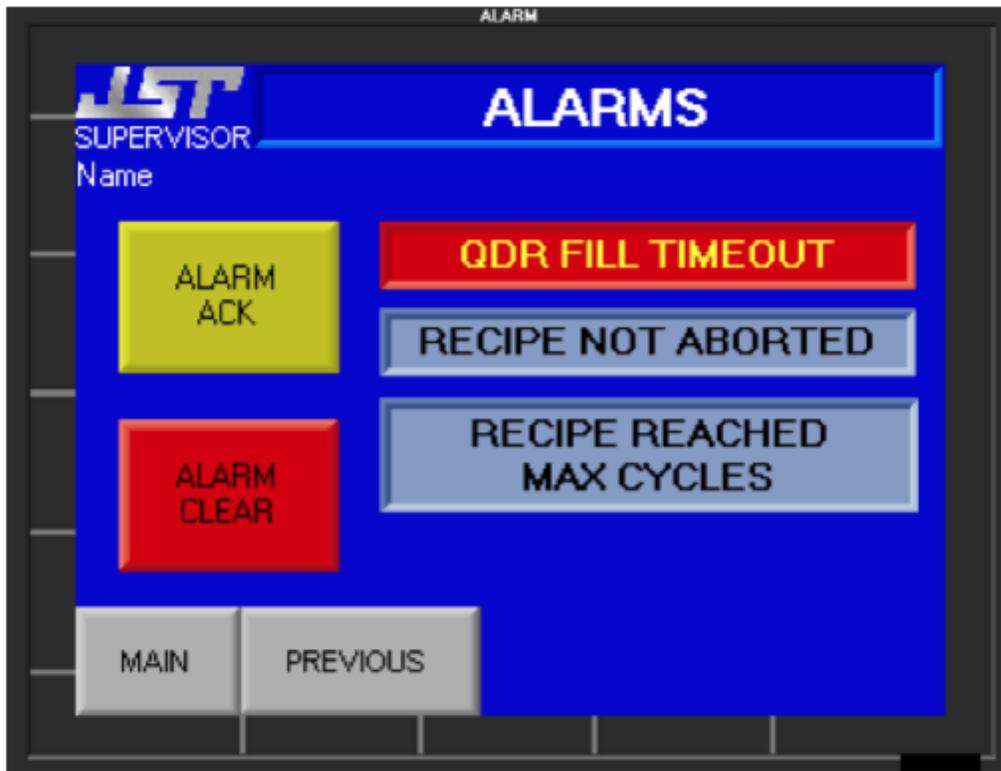
Recipe Start - Takes the user to the Recipe Start screen.

Manual Control - Takes the user to the Manual Control screen.

Login - Enables a keypad entry to enter the supervisor password.

Logout - Pushbutton to set the user to operator.

Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

ALARMS

JST
SUPERVISOR
Name

ALARM
ACK

ALARM
CLEAR

QDR FILL TIMEOUT

RECIPE NOT ABORTED

RECIPE REACHED
MAX CYCLES

MAIN   PREVIOUS

Alarm Screen
Security - Operator

The alarm screen will display which functions are in an alarm state.

Supervisor/Operator - Display in the upper left corner to show who is logged in. The supervisor can program setpoints and have access
    to recipe setup and password setup screens.
Alarm Ack - Pushbutton to silence the audio indicator.
Alarm Clear - Pushbutton to clear the alarm and reset the alarm states.

