

# LS20 / LS60

LIQUID BATCH SAMPLER



Operators Manual

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## Lighthouse Worldwide Solutions

# Liquid Batch Sampler

LS20 and LS60



## Operators Manual

LS Software Version 2.3

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LWS Part Number: 248083484-1 Rev 2

## EU DECLARATION OF CONFORMITY

**Manufacturer's Name:** Lighthouse Worldwide Solutions, Inc.

**Manufacturer's Address:** Lighthouse Worldwide Solutions, Inc.  
1221 Disk Drive  
Medford, OR 97501 USA

**Declares that the product:**  
**Product Name:** Liquid Sampler  
**Model Number(s):** LS20, LS60

**Conforms to the following Product Specifications:**

**SAFETY** EN610-1:2001 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 1: General Requirements IEC 61010-1:2000

CAN/CSA C22.2 No. 1010.1-1992 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements

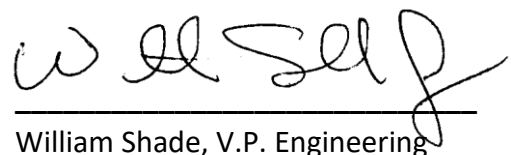
**LASER SAFETY** IEC 60825-1 Am. 2 IEC 60601-2-22 (Laser Notice 50) Guidance on Laser Products: Confirms to FDA 21 CFR Chapter 1 Subchapter 1

**Supplementary Information**

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC amended by Directive 93/68/EEC and the EMC Directive 89/336/EEC amended by Directive 93/68/EEC and carries the CE marking accordingly.

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Fremont, CA March 7, 2008



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William Shade, V.P. Engineering

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## ABOUT THIS MANUAL

### SOFTWARE LICENSE AGREEMENT

SOFTWARE PROGRAM: LIGHTHOUSE LS20 LIQUID SAMPLER SYSTEM

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Lighthouse Worldwide Solutions  
Tel: 800 945 5905 (Sales and Service)  
541 770 5905 (Outside of USA)

## GENERAL SAFETY

Warnings and cautions are used throughout this manual. Familiarize yourself with the meaning of a warning before operating the sampler. All warnings will appear in the left margin of the page next to the subject or step to which it applies. Pay close attention to each warning message. Take extreme care when performing any procedure preceded by or containing a warning.

## LASER SAFETY INFORMATION

**WARNING:** The use of controls, adjustments, or performance of procedures other than those specified within this manual may result in exposure to invisible (infrared) radiation that can quickly cause blindness. As a general precaution, avoid any possible exposure to laser radiation by honoring manufacturer seals and warranty stickers.



**Example of Laser Warning Label**

## INTRODUCTION

This operating manual describes how to use the Lighthouse **LS20 and LS60 Liquid Sampler Systems**.

Following a quality standard of reliability and dependability, Lighthouse Worldwide Solutions developed the **LS20 and LS60 Liquid Samplers** (referred to in this document often as the **Liquid Sampler** and meaning either the LS20 or the LS60) using the latest in laser optical particle counter technology. The Lighthouse Liquid Sampler has an integrated syringe sampler and optical particle counting system. Its easy-to-use Windows based user interface is designed to meet the international regulatory EP, and JP, as well as USP 788 requirements. The Liquid Sampler uses a high accuracy syringe pump flow control system and a high sample volume sensor. With sample volumes adjustable from 1 to 1000 milliliters (10 mL syringe), it is a perfect tool for multiple batch sampling applications.

The **LS20** uses a laser-diode light source and collection optics for particle detection. Particles suspended in liquid block (obscure) light from a focused laser beam. The photo detection electronics count the particles and determine their sizes based on how long the light is obscured. Results are displayed as particle counts in the specified size channel. The **LS20** provides up to eight particle-size channels starting at 1.0 microns with a flow of 20 ml/min.

Data is gathered through the use of the included LS Software. Data is automatically recorded from up to eight particle size channels ranging from 1.0 to 50.0 microns and is available, in real time, in graph and tabular form.

The graphical user interface of the LS Software makes the LS20 and LS60 easy to configure and operate. All reports can be preconfigured and printed at the touch of a button.

The LS Software allows the user to:

- Set the Sample Volume
- Configure the number of samples taken
- Display count data as cumulative or differential values
- Create sample recipes for repeated use
- Save reports as Portable Document Format (PDF) files
- Save your data for historical data review

LS20 SPECIFICATIONS

|                        |  |
|------------------------|--|
| Size Range:            | 1.0 - 50.0 $\mu\text{m}$                                 |
| Channel Configuration: | 1.0, 2.0, 5.0, 7.0, 10.0, 15.0, 25.0, 50.0 $\mu\text{m}$ |
| Number of Channels:    | 8  |
| Flow Rate:             | 20 ml per minute   |
| Fluid Viscosity        | Range: 0-10 cP   |
| Channel sizes:         | User Selectable  |
| Syringe sizes:         | Standard - 25 mL; Optional Accessory - 10 mL             |
| Laser Source:          | Laser diode  |
| Maximum Sample:        | 1 Liter  |
| Calibration:           | NIST Traceable   |
| Wetted Parts:          | PFA, Quartz, Kalrez, Kel F, Stainless Steel 4406 or 4571 |
| Communication Modes:   | RS-232, RS-485 MODBUS (via proprietary cable)            |
| Supporting Software    | LS20 Software  |
| Enclosure              | Stainless Steel  |
| Power:                 | Unit: +24VDC; AC/DC, Adapter: 100-240V, 50-60Hz          |
| Dimensions             | 12.875"(L) x 8.75"(W) x 14.75"(H) [32.7 x 22.2x 37.5 cm] |
| Weight                 | 20.5 lb. (9.3 kg) (LS20 Sampler)                         |
| Operating Temp/RH      | 50°F to 104°F (10°C to 40°C) / 20% to 95% non-condensing |
| Storage Temp/RH        | 14°F to 122°F (-10°C to 50°C) / Up to 98% noncondensing  |

**LS20 Specifications**

Lighthouse recommends that your LS20 instrument is calibrated annually by a Certified Lighthouse Service Provider, to ensure it continues to perform within specification.

LS-60 SPECIFICATIONS

|                          |  |
|--------------------------|--|
| Size Ranges:             | 0.1-0.5µm; 0.2-2.0µm; 0.3-3.0µm; 0.5-100µm; 2.0-140µm  |
| Channels Configurations: | 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.5 µm<br>0.2, 0.3, 0.4, 0.5, 0.7, 1.0, 1.3, 2.0 µm<br>0.3, 0.5, 0.7, 1.0, 1.3, 2.0, 2.5, 3.0 µm<br>0.5, 1.0, 2.0, 5.0, 10.0, 25.0, 50.0, 100.0 µm |
| Number of Channels:      | 8  |
| Flow Rate:               | 60 ml per minute   |
| Syringe sizes:           | Standard - 25 mL; Optional Accessory - 10 mL   |
| Laser Source:            | Laser diode  |
| Maximum Sample:          | 1 Liter  |
| Calibration:             | NIST Traceable   |
| Wetted Parts:            | Teflon (PFA), Quartz, Kalrez, Kel F, Polypropylene   |
| Communication Modes:     | RS-232, RS-485 MODBUS (via proprietary cable)  |
| Supporting Software      | LS Software  |
| Enclosure                | Stainless Steel  |
| Power:                   | Unit: +24VDC; AC/DC Adapter: 100-240V, 50-60Hz   |
| Dimensions               | 12.875"(L) x 8.75"(W) x 14.75"(H) [32.7 x 22.2x 37.5 cm]   |
| Weight                   | 20.5 lb (9.3 kg)   |
| Operating Temp/RH        | 50°F to 104°F (10°C to 40°C) / 20% to 95% non-condensing   |
| Storage Temp/RH          | 14°F to 122°F (-10°C to 50°C) / Up to 98% noncondensing  |

**LS60 Specifications**

Lighthouse recommends that your LS-60 instrument is calibrated annually by a Certified Lighthouse Service Provider, to ensure it continues to perform within specification.

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## OPERATING THE SAMPLER

### OVERVIEW

The Lighthouse **Liquid Sampler** has been thoroughly tested at our factory and includes sample tubing and a sample beaker, for your convenience.

Please review and follow the LS20 or LS60 Liquid Sampler set up and configuration steps that are outlined on the printed **Read Me First** document and on the USB key included in the instrument shipping box.



LS20 with beaker

## UNPACKING

When the LS20/LS60 is first received, inspect the outside of the shipping container for any damage that may have occurred during shipping. If any damage to the shipping container is found, report the damage to Lighthouse immediately. If the container is undamaged, next carefully inspect the Liquid Sampler itself for any broken parts, scratches, or dents. Report any damage found on the instrument to Lighthouse Technical Support before proceeding. Verify the contents of the shipment against the shipping list. If anything appears to be missing, immediately contact your local sales representative or Lighthouse Worldwide Solutions at 1+ 800-945-5905, 1+ 541-770-5905 or [techsupport@golighthouse.com](mailto:techsupport@golighthouse.com). Keep the shipping container and all packing material for reshipment of the sampler for annual calibration.

## RETURNS AND YOUR RMA NUMBER

Should it become necessary to return the instrument to the factory for any reason, please contact Lighthouse Customer Service, or visit our web site, [www.golighthouse.com/rma](http://www.golighthouse.com/rma), and obtain a Return Merchandise Authorization (RMA) number. Reference the RMA number on all shipping documentation and purchase orders. After receiving an RMA number, follow the shipping instructions below.

## SHIPPING INSTRUCTIONS

If the LS20 or LS60 needs to be returned to the factory for any reason, please follow the shipping instructions below.

1. Use the original shipping containers, nozzle caps and packing materials whenever possible.
2. If the original shipping containers or packing materials are not available, you may contact Lighthouse to purchase replacement containers, packing materials and nozzle caps. It is not recommended, but when an approved shipping container is not available, the instrument may be wrapped in “bubble pack”, surrounded by shock absorbent material, and placed in a double-walled shipping carton. However, if the shipping container is vigorously shaken, the instrument should not rattle inside it. If the instrument is damaged during shipping because of inadequate user packing, the instrument’s warranty may be voided and all required repairs will be billed to the customer.
3. Seal the shipping container securely. Mark the container “FRAGILE” and write the Return Merchandise Authorization (RMA) number on any unmarked corner of the shipping container.
4. Return or ship the instrument to the address provided by your Lighthouse representative or the RMA website.

## RUNNING THE LS SOFTWARE

To operate the LS Software it must be installed on a computer and the instrument must be connected to the computer USB port using the included USB to RS-232 cable.

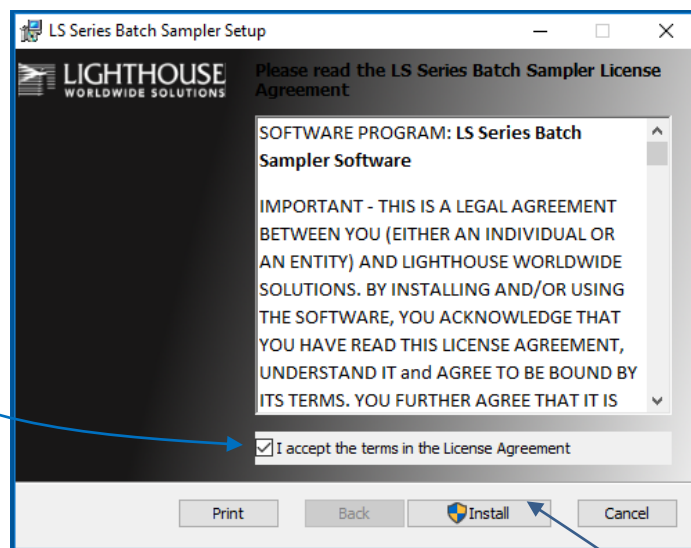
All the Liquid Sampler instrument functions are controlled by the LS Software. There are no control buttons on the instrument itself, other than the power on/off switch on the back of the instrument.

Once the user has installed the LS Software, the user can click on the LS Software desktop short-cut icon to start the software and operate the Liquid Sampler.

## LS SOFTWARE INSTALLATION (COMPUTER REQUIRED)

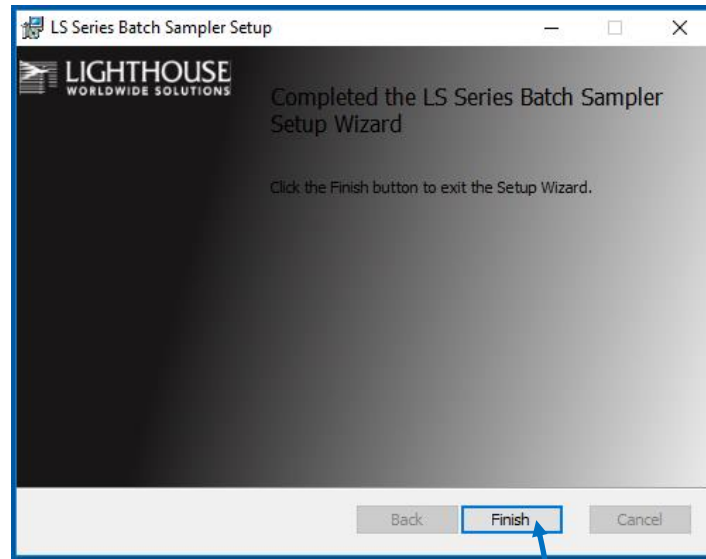
The LS Software Installer file name is **LwsLSSeriesSoftware.msi**. The file is provided on a USB key or available by download. Copy the installer file to your computer root directory and double click to install the LS Software.

Read the License Agreement and then click to accept the terms in the license agreement.



LS Software Installation Screen

Press the Install button to start installation of the LS Software.



Click the Finish button to exit the Setup Wizard.

The LS Software, by default, will be installed on the computer in the folder:

**C:\Program Files (x86)\Lighthouse Worldwide Solutions\LS Software**

Sub folders created:

- \Recipes
- \x64
- \x86

Files in LS Software root folder:

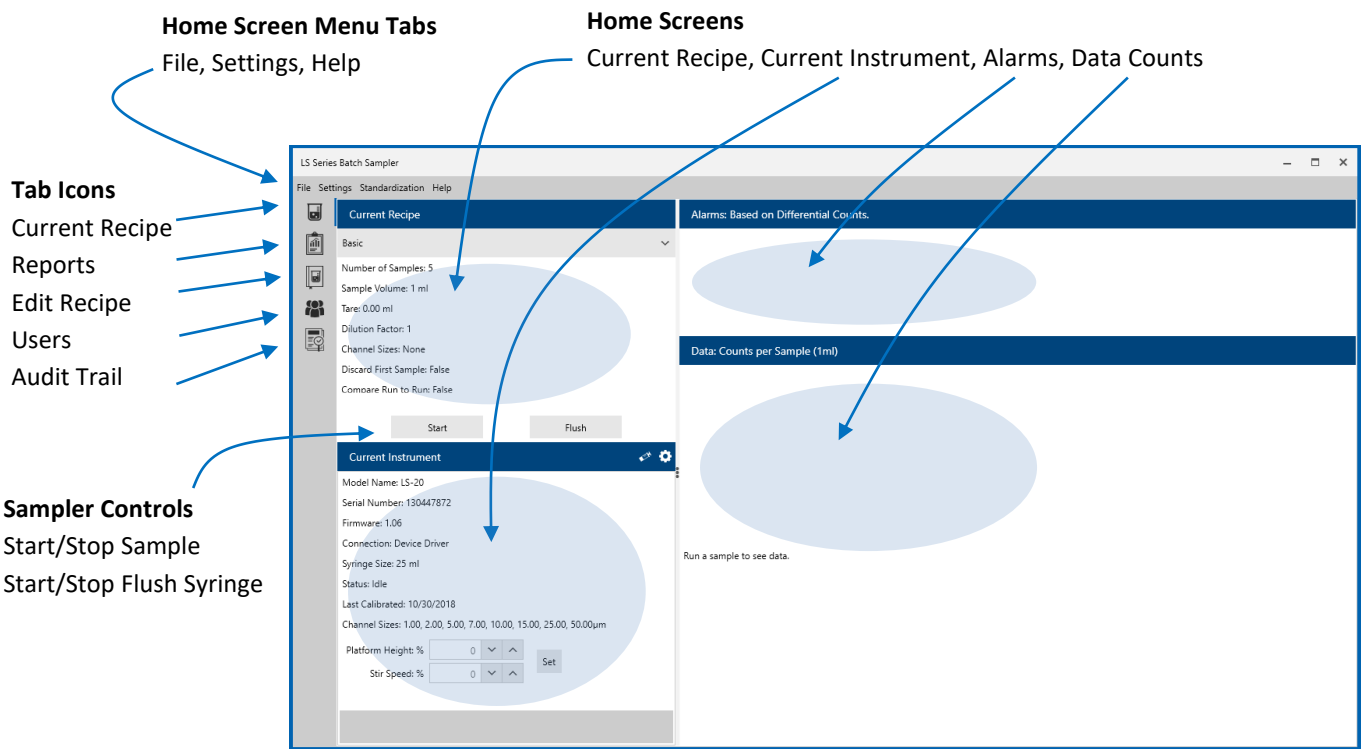
- LS20 Application
- LS20.exe
- Sqlite3.dll

## LS SOFTWARE USER INTERFACE

### HOME PAGE

The LS Software Home Page displays the current selected instrument and recipe sample settings. The Data and Alarm windows display real time particle count and threshold alarms for the current or last sampled recipe.