Main - Takes the user to the main screen.
Previous - Takes the user to the previous screen.
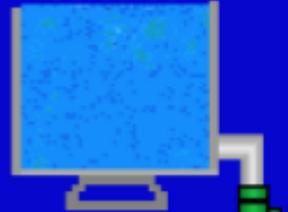
Manual Control Screen
Security - Operator
The Manual Control screen controls the different functions in the bath, DI Fill, DI Spray, and Drain control, It also gives a graphical representation of what is happening in the system.
Supervisor/Operator - Display in the upper left corner to show who is logged in. The supervisor can program setpoints and have access to recipe setup and password setup screens.
Liquid Level - Displays if the bath liquid level is full or not full.
DI Fill Off/On - Pushbutton to control the DI Fill. The fill will display off and be gray, if the button is pressed it will display fill on and be green.
Fill past full timer - This timer located above the graphical display will display time remaining for the fill past full parameter. This parameter is set in the global settings screen.
DI Fill Conditions - If the Fill Conditions are green it can run, if the conditions are red the DI fill interlock is set and will not allow the DI fill to turn on.
DI Spray Off/On - Pushbutton to control the DI sprays. If the sprays are off it will display off and be gray, if the button is pressed it will display on and the spray bar above the bath will be displayed.
Drain Off/Draining - Pushbutton to control the drain, If the drain is closed it will display off and be gray, if the button is pressed it will display draining and the button will turn green. The dump valve on the bottom of the graphical display will turn green to indicate the drain is open and the "Drain Lock On" indicator will also turn on.
Drain Time Remaining - The time display below the graphical display shows how much time is remaining when the drain is draining.
Drain Conditions - If the Drain Conditions are green it can run, if the conditions are red then the Drain Interlock is set and will not allow the Drain to open.

Next Dump In - Display to show how much time is remaining until an automatic dump is performed if the autodump is enabled and bath is not in use..
Main - Takes the user to the Main screen.
Recipe Setup - Takes the user to the Recipe Setup screen. Only the supervisor has access to this screen.
Recipe Start/Operation Conditions - Takes the user to the respective screen.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

OPERATION CONDITIONS

Name

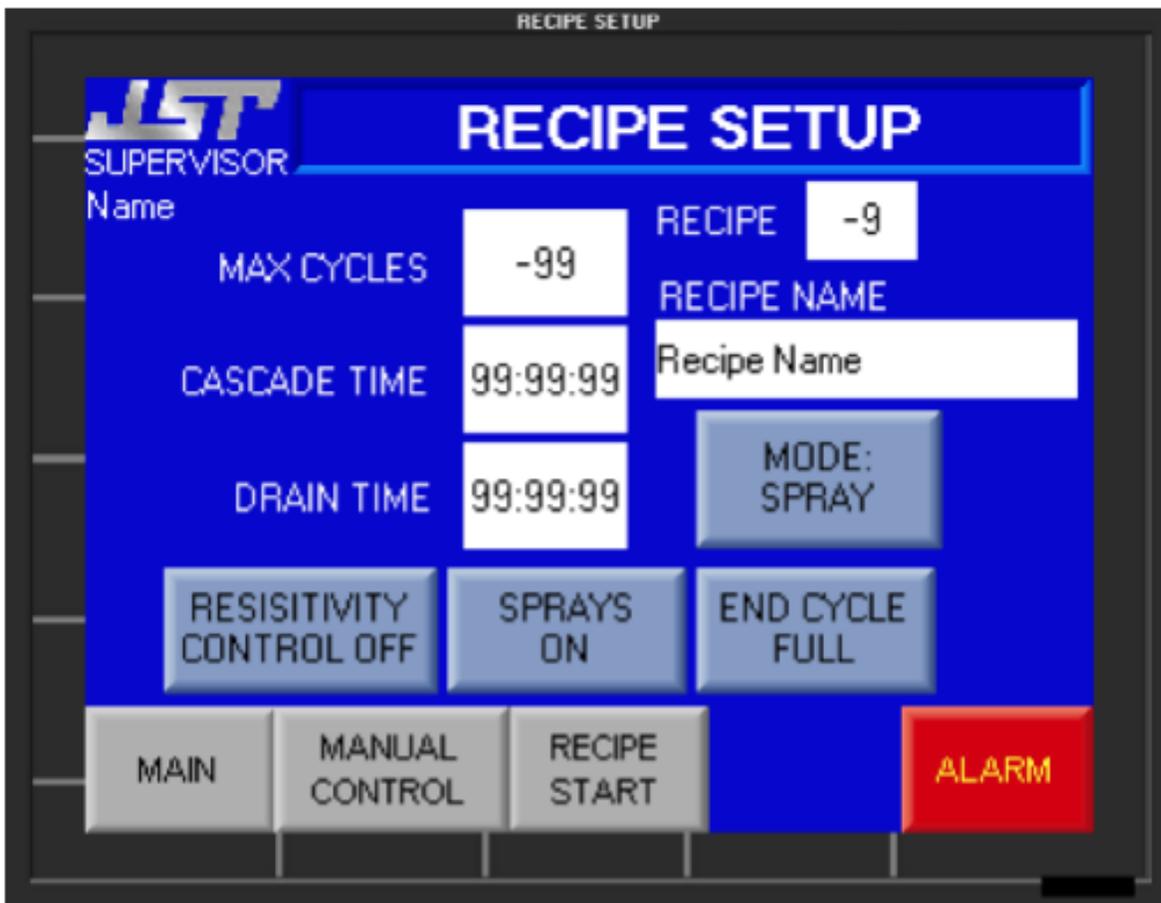| DI FILL	DRAIN
DRAIN OPEN	DI FILL ON
RECIPE RUNNING	RECIPE RUNNING

MAIN   MANUAL CONTROL   ALARM

Operation Conditions Screen
Security - Operator

The Operation Conditions screen displays what conditions are met in order to run the corresponding function. If the display is green, the interlocks release condition has been met. If the display is red, the interlocks condition has not been met and the function cannot be ran.

Main - Takes the user to the Main screen.
Manual Control - Takes the user to the Manual Control screen.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

RECIPE SETUP

SUPERVISOR
Name

MAX CYCLES `-99`

CASCADE TIME `99:99:99`

DRAIN TIME `99:99:99`

RECIPE `-9`

RECIPE NAME

`Recipe Name`

MODE: SPRAY

RESISITIVITY CONTROL OFF

SPRAYS ON

END CYCLE FULL

MAIN

MANUAL CONTROL

RECIPE START

ALARM

Recipe Setup Screen

Security - Supervisor

The Recipe Setup screen programs up to 5 independent recipes with setpoints for Mode, Number of Cycles, Cascade/Spray time, Drain Time, Sprays, and End of Cycle state.

Supervisor/Operator - Display in the upper left corner to show who is logged in. The supervisor can program setpoints and have access to recipe setup and password setup screens.

Recipe Number - Numeric entry to set which recipe to edit.

Recipe Name - Each recipe can be named by the user consisting up to 12 characters.

Mode select - Pushbutton to select which mode the bath will run in, QDR, Overflow, or Spray. In QDR mode the bath will fill with DI, Run the cascade for the time set in the start cascade time, then cascade for the set amount of time in the recipe, open the drain for the set amount of time, and repeat those steps for number of cycles programmed in the recipe. When the cycles have finished the bath will either fill or drain the bath depending on the end of cycle setting and an audio will sound to indicate it has finished. In Overflow mode the bath will cascade for the set amount of time and then give an audio to indicate that it has finished. In Spray mode the bath will have keep the drain open while the sprays stay on for the set amount of time and then give audio to indicate that it has finished.

Cycles - Numeric entry to set how many QDR cycles will run. If the mode is Overflow or Spray, this option is not available.

Cascade/Spray Time - Numeric entry to set how long the bath will Cascade for in QDR or Overflow mode. If it is in Spray mode it will set how long the sprays will stay on while draining.