While running a sample recipe the Home Page will display Data Counts and Threshold alarm limits in real time.

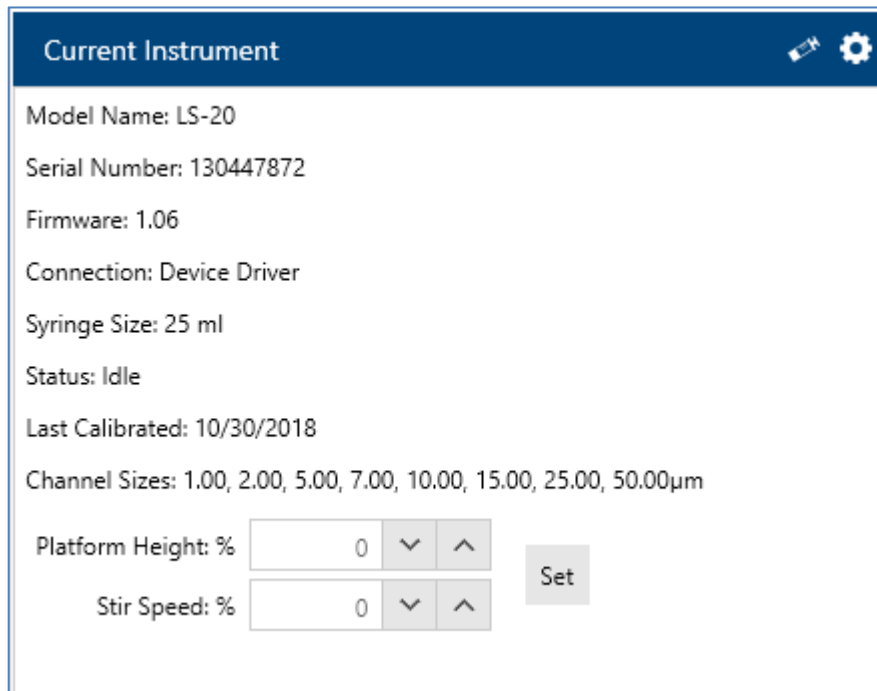


LS Software Home Page

CURRENT INSTRUMENT

The Current Instrument window allows the operator to connect to the Liquid Sampler instrument via a Serial communication.

Click on the Instrument Settings gear icon to set up a serial connection.



Current Instrument Screen

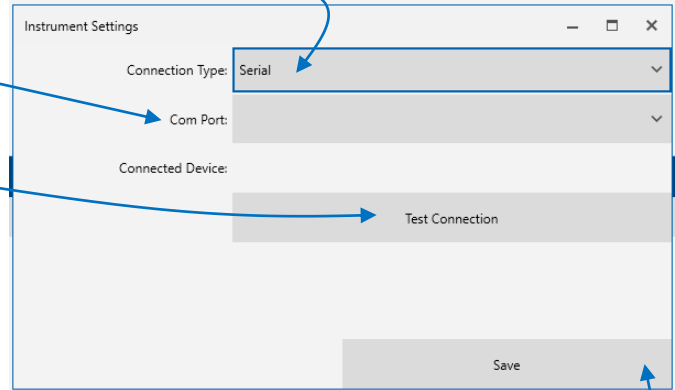
INSTRUMENT SETTINGS – SERIAL CONNECTION

Connect the instrument to the computer with the included USB to RS-232 serial communication cable.

Select Serial from the Connection Type list

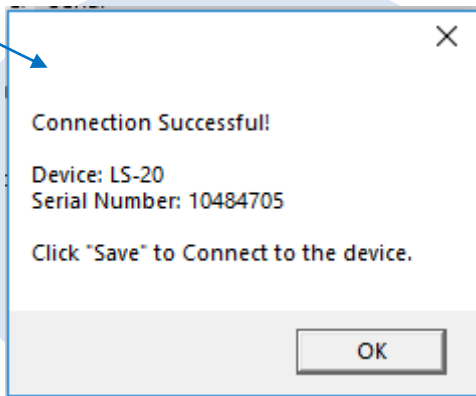
Select an available Com Port from the list.

Click on Test Connection

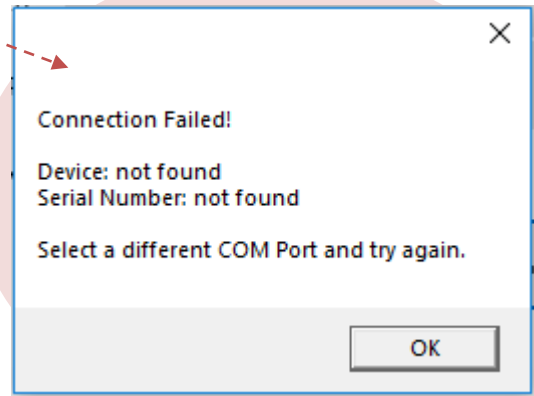


Instrument Settings Serial Set Up Screen

The LS Software will test the connection to the instrument and display a Connection Successful or Connection Failed message.



Connection Successful Message



Connection Failed Message

Click Save to save the serial connection to the instrument.

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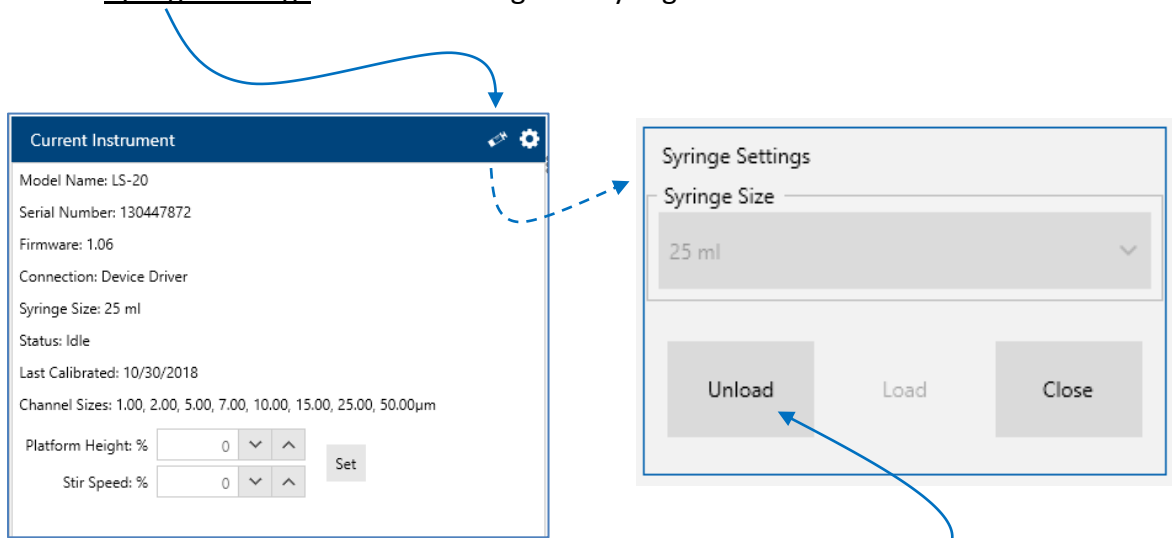


## UNLOAD SYRINGE

The Syringe Settings button allows the operator to Load and Unload the syringe.

The LS Software supports two syringe sizes; 10 ml and 25 ml.

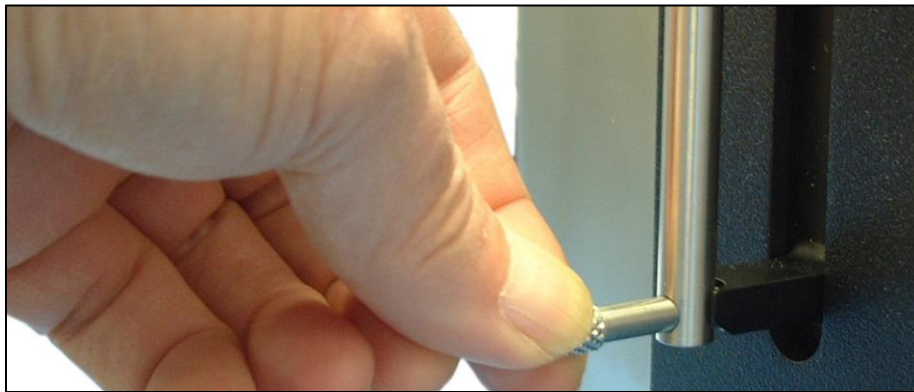
Click on the Syringe Settings button to change the syringe size.



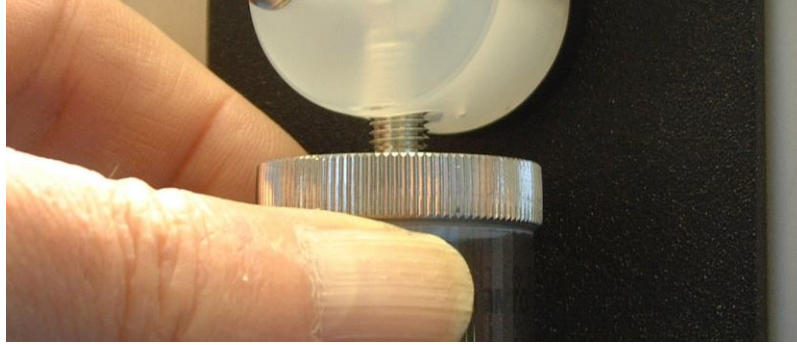
### Select Unload

Clicking on the Unload Button moves the plunger mechanism all the way to the bottom of its stroke. The bottom pin can then be removed and the syringe unscrewed from the valve.

Removing the bottom pin requires care to prevent damage to the pin's threads. When the pin has been removed from the plunger rod, the syringe body can be unscrewed from the valve.



**Removing Syringe Mounting Pin**



### Unscrewing Syringe Cylinder

Carefully unscrew the syringe cylinder from the valve body in a counter-clockwise manner. Use extreme care while doing this to prevent damage to the valve and the plunger. After removal, carefully store the syringe and plunger together in a container for safe keeping.

### LOAD SYRINGE

Reinstalling the original or installing a replacement syringe requires care to prevent damage to the valve body or syringe. A suggested procedure is to align the plunger rod in the actuator arm cradle as shown. This provides an alignment guide so the syringe will be vertical while threading it into the valve body. Threading should be relatively easy so if it feels like the syringe is binding, stop, unscrew and then try again taking extra care. A cross-threaded valve body must be replaced at the factory.



Actuator Arm Detail



Plunger Rod and Actuator Arm Detail

Installing the replacement syringe requires the same, or an even greater level of care, as is required for removal.

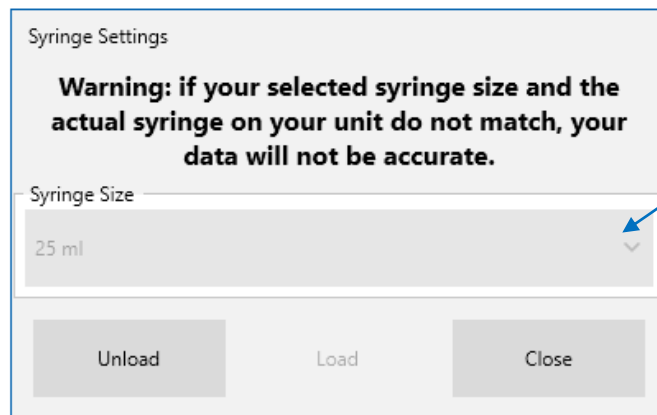


### Reinstalling Plunger Rod Pin

After the syringe has been threaded into the valve body, carefully pull and turn the plunger rod, as needed, to mate it to the actuator arm. Carefully install the attachment pin, to mate it to the actuator arm. Carefully install the attachment pin, taking care to not cross-thread it. Hand-tighten the pin and then hand-tighten the syringe. Doing this, in this order, keeps the rod and syringe in alignment.

After installing the new syringe, select the matching syringe size, 10 ml or 25 ml, from the pull down list.

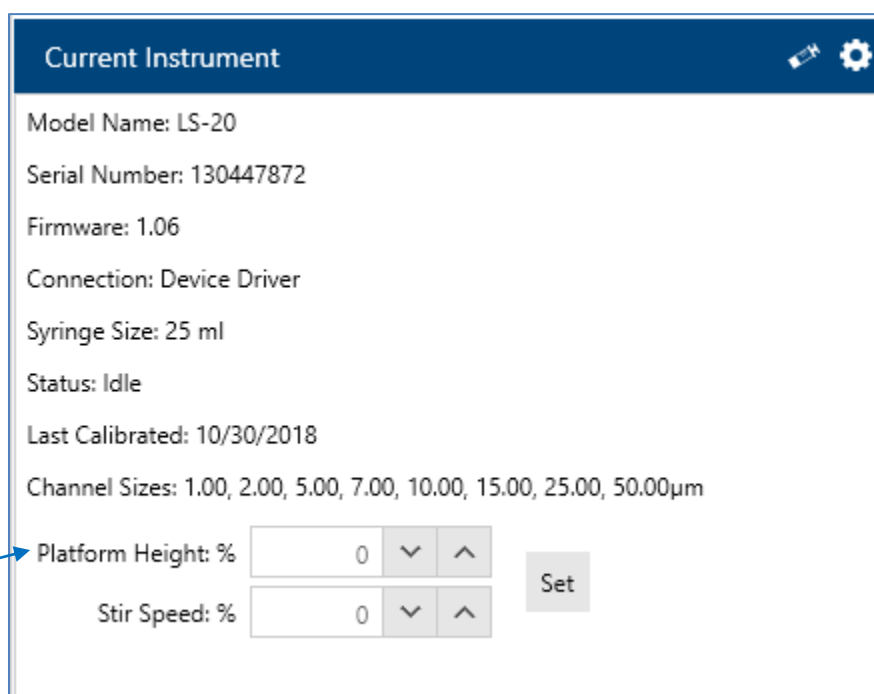
**Note:** If the syringe size saved in the LS Software does not match the actual syringe size installed then particle calculation will not be calculated accurately.



### Load Syringe Screen

#### Select Load

After successfully changing the syringe size and selecting the matching Syringe Size (10 ml / 25 ml), press the Load button. The Load button brings the plunger actuator back up to the top position. Once at the top, the syringe will go through the reset sequence of pulling down, then moving back up to zero itself.



**Current Instrument Window**

#### PLATFORM HEIGHT %

From the Current Instrument Window the user can adjust the Platform Height % in real time. After pressing the Set button the Platform Height will adjust to the new setting.

If a recipe requires a specific size beaker, the Platform Height can be set and saved in the recipe to accommodate that beaker size. When the recipe is run, the platform will raise to the saved height. When the beaker has an opaque edge guard, the LS software edge detector will sense the beaker's edge and override a platform height that could result in a shattered beaker.

#### STIRRER SPEED %

From the Current Instrument Window the user can select the Stir Speed %. After pressing Set the Stirrer will start stirring. Note below 30% the stirrer bean may not spin depending on the viscosity of the fluid.

**Note:** Platform Height and Stir Speed can also be saved in the sample settings of a recipe.

## THE SET BUTTON

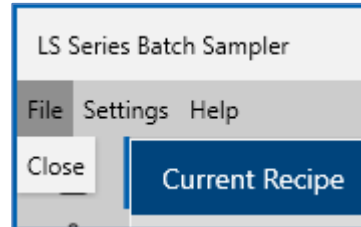
After pressing the Set button the LS platform height and stir speed will adjust to the entered settings.