Drain Time - Numeric entry to set how long the drain will remain open in QDR mode as well as in the autodump feature. If the mode is Overflow, this option is not available and the drain time for the autodump is set to 20 seconds.
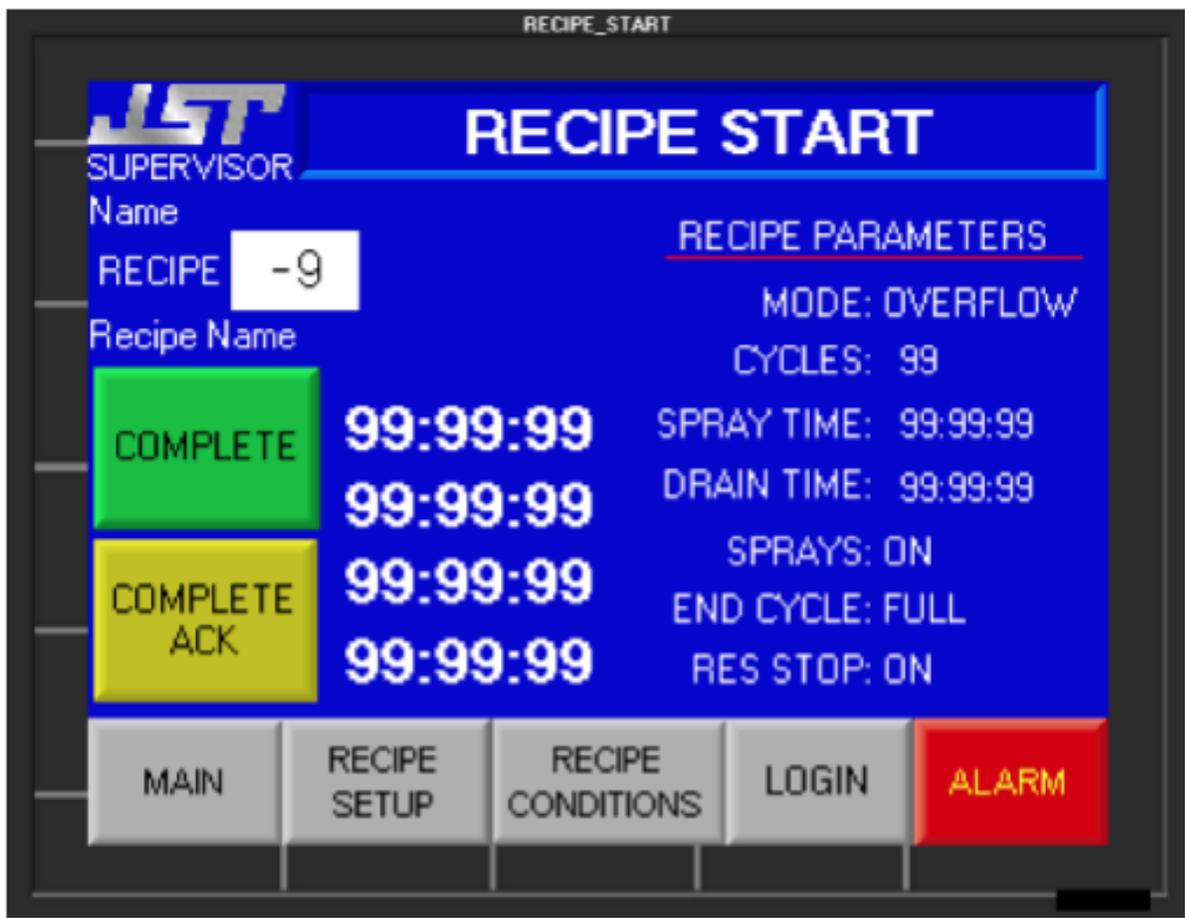
Spray Off/On - Pushbutton to select if the sprays are on or off during the drain and fill of the QDR mode. If the mode is Overflow or Spray, this option is not available.

End Cycle - Pushbutton to select if the bath will finish full or empty. If the mode is Overflow or Spray, this option is not available.

Resistivity Control On/Off - Push button to select whether or not to use a resisivity monitor to stop the recipe. In the QDR mode in between the Cascade cycle and the drain step the resisitivity stop from the resisitivity controller will be checked. If resisitivity has been reached the recipe will terminate without running any more cycles. The Cycle setting will be changed to max cycles and now be used to terminate the recipe in the event the desired resistivity is not reached before that amount of cycles. In the overflow mode, 20 seconds into the recipe the resisitivity controller will be used to stop the recipe. Resistivity control not available in spray mode.

Main/Recipe Start/Password Setup- Takes the user to the respective screen.

Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

RECIPE START

JST

SUPERVISOR

Name

RECIPE `-9`

Recipe Name

COMPLETE

COMPLETE ACK

99:99:99
99:99:99
99:99:99
99:99:99

RECIPE PARAMETERS

MODE: OVERFLOW
CYCLES: 99
SPRAY TIME: 99:99:99
DRAIN TIME: 99:99:99
SPRAYS: ON
END CYCLE: FULL
RES STOP: ON

MAIN	RECIPE SETUP	RECIPE CONDITIONS	LOGIN	ALARM

Recipe Start Screen
Security - Operator

The Recipe Start screen allows the selection of 5 different recipes with the recipe parameters shown on the right side of the screen. These parameters are programmed in the setup screen.