Note that the Platform Height % and Stir Speed % can also be saved in a recipe's Sample Settings. When a recipe is run the platform height and stir speed will adjust to the settings from the recipe.

## MAIN MENU TABS

### FILE TAB

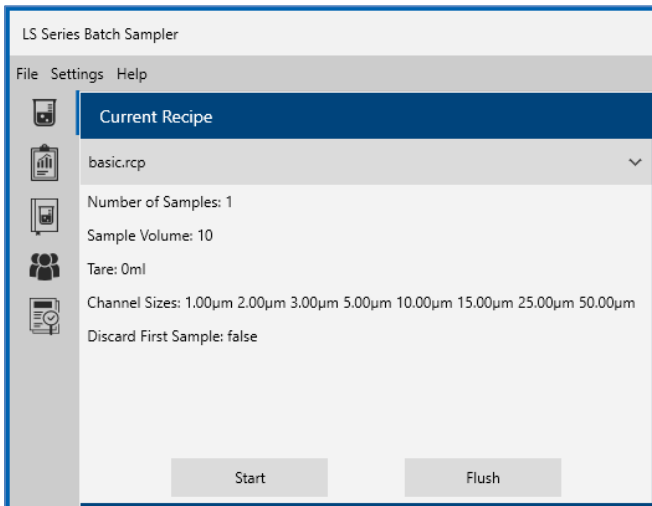
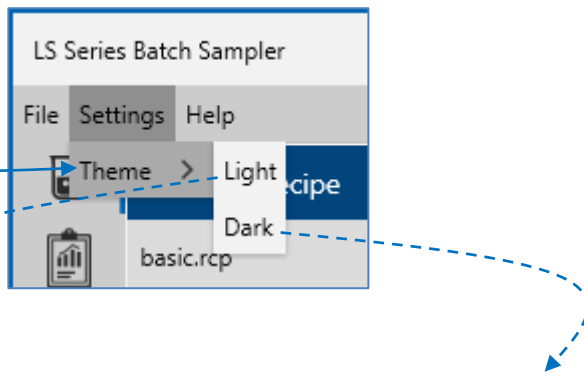
The File Tab includes the Close button.  
Press Close to shut down the LS Software.



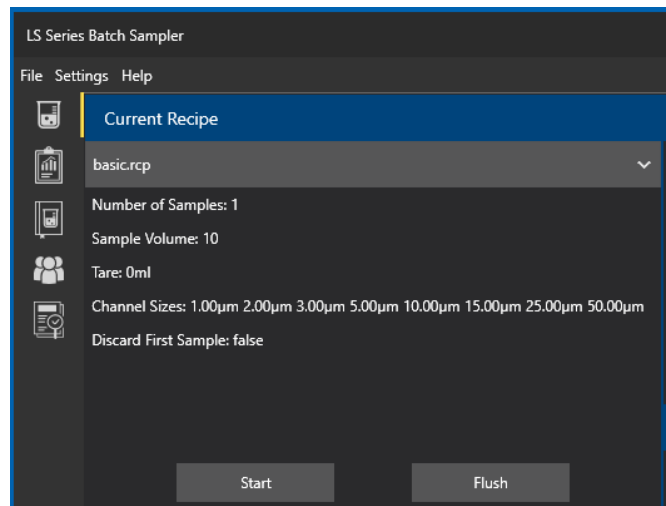
### SETTINGS TAB: THEMES LIGHT/DARK

The Settings Tab includes a Theme for Light and Dark screen back ground.

Select Light or Dark.



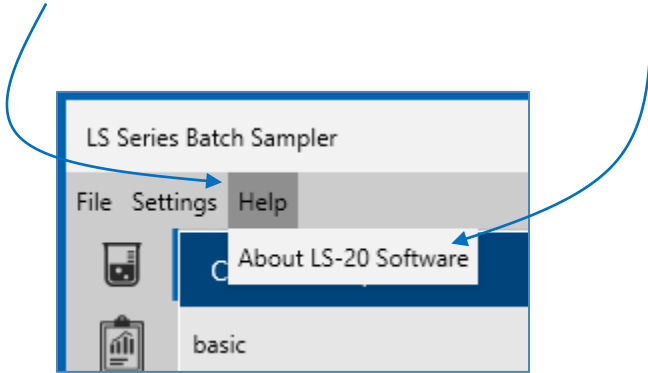
Light Theme



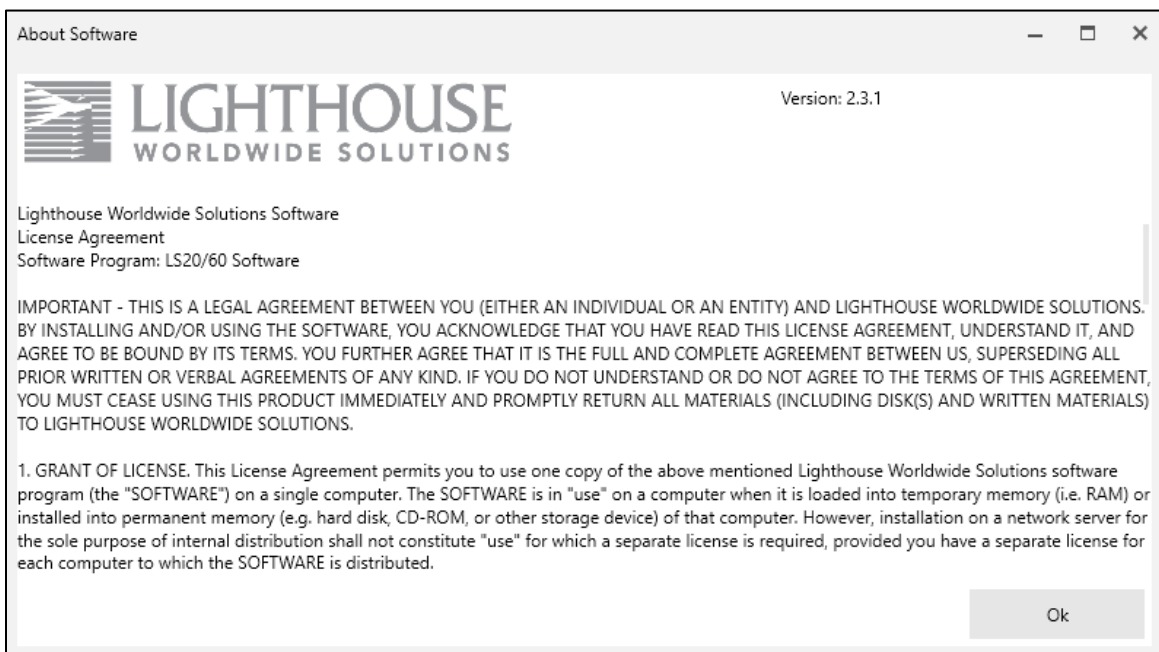
Dark Theme

## HELP TAB

The Help Tab includes information about the LS20/LS60 hardware and the LS Software. Click on the [Help Tab](#) and then click on the [About LS20 Software](#) button.



The About Software screen will display below.



### About LS Software

Clicking the Help Menu and then "About LS Software" displays the About screen. The About screen displays the version of the LS Software, its copyright date, and Lighthouse Worldwide Solution's software license agreement.



## USERS

The LS Software can operate with user accounts enabled or disabled. When user accounts are enabled the LS Software will require a login username and password to run. Additionally LS Software feature use is restricted by the User Level assigned. When user accounts are disabled no login will be required and full use of the LS Software will be available to the operator.

When the LS Software is first installed User Accounts will be disabled and LS Software can be started without any login. In this state the operator can easily set up User Accounts. To require all operators to login when they start the LS Software at least one Admin level operator must be created initially. When the Enable Users button is enabled a pop up login window will display and require an Admin level operator to login and confirm.

Each user account is assigned to one of three different User Levels: Admin, User or Maintenance. Permissions vary per user level. See the “User Level Feature Matrix” chart below for details about which features are available for Admin, User, and Maintenance level users.

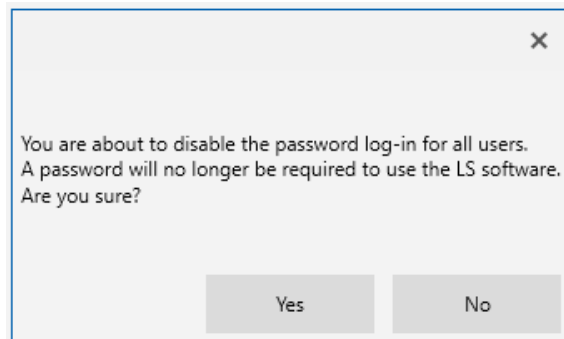
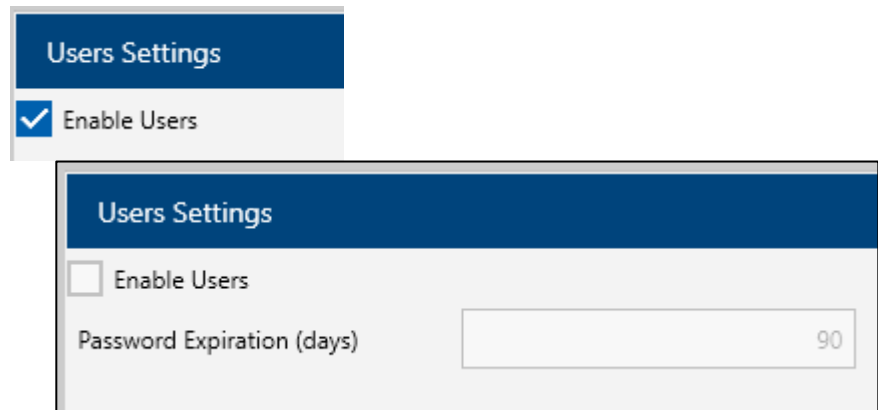
### USERS DISABLED: NO LOGIN REQUIRED

From the Users Screen:

Uncheck Enable Users  
Click on Yes to confirm.

**Note:** If Users are enabled then uncheck the “Enable Users” box and press the “Yes” button on the “Are you sure?” pop up message.

**Note:** If you have no access to the Users icon you may be logged in at only a “User” level. You will need to logout and then login as an “Admin” level user to access the Add and Edit User screens.



## USER SETTINGS

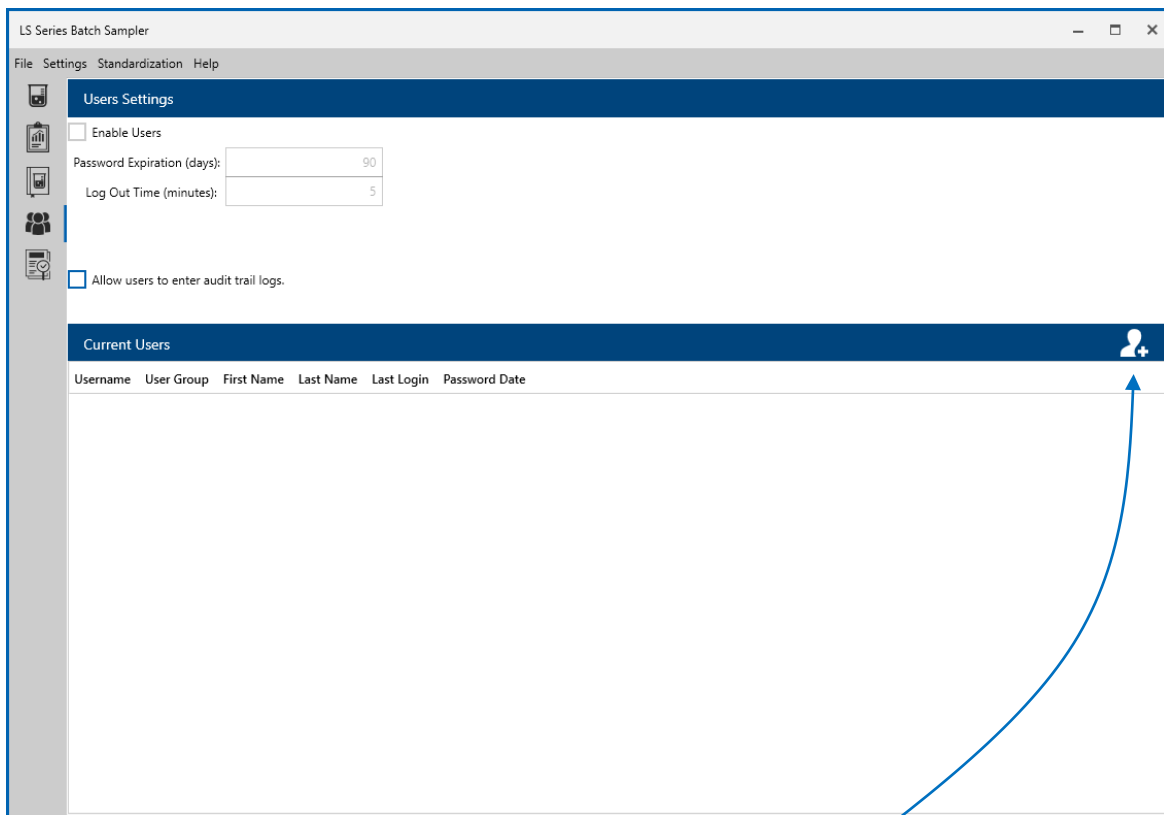
You must be logged in as an Admin level user to add, edit or delete a user account. Once logged in at the Admin user level, click on the User Icon to display the User screen. If Users are disabled then User Settings will be available to any operator of the LS Software.

### SELECT PASSWORD EXPIRATION DAYS AND LOGOUT TIMER

Enter Password Expiration days. This is the number of days after which a user must change their password. Enter 0 (zero) days to turn off password expiration.

Enter the Log Out Timer (minutes)

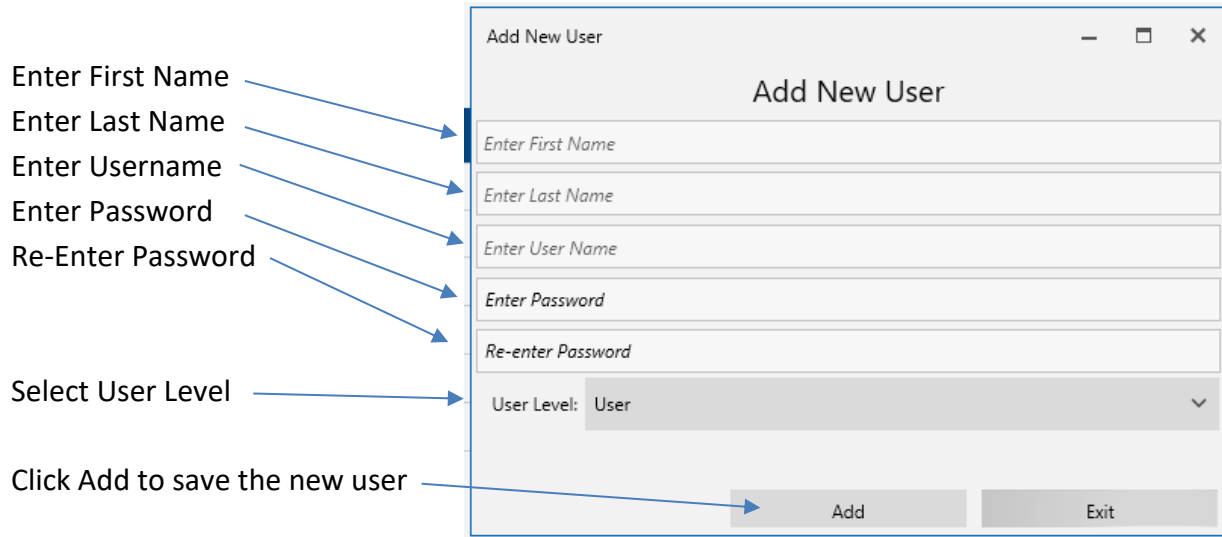
Click to enable users to enter date and time stamped Audit Trail Messages.



Click on the Add User Icon to display the Add New User screen.



**Add User Icon**



**Add New User Screen**

**USER LEVELS**

There are 3 user levels available in the LS Software system; User, Admin and Maintenance. Select User Level



**Select User Level Screen**

**USER FEATURE MATRIX**

The three User Levels can access the following LS20 Software functions.

|             | Run Recipe | Add/Edit Recipe | Reports | Edit Users | Audit Trail | Syringe Size | Standardization |
|-------------|------------|-----------------|---------|------------|-------------|--------------|-----------------|
| Users       | ✓          | -               | ✓       | -          | ✓           | -            | -               |
| Admin       | ✓          | ✓               | ✓       | ✓          | ✓           | ✓            | ✓               |
| Maintenance | ✓          | ✓               | ✓       | -          | ✓           | ✓            | ✓               |

**User Level Feature Matrix**

USERS ENABLED: LOGIN REQUIRED

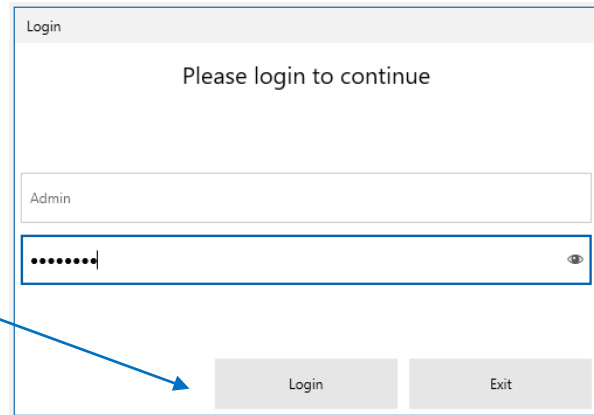
When Users are enabled and the LS Software is started it will require the user to enter a username and password. Without a valid username and password the LS Software will not run.

LOGIN "ADMIN" LEVEL USER

Enter Admin Username

Enter Password

Click on Login



When the user logs in as an Admin user, after the LS Software starts and the Home page appears, the following screen icon buttons are available on the tool bar on the left side of the window.

Admin Tabs Include:

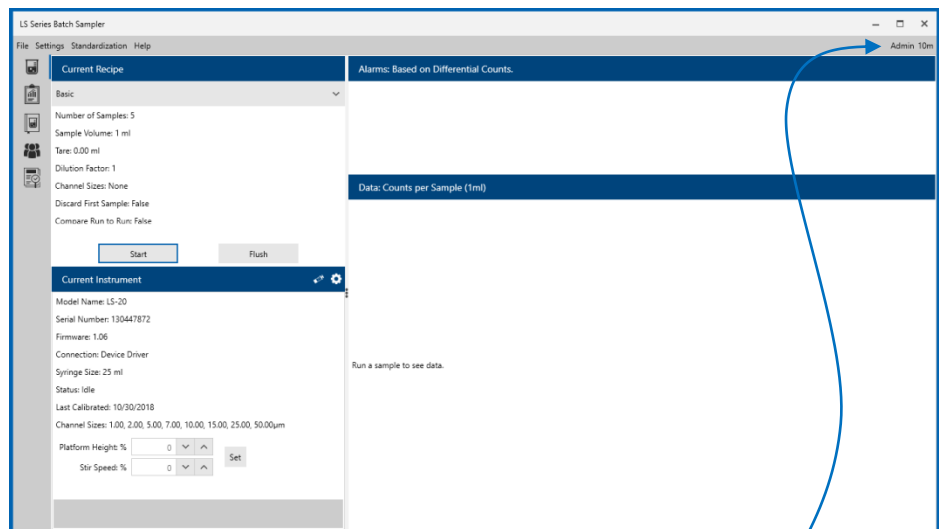
Current Recipe

Reports

Edit Recipes

Users

Audit Trail



Current Recipe Screen

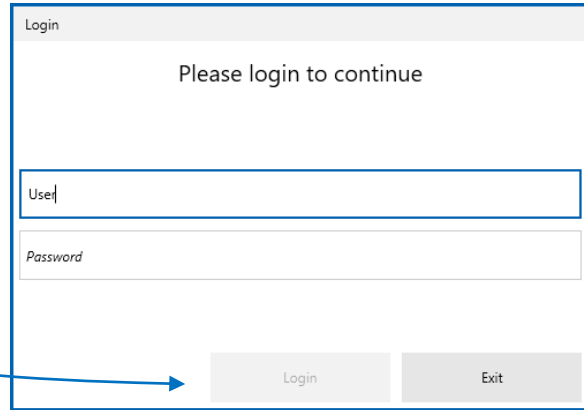
The Username and Inactivity Timer are displayed in the top right of the Home screen window.

LOGIN "USER" LEVEL USER

Enter User Username

Enter Password

Click on Login



The Home screen for User level accounts will include the following menus and icons.

Menu Tabs for the User Level include: File, Settings and Help.

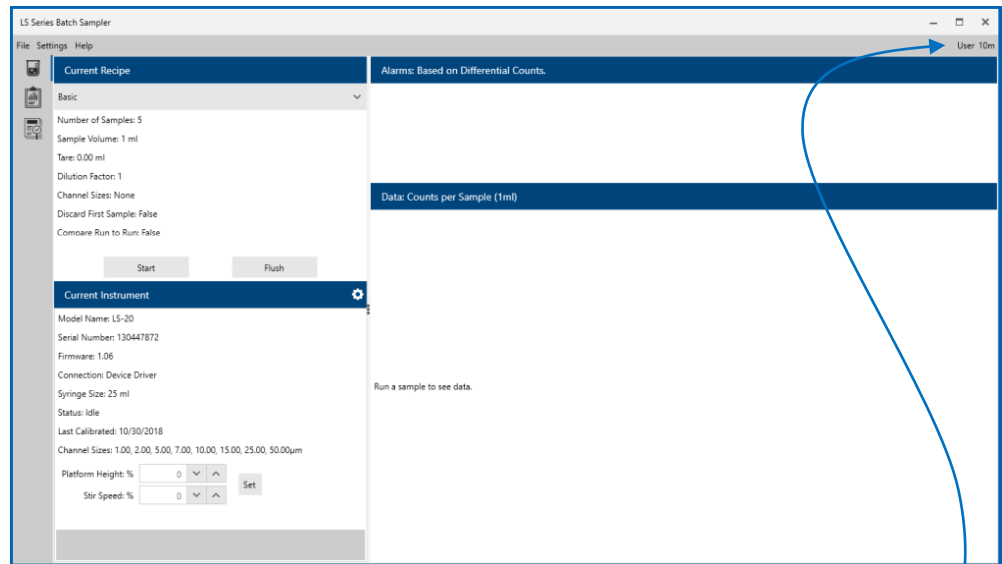
User Level Icons

Current Recipe

Reports

Audit Trail

Note: Change syringe size is not available to User level accounts.

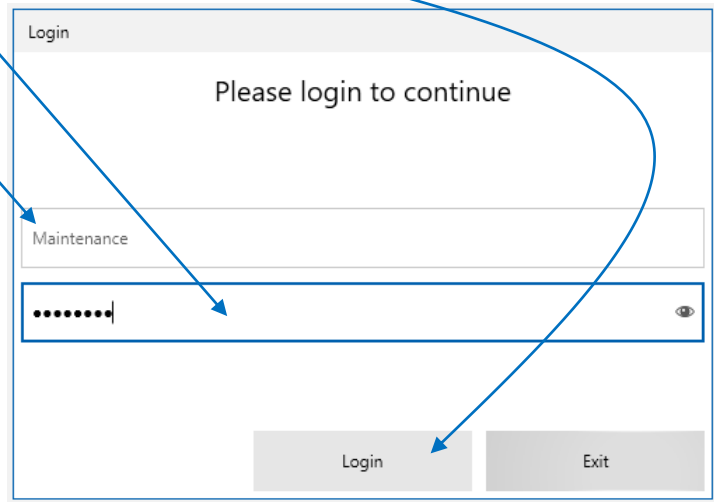


Current Recipe Screen

The Username and Inactivity Timer are displayed in the top right corner of the Home screen.

LOGIN "MAINTENANCE" LEVEL USER

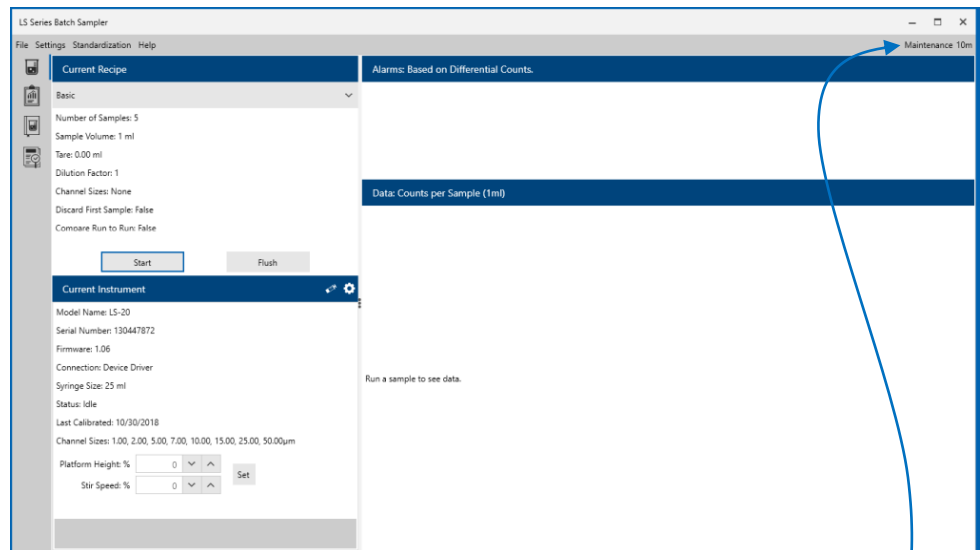
Enter Maintenance Username, Password and press Login.



For Maintenance level user accounts the Home screen will include icons for Current Recipe, Reports and Audit Trail. Note that the Edit Recipe and User icons are not available to the User group level. When the user logs in at the Maintenance level the following menu tabs appear.

Menu Tabs: File, Settings, Standardization and Help.

- Maintenance
- Screen Icons
- Sample
- Reports
- Edit Recipe
- Audit Trail



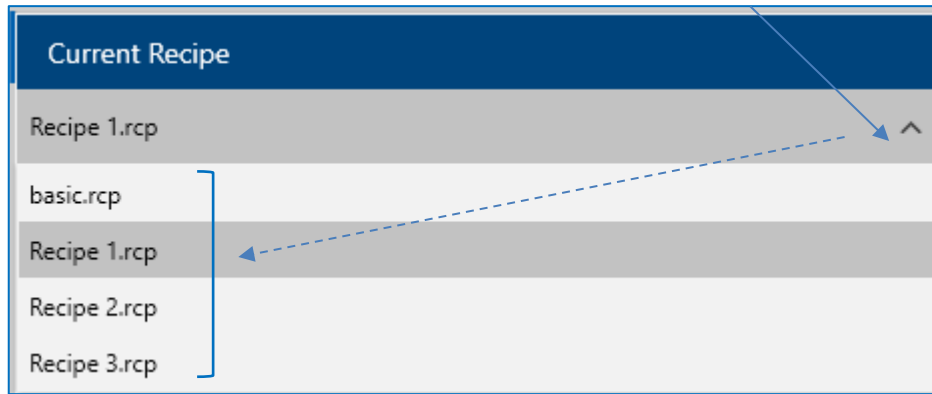
Home Screen – Maintenance Level

The Username and Inactivity Timer are displayed in the top right corner of the Home Page.

**CURRENT RECIPE SCREEN**

Click on the Current Recipe pull down list to view a list of all saved recipe file names.

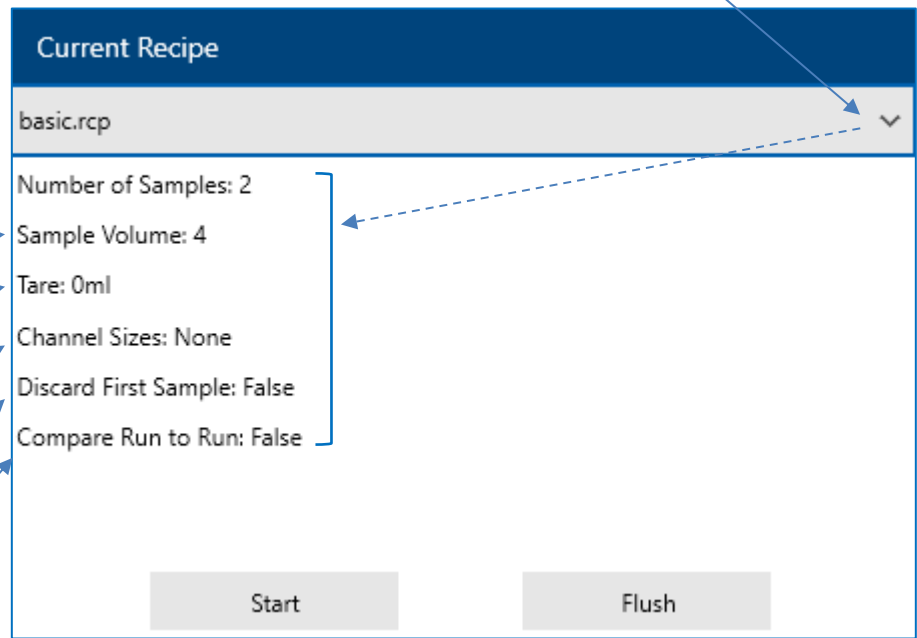
**Note:** Recipe files can be found in the LS Software root directory folder named "Recipes".



Click on a recipe in the list to select it. The recipe's main settings will be displayed below the recipe's name in the Current Recipe window.

**Recipe Settings**

- Number of Samples (integer)
- Sample Volume: (ml)
- Tare: (ml)
- Channel Sizes: (µm)
- Discard First Sample:
- Compare Run to Run:



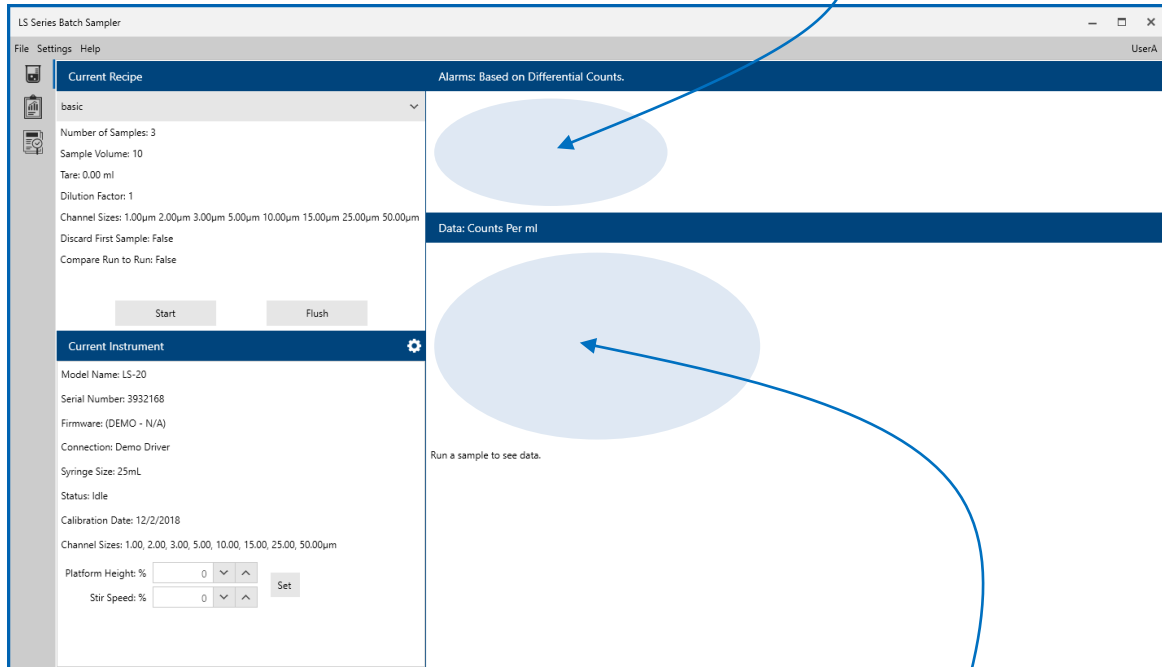
**Current Recipe**

If customized recipe channel sizes have been saved in the recipe, a warning message will be displayed on the screen:

“Warning! Recipe particle sizes DO NOT match device particle sizes”.

## ALARMS SCREEN

When the user clicks the “Start” button and runs a recipe, if the recipe includes enabled alarm thresholds, the status of the alarm limits will be displayed in the “Alarms” section of the Home screen.