Supervisor/Operator - Display in the upper left corner to show who is logged in. The supervisor can program setpoints and have access to recipe setup and password setup screens.
Recipe Number - Numeric entry to set which recipe to started.
Recipe Name - Display shows the name of the current recipe loaded.
Recipe Start/Recipe Unpause from Paused State - Pushbutton to start the Recipe. When the Recipe is not running it will display "Start" and be gray, when the Recipe is running it will display the current step in the recipe, and turn green. When a Recipe is paused it will be green and will display the current recipe state but will not unpause the recipe when depressed.
Recipe Pause/Recipe Reset from Paused State/Recipe Acknowledge - Pushbutton Control to pause recipe, reset recipe, and acknowledge when recipe is done.. When recipe is running it will display "Pause" and be gray. When recipe is paused it will display "Reset" and turn red. When recipe is finished it will display "Complete Ack" and turn yellow. When recipe is not running button will be hidden.
Recipe Parameters - Displays what settings will run when the corresponding recipe is started.

Main - Takes the user to the Main screen.
Recipe Setup - Takes the user to the Recipe Start screen.
Login - Enables a keypad entry to enter the supervisor password.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

RECIPE CONDITIONS

Name

DRAIN LOCKED OPEN

MAIN | MANUAL CONTROL | RECIPE START | ALARM
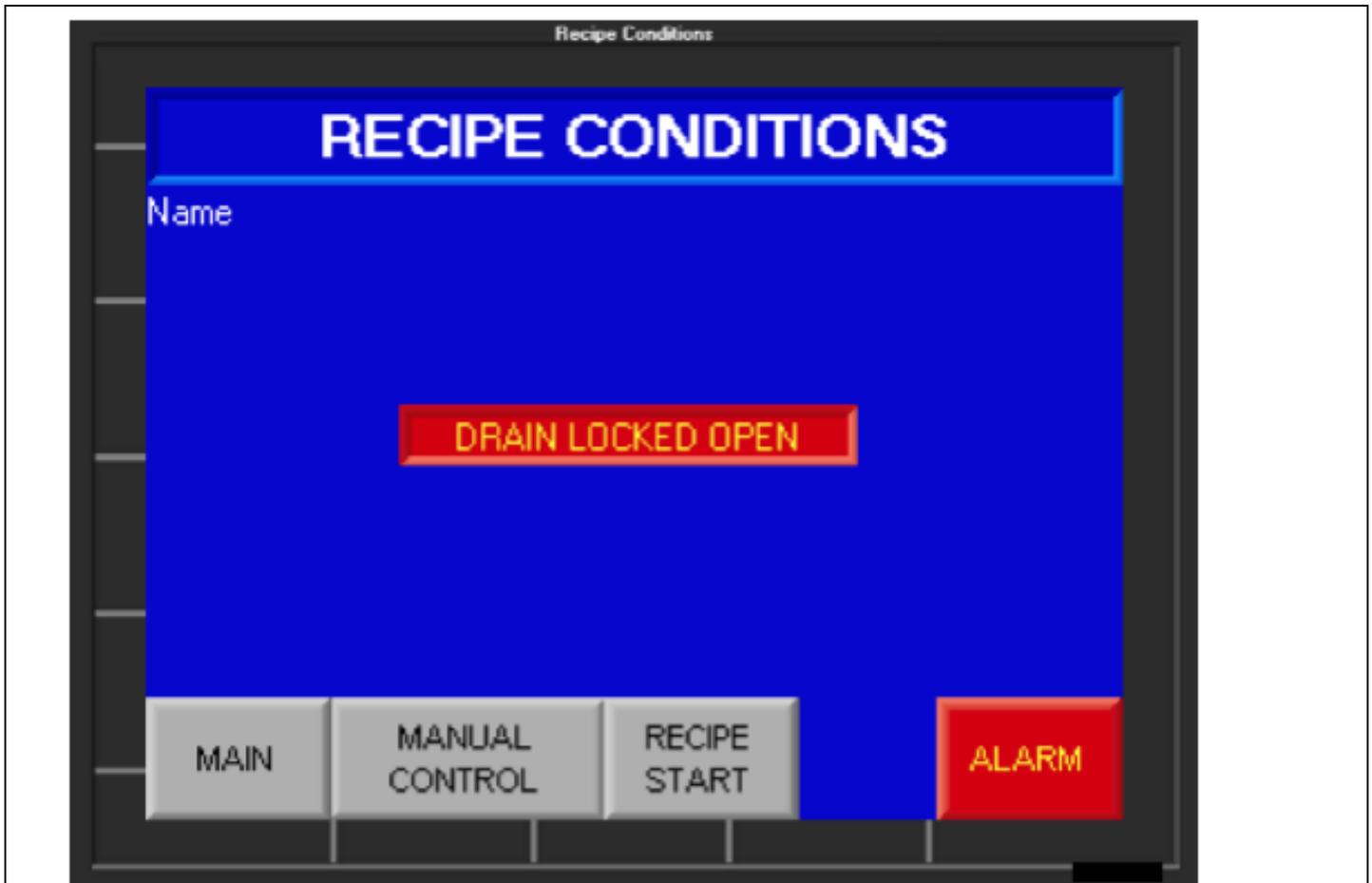
Recipe Conditions Screen
Security - Operator