## DATA SCREEN

When a recipe sample is running, data counts will be displayed in the “Data:” section of the Home screen. No data will be displayed in the Data screen region until after a sample has been run. Selecting a Recipe will not display data. Only after running a sample will data be displayed on the screen Date in the Data section of the screen.



## TAKING A SAMPLE

### RUNNING A SAMPLE

After the LS20 system is readied for operation, the LS Software is started and a recipe is selected, prepare a sample to be run.

To prepare a sample, use the supplied Pyrex glassware or a comparable container. Make sure that the top edge of the beaker or container has light-blocking material added on to it so that the LS20's sensors can detect where the top edge of the container is.

Place the LS20's stirrer into the sample and place sample tube into the container. Put the container onto the LS20's sample platform. If the end of the tube is not fully submerged in the liquid in the container, use the LS Software to raise the LS20's platform height so that the tube is fully submerged in the liquid to be sampled.

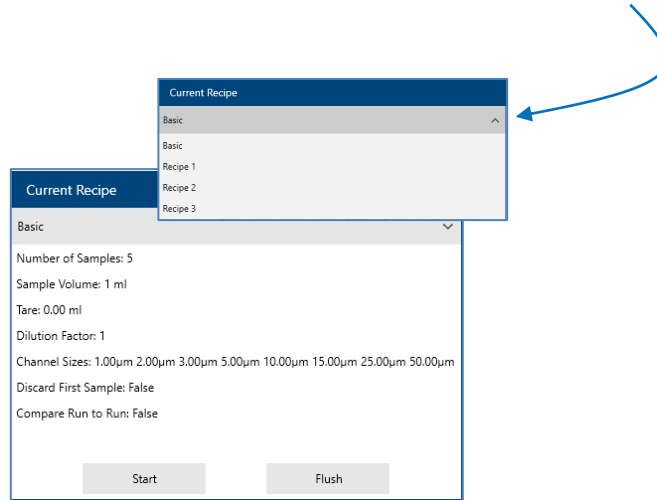
If a stirrer speed is not saved in the recipe, move the Stirrer Speed slider to a desired position. Make sure the speed of the stirrer does not create bubbles or excessive turbulence.

Click the Start button in the LS Software to start running the recipe.

When the entire recipe's sample(s) are completed, a confirmation box will appear. The data can be reviewed on the screen.

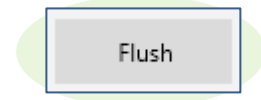
## START RECIPE SAMPLE

In the LS Software, select a Recipe from the Current Recipe Screen pull down list.



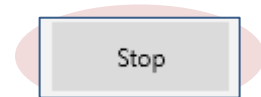
## FLUSH BUTTON

Press the Flush Button to initiate flushing of the syringe. →



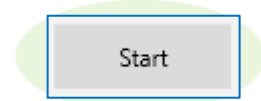
Note: The syringe will flush continuously until stopped by the user.

Press the Stop button to stop the flushing of the syringe. →

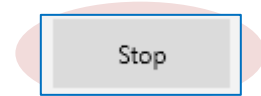


## START / STOP BUTTON

Press the Start button to start sampling the selected recipe.



*Or Press the Stop button to stop sampling the current recipe.*



WHILE THE SAMPLE IS RUNNING

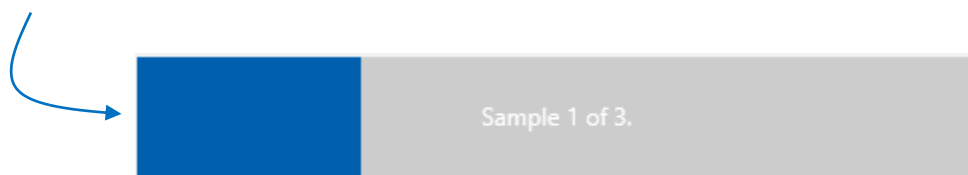
If thresholds are enabled, alarm data will display in the Alarms screen.

The screenshot displays the 'Alarms: Based on Cumulative Counts.' screen. It features an alarm message for channel 5: '10.00µm value of 133 is Over the limit of 100'. Below the alarm is a histogram titled 'Data: Counts per Sample (1ml)' showing cumulative counts for various particle sizes. The x-axis ranges from 1.00µm to 50.00µm, and the y-axis ranges from 0 to 1600. The highest count is at 1.00µm, with approximately 1400 counts. Below the histogram is a table of samples with columns for Date, Time, and particle sizes (1.00µm, 2.00µm, 3.00µm, 5.00µm, 10.00µm, 15.00µm, 25.00µm, 50.00µm). The table includes five rows of sample data and a summary row for averages and totals.

| Samples    |             | 1.00µm   | 2.00µm   | 3.00µm | 5.00µm | 10.00µm | 15.00µm | 25.00µm | 50.00µm |
|------------|-------------|----------|----------|--------|--------|---------|---------|---------|---------|
| 10/17/2018 | 11:19:02 AM | 1,407    | 337      | 75     | 46     | 27      | 17      | 6       | 0       |
| 10/17/2018 | 11:19:03 AM | 1,368    | 312      | 70     | 43     | 26      | 16      | 5       | 0       |
| 10/17/2018 | 11:19:03 AM | 1,372    | 314      | 71     | 43     | 26      | 16      | 5       | 0       |
| 10/17/2018 | 11:19:04 AM | 1,397    | 331      | 74     | 45     | 27      | 16      | 6       | 0       |
| 10/17/2018 | 11:19:05 AM | 1,401    | 334      | 74     | 45     | 27      | 16      | 6       | 0       |
| Avg:       |             | 1,389.00 | 325.60   | 72.80  | 44.40  | 26.60   | 16.20   | 5.60    | 0.00    |
| Sum:       |             | 6,945.00 | 1,628.00 | 364.00 | 222.00 | 133.00  | 81.00   | 28.00   | 0.00    |

Home Screen while sampling

The Sample Status Bar will display Sample (Current) of (Total).



Sample Status Bar



When the recipe sampling has completed a Report file will be created and saved in the LS Software folder named "Reports". Select the Report Icon to display the Reports Screen. Select the most recent report to view samples that were just run.

Blank Page

## RECIPES

The LS Software saves sample settings as Recipes in its database. Recipes store the batch liquid sample settings; report settings, channel sizes, threshold and alarm settings necessary to run the desired batch sample. Recipes can be exported to a .RCP file and saved on a local hard drive or USB key. Additionally Recipes can be imported into the LS Software from a .RCP file on a local hard drive or USB key.

The LS Software installs with the following 9 recipe standards:

### STANDARD RECIPES

#### **USP** – United States Pharmacopeia

- USP33\_Environment.rcp
- USP33\_Test 1A.rcp
- USP33\_Test 1B.rcp

#### **EP** – European Pharmacopeia

- EP\_Environment.rcp
- EP\_Test\_1A.rcp
- EP\_Test\_1B.rcp

#### **JP** – Japanese Pharmacopeia

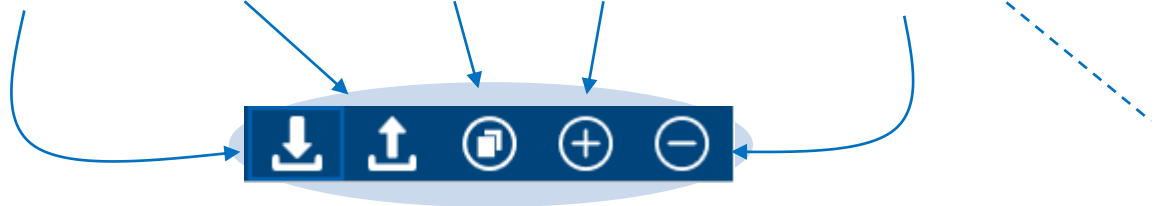
- JP\_Environment.rcp
- JP\_Test\_1A.rcp
- JP\_Test\_1B.rcp

**BASIC RECIPE**

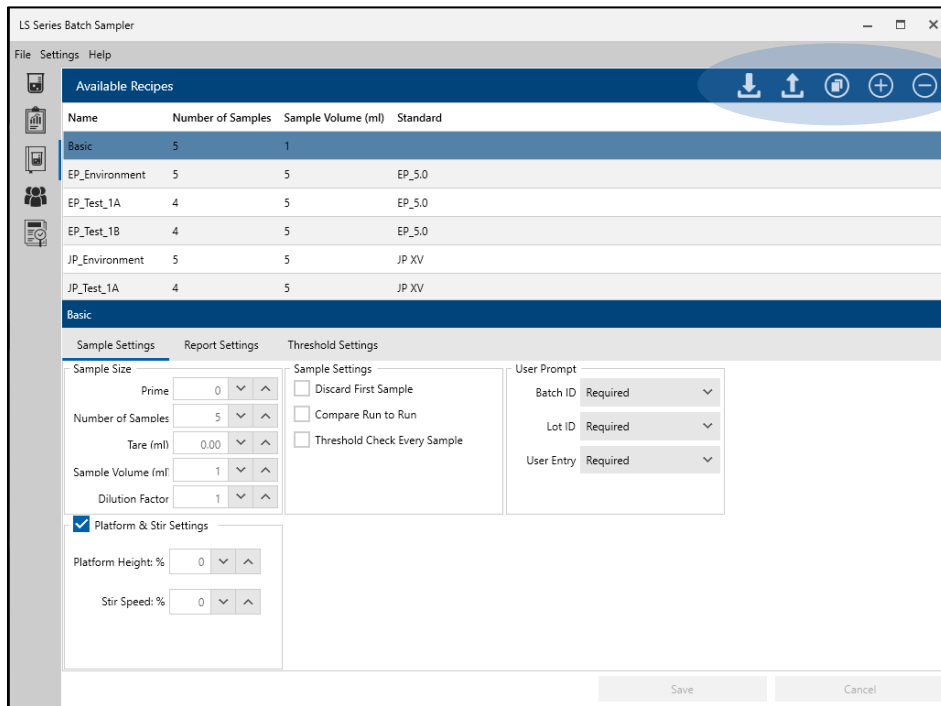
The LS Software is initially installed with a default recipe file named Basic (basic.rcp).

The LS Software allows the user to;

**Import Recipe, Export Recipe, Clone Recipe - Create New Recipe - Delete Recipe**



**Import, Export, Clone, Add, or Delete Recipe**



**Recipe Screen**

All recipe files will be saved in the LS Software Database. Exported recipe files can be saved on your local hard drive folder with a .rcp file extension. To Edit a Recipe, the user must be logged in as an Admin group level user, or Enable Users must be disabled from the Users screen. User level login will only allow the user to run a recipe but not to edit the recipe sample settings.

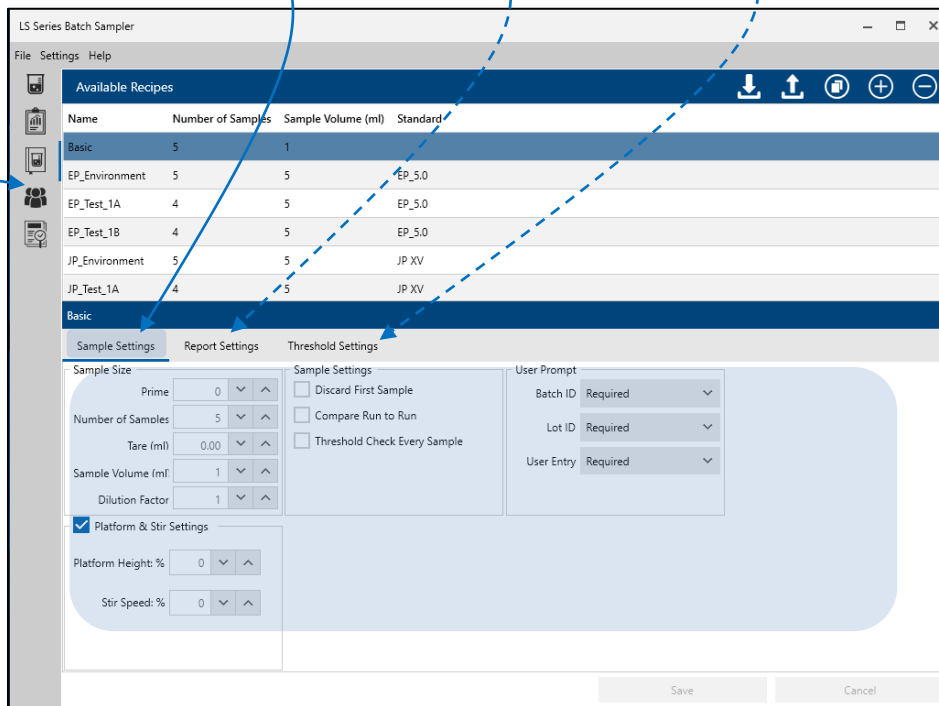
EDIT A RECIPE



To edit a recipe, click the Edit Recipes icon button on the toolbar on the left side of the screen. Then select a recipe from the list of recipes shown in the top section of the screen.

The selected recipe's settings are displayed on 3 menu tabs:

Sample Settings - Report Settings - Threshold Settings

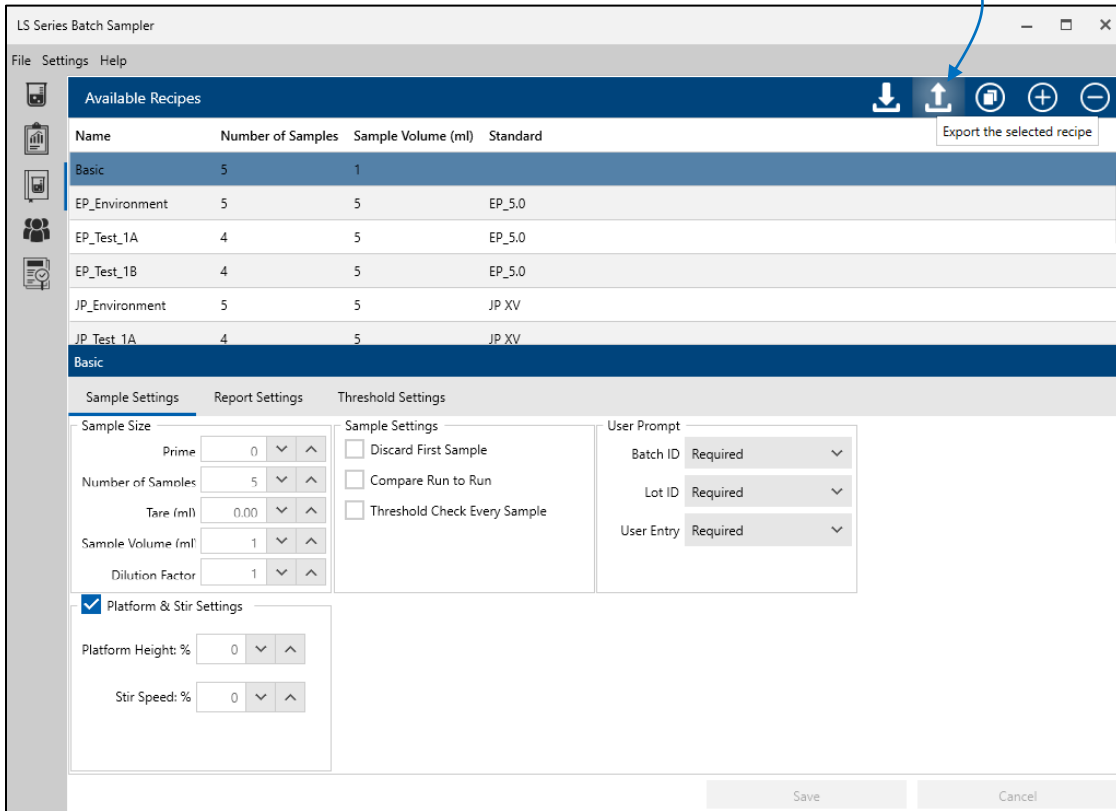


**Recipe Sample Settings Screen**

Click on the corresponding tab and edit the Sample, Report and Threshold Setting inputs. See chapters: *Recipe Sample Settings*, *Recipe Report Settings*, and *Recipe Threshold Settings*.

EXPORT A RECIPE

Select a recipe and that recipe will highlight blue indicating it has been selected. Select the Export button to export the highlighted recipe.



After selecting the Export button your computer File Save window will pop up to allow you to name and save your exported .rcp file to a connected hard drive or USB key.

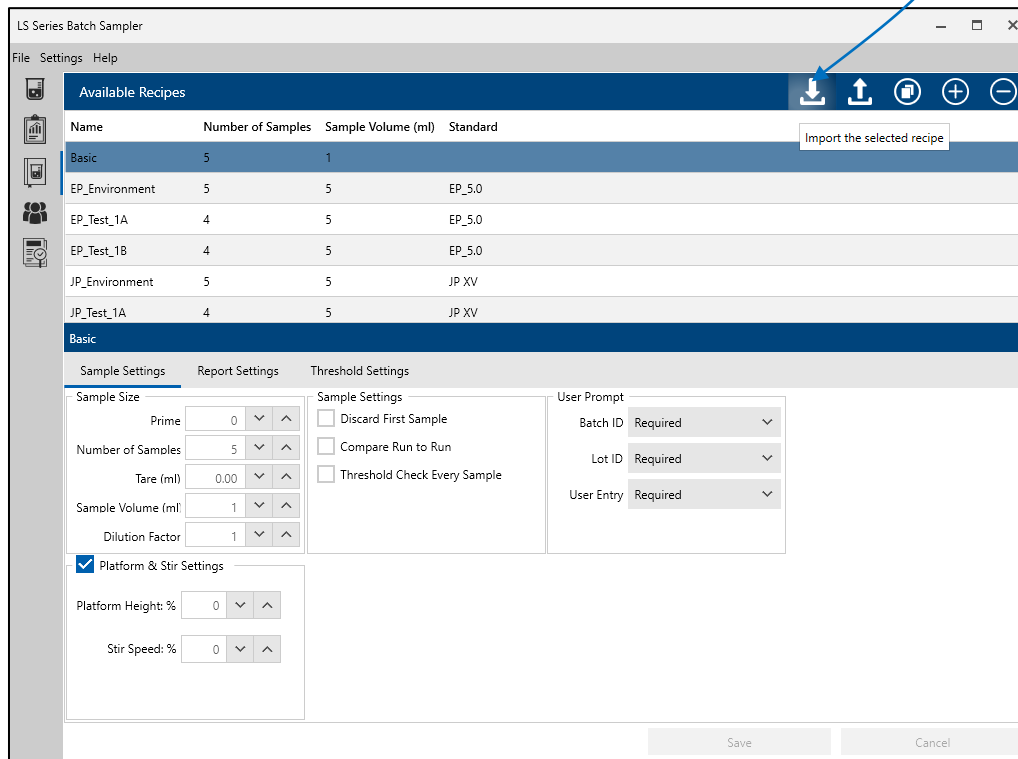
Save the exported recipe file (.rcp) on your hard drive or a connected USB key.

This exported recipe file can be imported into the LS Software system on any other computer.



## IMPORT A RECIPE

To import a recipe into the LS Software database select the import button.



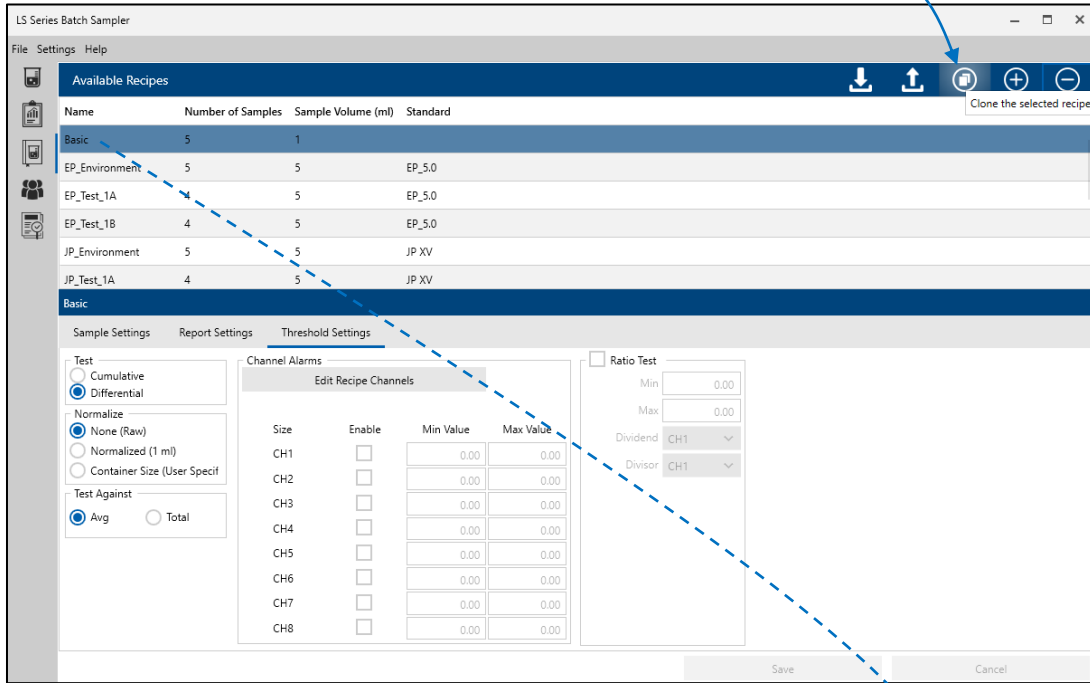
After selecting the Import button your computer File Open window will pop up to allow you to select the .rcp file from any connected hard drive or attached USB key.

Find and Select the Recipe file (.rcp) you wish to import in the LS Software.

Press the Open button and the selected recipe will be imported and displayed on the Available Recipes screen.

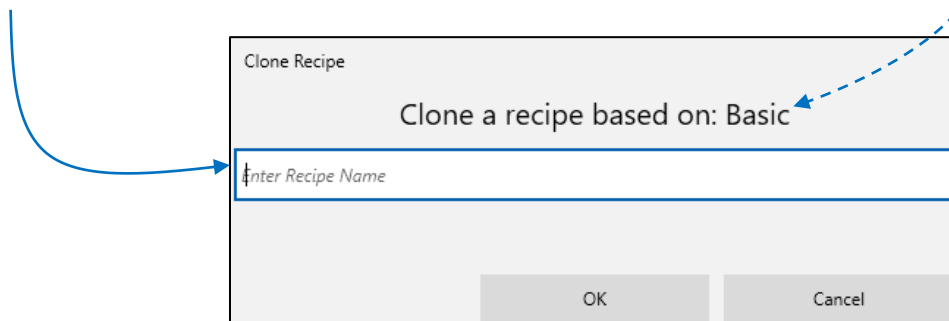
**CLONE A RECIPE**

Click the “Clone the selected recipe” button to name and make a copy of the currently selected recipe.



**Recipe Screen**

Enter the new recipe name and press the Okay button.

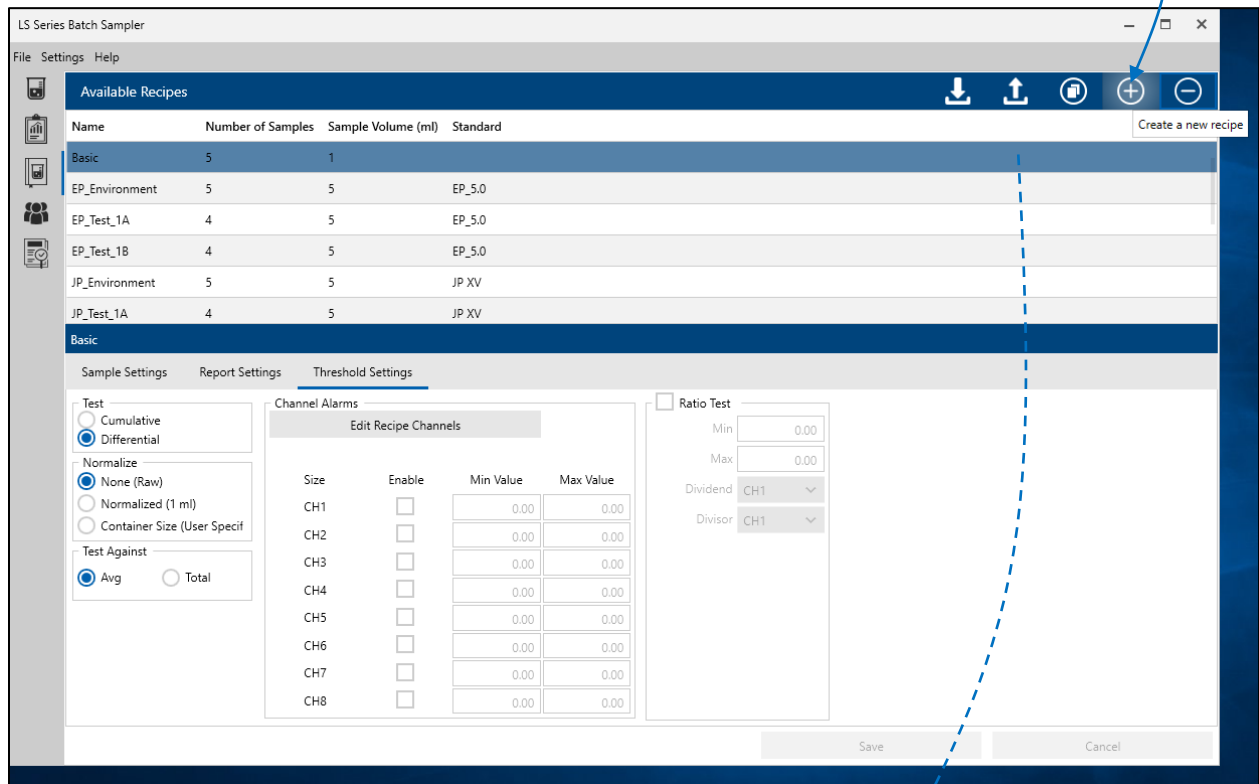


**Clone a recipe**

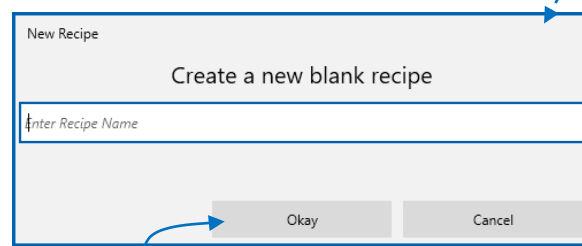
Click on the corresponding tab and edit the Sample, Report and Threshold Setting inputs. See chapters: *Recipe Sample Settings*, *Recipe Report Settings*, *Recipe Threshold Settings*.

ADD A NEW RECIPE

Click the “Create a new recipe” button to add a new blank recipe.



Recipe Sample Settings



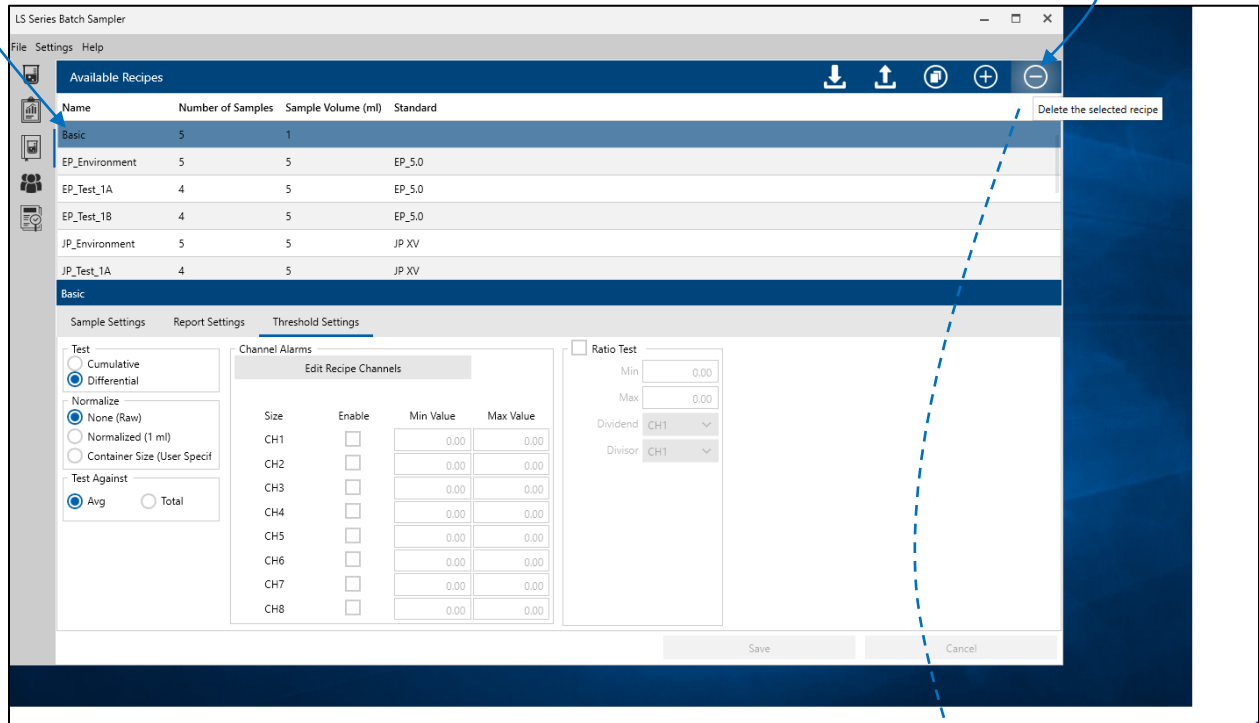
Enter a new recipe name and click Okay. After entering a new recipe name and pressing Okay, the new recipe will be highlighted as the current recipe. The new recipe can now be edited and customized for Sample, Report and Threshold settings.

Note: you cannot rename a recipe. You can only clone add or delete a recipe.

## DELETE A RECIPE

Select the recipe name to be deleted and it will highlight blue indicating it has been selected.

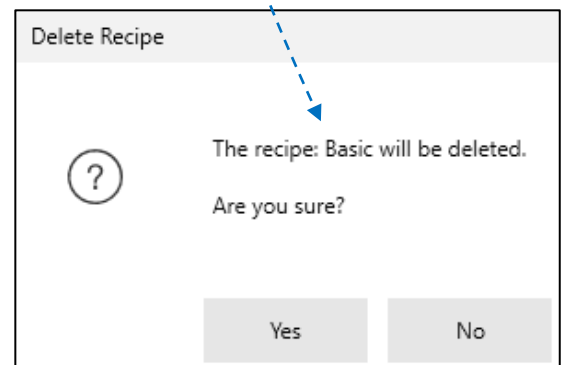
Click on the Delete button to delete the highlighted recipe.



Recipe Screen

### Delete Recipe Confirmation Message

Press Yes to confirm and delete the recipe or press No to cancel.

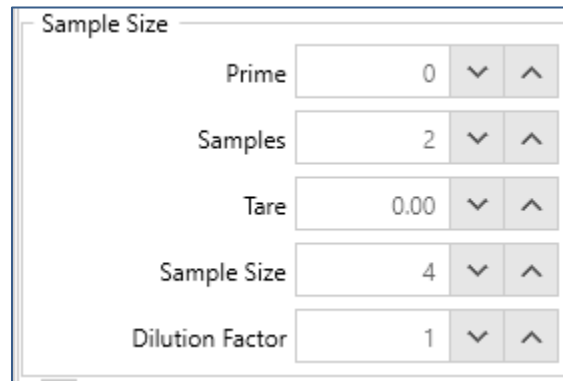


## RECIPE SAMPLE SETTINGS

To edit a recipe, click the Edit Recipes icon button on the toolbar on the left side of the screen, and select a recipe from the list of recipes shown in the top section of the screen.

The selected recipe's saved settings will be displayed on the Sample Settings, Report Settings, and Threshold Settings tabs in the lower section of the Edit Recipes screen.

Note, to edit a recipe, the user must be logged in as an Admin user, or user logins must be disabled.



| Sample Size     |      |     |
|-----------------|------|-----|
| Prime           | 0    | ▼ ▲ |
| Samples         | 2    | ▼ ▲ |
| Tare            | 0.00 | ▼ ▲ |
| Sample Size     | 4    | ▼ ▲ |
| Dilution Factor | 1    | ▼ ▲ |

### Sample Settings

#### PRIME

The Prime field sets the quantity of liquid (in ml) to run through the sensor and discard before starting samples. This clears air bubbles from the sensor and is also intended to purge the sensor of residue left from previous sample. If the LS20's input tube is less than 10 inches long, a Prime value of 1.0 ml is sufficient to clear the previous sample from the instrument.