The Recipe Conditions screen displays what conditions are met in order to run the corresponding function. If the display is green, the interlocks release condition has been met. If the display is red, the interlocks condition has not been met and the function cannot be ran.

Main - Takes the user to the Main screen.
Manual Control/Recipe Start - Takes the user to the Corresponding screen.
Alarm - Pushbutton to take the user to the Alarm screen. This button will be red if the system is in alarm.

Quartz Bath Control

Attention: There are two quarts baths with individual controllers make sure you are using the correct controller for the bath you are using.

Five functions keys on the faceplate are provided for: Start/Continue Timer, Stop/Pause/Reset Timer, Heater On/Off, Drain, and Alarm Acknowledge/Go to Alarm Screen.

- When the Heater button is pressed the heater will turn on and heat the bath to the Temperature set point using PID control.
- When the Timer Start button is pressed the timer will start.
- When the Timer Reset button is pressed once it will Pause the timer. The Timer can be restarted by pressing the Start button. To reset the timer, press the Timer Reset button once more.
- When the Drain button is pressed(twice) the drain will open if the drain function parameters are met. The Drain function provides a timed and temperature interlocked drain cycle. The drain button may be used to start the drain cycle and also stop it. If the cycle is not manually stopped before the timer elapses, the timer will automatically stop the Drain. The Drain function is configured so the user will need to confirm drain function so that the end user will press drain twice before the bath will start the Drain function. The Drain Interlock Temperature can be set so that the drain will not open if the Temperature of the bath is higher than that of the Drain interlock temperature. The drain interlock temperature is programmed by IML staff if you need the temperature changed please contact the IML director.
- When the Alarm Acknowledge/Go to Alarm Screen button is pressed the audio alarm is silenced and the page displayed will be the alarm screen.

The Temperature/Timer controller:
- Five different preset times can be stored for timer operation. The timer can be programmed to show remaining or elapsed time. If you need a timer programmed, please contact IML Staff.
- The Timer interlock can be set so that the timer can only be started when the process is Ready. When this interlock is on the system will alarm for out of process conditions when running.
- There are alarms for High and Low Temperature, High Limit Trip, Thermostat Trip, and Bath Liquid Level Low.
  - The high and low temperature will alarm if the temperature falls outside the alarm limits after reaching the desired set point.
  - High limit will alarm whenever the high limit relay is tripped
  - The thermostat will alarm whenever the thermostat is tripped.
  - The Bath Life alarm will appear after the bath cycles are greater than the set amount. The supervisor configures who can reset the bath cycles count, the reset appears on the alarm screen.

The user will be able to go to the Directory screen to navigate through the screens and controls on the controller.
The Trend screens give a visual interpretation of real time data from the controller over a period of time. The Data Collection screen shows the lot information and settings used for that lot.

7. Acid Bench shut off		
• Clean, rinse and dry any glassware you have used • Put away all chemicals • Dispose of the waste per your process SOP • Wipe all liquids from bench worktop • Turn off N2 gas • Turn off DIW • Turn off main power		