The Prime value should be set to 0 (zero) when DISCARD FIRST SAMPLE is enabled. The Prime amount is added to the beginning of each run, during which counting does not take place.

#### SAMPLES

Enter the number of samples to be taken during the test cycle of the recipe.

#### TARE

The TARE button allows the user to change the LS software's internal default of 0.2 ml. Tare should not be changed unless instructed by Lighthouse Technical Support. TARE is added to each syringe cycle. The TARE volume is ignored and not counted at the beginning of every syringe of liquid.

**SAMPLE SIZE**

This Sample Size field allows the user to change the volume of the sample, in ml, from the default value of 4 ml. Counting takes place on this volume of liquid.

**DILUTION FACTOR**

The Dilution Factor field allows the user to set the ratio of fluid added to the sample for dilution. Values from 1 to 99.99 may be used. A Dilution Factor of '1' means the sample has not been diluted. A dilution factor of 2 means the sample has been diluted in half. With a dilution factor of N the expected fluid dilution will be  $1/N^{\text{th}}$ .

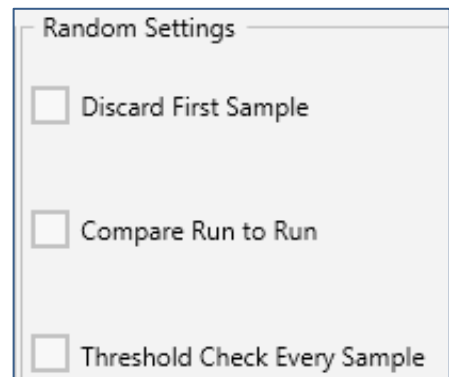
| <b>Dilution Factor</b> | <b>N</b>          | <b>1</b> | <b>2</b>      | <b>5</b>          | <b>10</b>          |
|------------------------|-------------------|----------|---------------|-------------------|--------------------|
| Fluid Dilution         | $1/N^{\text{th}}$ | 0        | $\frac{1}{2}$ | $1/5^{\text{th}}$ | $1/10^{\text{th}}$ |

Dilution Factor Fluid Dilution Calculation Matrix

**DISCARD FIRST SAMPLE**

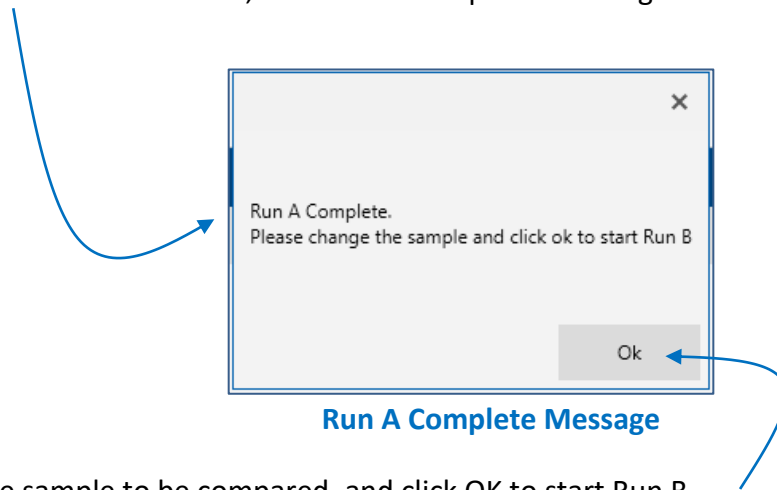
When Discard First Sample is enabled and saved in a recipe, the LS Software will discard the first sample data that is sampled from the Recipe.

The Prime value should be set to 0 (zero) when Discard First Sample is enabled.



## COMPARE RUN TO RUN

Enabling Compare Run To Run enables a Run-to-Run comparison of the data. After all samples are complete for the first run, the “Run A Complete” message will be displayed.



Change the sample to be compared, and click OK to start Run B.

The Recipe sampling will repeat for Run B. The Alarm Screen, Data Screen and Status Bar will display and append Run B results.

After Run B completes the Report (yyyy-mm-dd-hh-mm-ss.pdf) file will be created and will include comparisons of Run A to Run B.

## THRESHOLD CHECK EVERY SAMPLE

When Threshold Check Every Sample is enabled, the sensor alarm thresholds are checked after each sample's counts have been read and processed.

If the sample's data exceeds the recipe's set thresholds, alarms will be displayed on the Alarms screen after each sample is completed.

USER PROMPT FOR BATCH ID, LOT ID, USER ENTRY

When a recipe is run, the user will be prompted to enter the Batch ID, Lot ID, and User Entry comments. These can be set as Optional, Required or Not Available in the User Prompt section of the Available Recipes screen.

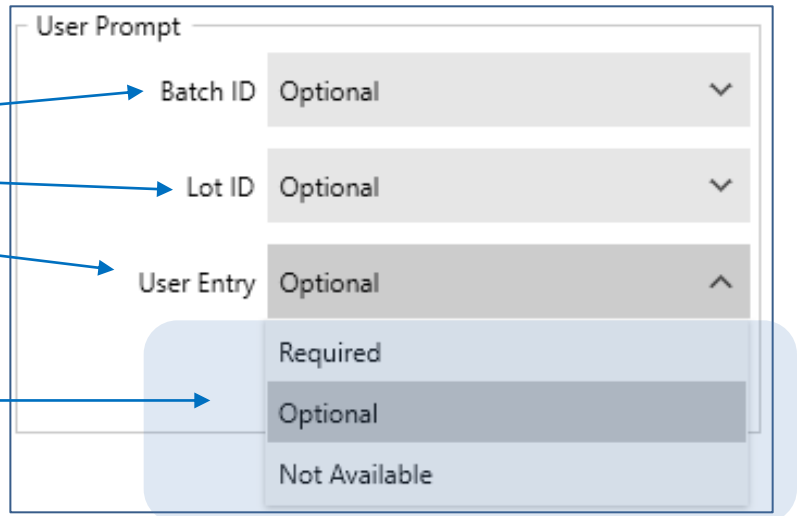
Prompts set to “Required” must be entered by the user when the recipe is run. Prompts set to “Optional” will be available for the user to enter a value but not required. If a prompt is set to “Not Available” the field will not be displayed when the user starts the recipe.

User Prompted Fields available:

- Batch ID
- Lot ID
- User Entry

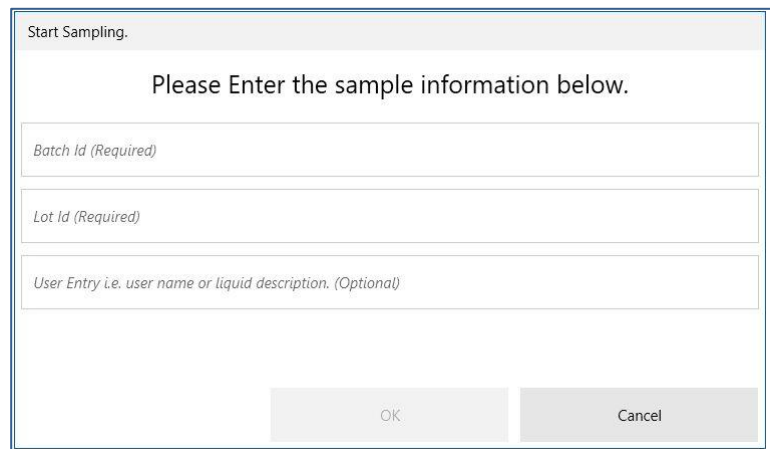
Select:

Required, Optional, or Not Available



User Prompt Input Screen for Recipes

Example: When a recipe is started, the user may be prompted to enter one or more values. This recipe requires that the user enter a Batch ID and a Lot ID, but gives the user the option to enter, or not enter text in the User Entry field.



User Prompt Screen When Sampling



## LS20 Settings

LS-20 Settings

Platform Height: % 0 ↓ ↑

Stir Speed: % 0 ↓ ↑

### PLATFORM HEIGHT %

The LS20 platform height can be adjusted to fit your beaker size and tubing length. The sample intake tube must be situated below the surface of the liquid in order to sample the liquid. The LS20's platform height % can be set and saved in a recipe to accommodate your beaker size. When the recipe is run, the platform will raise or lower to the saved recipe height.

### Edge Guard

The LS20 instrument has an edge guard detector and will prevent crushing your glass beaker if the platform is raised too high. To protect against the risk of crushing the glass beaker keep an opaque edge guard on your sample beaker when in use with the LS20. If the platform height is set too high it will be stopped when the edge detector senses the top of the rising beaker.

### STIRRER SPEED

If the sample liquid in the beaker needs to be stirred, the user can select a Stir Speed % and save on the Current Instrument section of the LS Software screen. After pressing the Set button next to the Stir Speed field, the LS20's Stirrer will start stirring.

Note: Stirrer Speed can also be set and saved in the Sample Settings of a Recipe.

Blank Page

## RECIPE REPORT SETTINGS

To edit a recipe's report settings, click the Edit Recipes icon button on the toolbar on the left side of the screen, and select a recipe from the list of recipes shown in the top section of the screen. The selected recipe's saved settings will be displayed on the Sample Settings, Report Settings, and Threshold Settings tabs in the lower section of the Edit Recipes screen.

Note, to edit a recipe, the user must be logged in as an Admin user, or user logins must be disabled.

### Recipe: Report Settings

Enable Histograms and Data Tables for Cumulative and/or Differential Counts. These will be displayed on screen and saved to the sample report.

Enable Alarm Information to display any alarm data on the screen and save to the report.

Enable End of Run Data to display the end of run data on the screen and saved to the report.

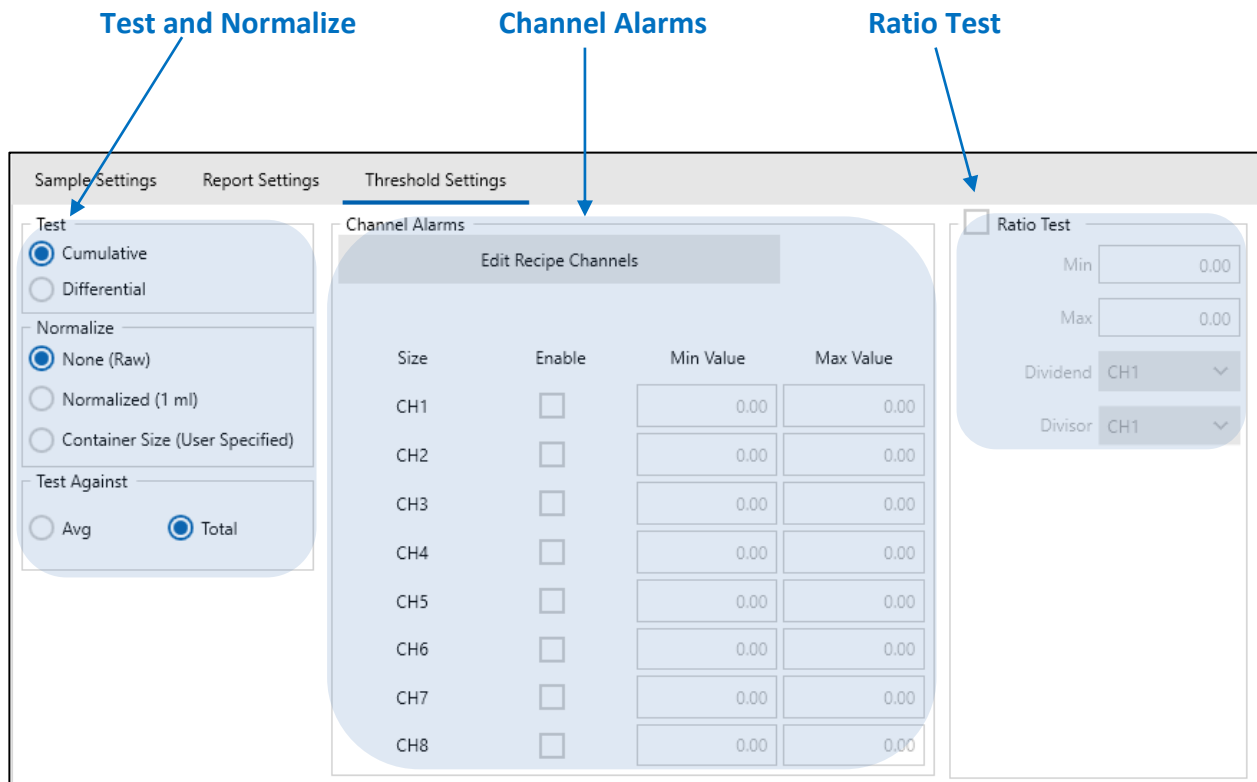
Enable Sign Off Lines to include signature lines on the saved report.

Blank Page

## RECIPE THRESHOLD SETTINGS

To edit a recipe’s threshold settings, click the Edit Recipes icon button on the toolbar on the left side of the screen, and select a recipe from the list of recipes shown in the top section of the screen. The selected recipe’s saved settings will be displayed on the Sample Settings, Report Settings, and Threshold Settings tabs in the lower section of the Edit Recipes screen.

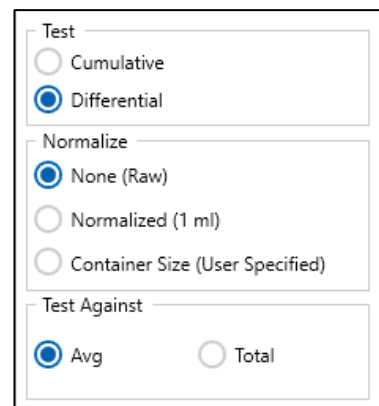
Note, to edit a recipe, the user must be logged in as an Admin user, or user logins must be disabled.



## TEST AND NORMALIZE

### Cumulative or Differential

Users can select to display data in either Cumulative or Differential mode by clicking on the Cumulative or Differential buttons. By default, the sample is displayed as cumulative data. That is, particle size data for a specific channel contains counts for that size and larger. Selecting differential will display counts for each particle size only and not also the sum the counts of higher particle sizes.



**Normalize**                      *Select One of the following three options:*

None (Raw):                      Raw data = the particle counts for a specific size.

Normalized (1 ml):              Normalized data = particles per milliliter.

Container Size:                  Normalized to user input Container Size and Number of Containers.

**Test Against:**                  Select to test the threshold alarm limits against either the samples' averages or the samples' Totals.

## CHANNEL ALARMS

Click to Edit the channels used for the Recipe.

The screenshot shows the 'Threshold Settings' window with the 'Channel Alarms' section active. A table lists channels CH1 through CH8 with columns for 'Size', 'Enable', 'Min Value', and 'Max Value'. All 'Enable' checkboxes are unchecked, and all 'Min Value' and 'Max Value' fields are set to 0.00. A blue arrow points to the 'Edit Recipe Channels' button above the table.

| Size | Enable                   | Min Value | Max Value |
|------|--------------------------|-----------|-----------|
| CH1  | <input type="checkbox"/> | 0.00      | 0.00      |
| CH2  | <input type="checkbox"/> | 0.00      | 0.00      |
| CH3  | <input type="checkbox"/> | 0.00      | 0.00      |
| CH4  | <input type="checkbox"/> | 0.00      | 0.00      |
| CH5  | <input type="checkbox"/> | 0.00      | 0.00      |
| CH6  | <input type="checkbox"/> | 0.00      | 0.00      |
| CH7  | <input type="checkbox"/> | 0.00      | 0.00      |
| CH8  | <input type="checkbox"/> | 0.00      | 0.00      |

### Channel Alarms

Click the Load Instrument Particle Sizes button to load particle sizes used on the connected LS20 instrument. The LS20's instrument particle sizes will be loaded into CH1-CH8.

The 'Edit Particle Sizes' dialog box shows a list of channels from CH 1 to CH 8. The 'Load Instrument Particle Sizes' button is highlighted with a blue box and a blue arrow points to it from the text above.

The 'Edit Particle Sizes' dialog box shows the same list of channels, but now each channel has a numerical value in its 'Particle Size' field: CH 1 (1.00), CH 2 (2.00), CH 3 (3.00), CH 4 (5.00), CH 5 (10.00), CH 6 (15.00), CH 7 (25.00), and CH 8 (50.00). A blue arrow points from the text above to the 'Load Instrument Particle Sizes' button.

Optionally the user can type over custom particle sizes for CH1-CH8. Click OK save channel sizes.

Click on Enable check box next to each Channel Size to enable from 1 up to 8 channels.

| Size | Enable                   | Min Value | Max Value |
|------|--------------------------|-----------|-----------|
| 1.0  | <input type="checkbox"/> | 0.00      | 0.00      |
| 2.0  | <input type="checkbox"/> | 0.00      | 0.00      |
| 5.0  | <input type="checkbox"/> | 0.00      | 0.00      |
| 7.0  | <input type="checkbox"/> | 0.00      | 0.00      |
| 10.0 | <input type="checkbox"/> | 0.00      | 0.00      |
| 15.0 | <input type="checkbox"/> | 0.00      | 0.00      |
| 25.0 | <input type="checkbox"/> | 0.00      | 0.00      |
| 50.0 | <input type="checkbox"/> | 0.00      | 0.00      |

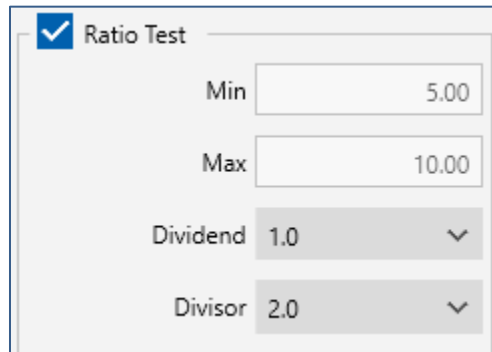
Enter Minimum and Maximum Alarm Values for desired particle channel sizes.

Use Zero if a minimum value is not desired.

The channel sizes saved in the recipe will be used in the instrument at sample time.

## RATIO TEST

Enable the Ratio Test to perform ratio of Channel 1 counts and enter values for the following fields:



The screenshot shows a configuration window titled "Ratio Test" with a checked checkbox. It contains four fields: "Min" with a value of 5.00, "Max" with a value of 10.00, "Dividend" with a dropdown menu showing 1.0, and "Divisor" with a dropdown menu showing 2.0.

| Field    | Value |
|----------|-------|
| Min      | 5.00  |
| Max      | 10.00 |
| Dividend | 1.0   |
| Divisor  | 2.0   |

Enter Minimum value (triggered by channel 1 counts below the Minimum)

Enter Maximum value (triggered by channel 1 counts above the Maximum)

Select Dividend (used for ratio dividend)

Select Divisor (used for ratio divisor)



## REPORTS

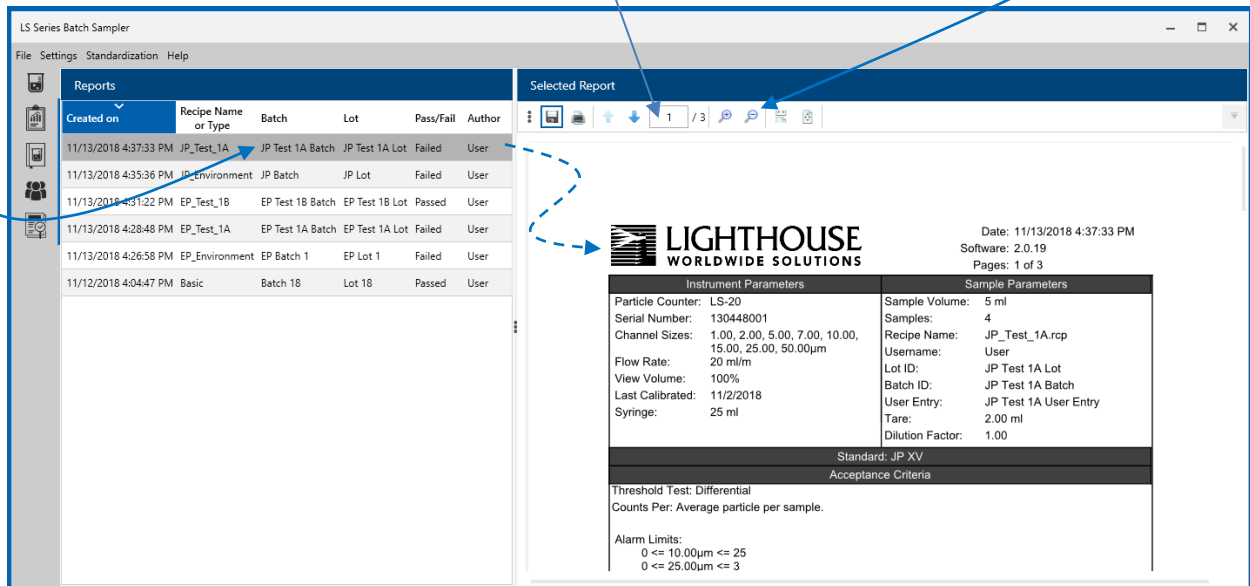
### PREVIOUSLY RUN REPORTS



To view reports from previously run recipes, click on the Reports button on the toolbar on the left side of the Home Screen and the Reports screen will be displayed. On the left of the Reports screen is a list of all previously created reports. On the right side of the Reports Screen is an area to view the currently selected report.

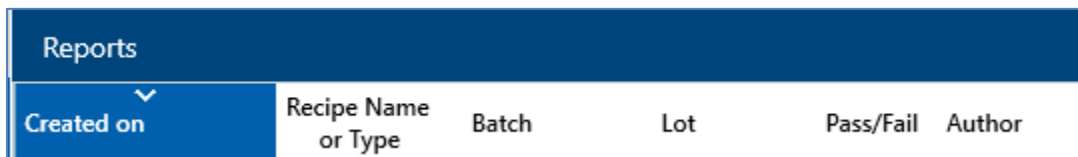
To view a previously run report, click on a report name listed on the left side of the screen. The report will be displayed in the right side, or viewer side, of the screen.

A toolbar at the top of the viewed reports lets the user save the report file to another name or folder, print a copy of the current report, move between pages of the report, or zoom in or out of a page of the viewed report.



**Reports Screen**

The user can also sort the column headers of the list of report names by clicking on the header of the list of reports. The user can slide the horizontal scroll bar at the bottom of the list of reports to view all 6 columns of the list, or expand the LS Software to full screen mode.



**Author, Date, Batch, Lot, Pass/Fail**

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## AUDIT TRAIL



The LS Software automatically records when users login to the LS Software, when recipe changes were made and by whom, when samples were run, and when standardization reports were run in its Audit Trail log.

Each Audit Trail entry includes the date, timestamp, username and message describing the action completed. Users can view the Audit Trail log by clicking on the Audit Trail icon on the left side of the Home Screen. Users can sort the Audit Trail log by clicking on a column header.

Users may enter a custom audit trail message. The entry must be different than the previous entry, must contain text and cannot be blank.

| Timestamp             | User | Message  |
|-----------------------|------|--|
| 11/2/2018 12:19:41 PM | User | User: [Admin] was created, with [Admin] level access |
| 11/2/2018 12:18:57 PM | User | User created recipe: Basic.rcp                       |
| 11/2/2018 12:18:56 PM | User | User successfully logged into the system.            |

### Audit Trail Screen

Click on the Icon: “Save the current audit trail to a new report” and the LS Software will create a .pdf report file of the Audit Trail records.

Note “Allow users to enter audit trail logs” must be enabled from the User screen to display on the Audit Trail screen.

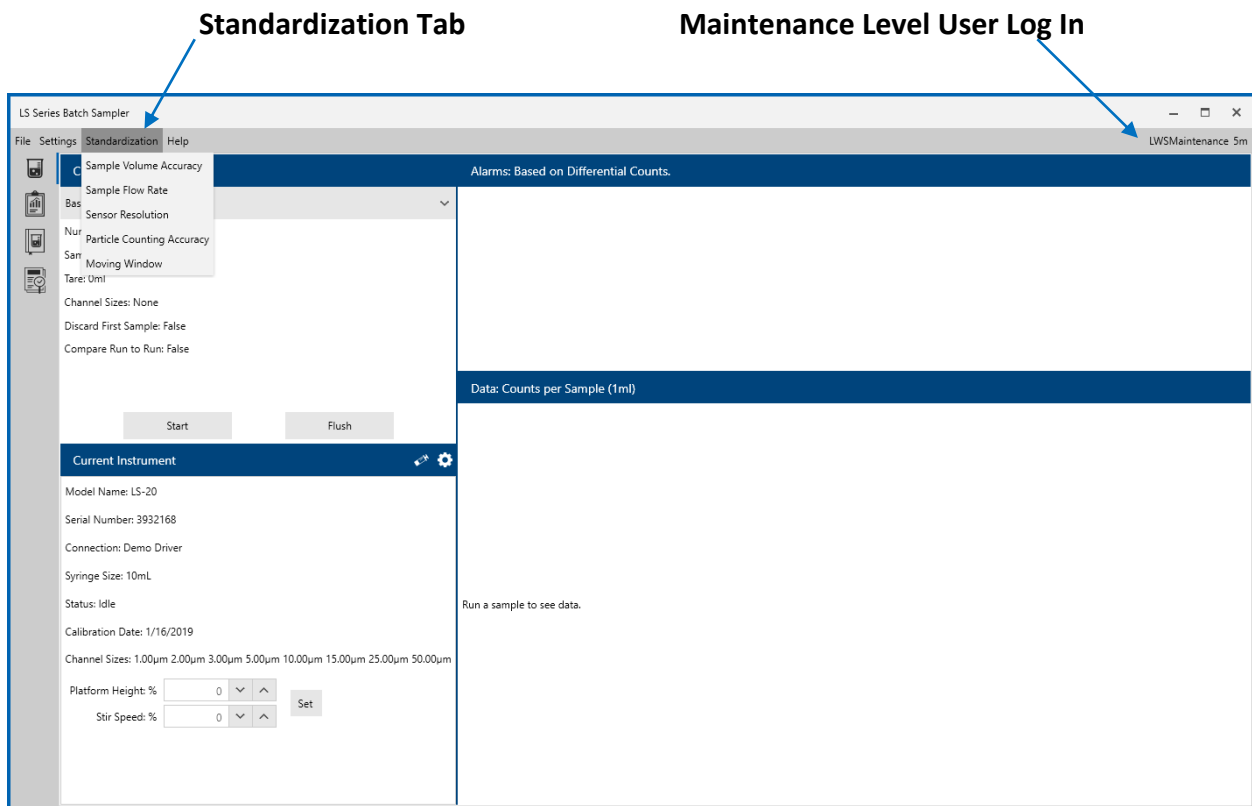
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**MAINTENANCE & STANDARDIZATION**

If user accounts are enabled, a user must be logged in as a Maintenance Level User in order to access the LS Maintenance and Standardization Tests & Reports.

Once logged in as a Maintenance User, click on the Standardization Tab to view the Standardization Tests and Reports pull down list.

Note, if Users are disabled, the Standardization menu tab and its LS Standardization Tests and Reports will be available to everyone who runs the LS Software.



**Standardization Tests**

**Standardization Tests and Reports:**

- Sample Volume Accuracy
  - Sample Flow Rate
  - Sensor Resolution
  - Particle Counting Accuracy
  - Moving Window
- (Test criteria come from ISO 21501-3:2007 and USP-NF <788>. )

SAMPLE VOLUME ACCURACY

The Sample Volume Accuracy test confirms that the sample volume is accurate. Users will need a calibrated digital scale that can measure the weight of the container and the liquid with an accuracy of 0.01g. Measure the weight of the container before and after performing a 5 ml sample (the sample size is read from the recipe when the test runs) and then enter the values in the **Initial Weight** and **Final Weight** boxes.

Note, it may be easier to use a 150 ml container to limit the total weight. A Pyrex 150 ml beaker (No. 1000) weighs just under 70 g. Note: 1 ml weighs 1 gram.

✕
Sample Volume Accuracy

**Enter Initial Weight**

Weigh the container and enter the value in grams. Initial Weight:  ▼ ▲

Default SG value of 1 should be fine for most liquids. Specific Gravity:  ▼ ▲

**Take Sample**

Place the container on the stage. When STATUS is ready, use the platform controls to position the tube for the test.

Push button to run test, wait for test to complete Test

**Enter Final Weight**

Weigh the container again and enter the value to the right. Final Weight:  ▼ ▲

Calculate Results

**Calculations**

**Results**

Report
Cancel

**Sample Volume Accuracy Test**

Enter the Initial Weight.

Enter the Specific Gravity.

Place sample on platform and position the tube.

Push the Test button to start the test.

Sample Volume Accuracy

**Enter Initial Weight**

Weigh the container and enter the value in grams. Initial Weight: 100.00 grams

Default SG value of 1 should be fine for most liquids. Specific Gravity: 1.00

**Take Sample**

Place the container on the stage. When STATUS is ready, use the platform controls to position the tube for the test.

Push button to run test, wait for test to complete **Test**

**Enter Final Weight**

Weigh the container again and enter the value to the right. Final Weight: 95.00 grams

**Calculate Results**

**Calculations**

|                         |                               |   |
|-------------------------|-------------------------------|---|
| Initial Weight: 100.00g | Specific Gravity: 1.00        | (Initial Weight - Final Weight - Tare) / Specific Gravity |
| Final Weight: 95.00g    | Tare: 0.2ml                   | <b>Calculated Sample Volume : 4.80ml</b>                  |
| Expected Volume: 5.00ml | <b>Minimum Volume: 4.75ml</b> |   |
|                         | <b>Maximum Volume: 5.25ml</b> |   |

**Results**

Pass Criteria: Minimum Volume <= Calculated Sample Volume <= Maximum Volume


**Results: Passed**

**Report** **Cancel**

### Sample Volume Accuracy Test Results

The result displays on the screen.

Click on the Report button to view report.

|   |  |  |
|---|--|--|
|  <b>LIGHTHOUSE</b><br>WORLDWIDE SOLUTIONS  |  | Date: 10/1/2018 1:23:18 PM<br>Software: 2.0.6<br>Pages: 1 of 1 |
| <b>Sample Volume Accuracy Test Report</b>   |  |  |
| <b>Instrument Parameters</b>  |  | <b>Test Parameters</b>   |
| Particle Counter: LS-20<br>Serial Number: 3932168<br>Flow Rate: 20 ml/m<br>View Volume: 100%<br>Last Calibrated: 1/16/2019<br>Syringe: 10 ml  |  | Username: LWSMaintenance                                       |
| <b>Test Results</b>   |  |  |
| Initial Weight: 100.00g<br>Final Weight: 95.00g<br>Specific Gravity: 1.00<br>Tare: 0.2ml<br><br>$(\text{Initial Weight} - \text{Final Weight} - \text{Tare}) / \text{Specific Gravity}$<br>Calculated Sample Volume : 4.80ml<br><br>Expected Volume: 5.00ml<br>Minimum Volume: 4.75ml<br>Maximum Volume: 5.25ml<br><br>Pass Criteria: Minimum Volume <= Calculated<br>Sample Volume <= Maximum Volume<br>Result: Passed |  |  |

### Sample Volume Accuracy Test Report

The Sample Volume Accuracy Test Report contains details about the test, the criteria used to determine the result, and the result.

Sample volume accuracy report names end in “\_SVA.pdf”.



## SAMPLE FLOW RATE

The Sample Flow Rate test measures the LS20's flow rate, which is controlled by the syringe.

The LS20's 25 ml syringe should take 75 seconds to fill when the flow rate is 20 ml/min.

Follow the directions on the Sample Flow Rate Test screen to complete the test.

Note: A calibrated stop watch must be used to validate the test.

The screenshot shows a software window titled "Sample Flow Rate" with a close button (X) in the top right corner. The window is divided into several sections:

- Directions:** Contains three paragraphs of instructions: "The syringe is used to control the flow rate.", "Use a stop watch to measure the time the syringe takes to fill.", and "Put a container with clean liquid on the stage. Use arrow keys to position the platform."
- Measure time it takes to fill syringe.** A dark blue header section.
- Start Test:** A button with a solid blue arrow pointing to it from the text "Press the 'Start Button' and start the timer at the same time."
- Stop Test:** A button with a dashed blue arrow pointing to it from the text "When the syringe is full, press the Stop button and stop the timer at the same time."
- Enter measured time.** A dark blue header section.
- Input:** A text field with the placeholder "Enter the fill time, in seconds. Than click 'Calculate Result'", a numeric input field showing "0.00", and up/down arrow buttons.
- Calculate Result:** A button to the right of the input field.
- Calculations:** A dark blue header section.
- Text:** "Flow Rate Calculation is 60 (seconds) \* Syringe Size (10 ml) / Fill Time." and "Calculated Flow Rate = 0.00 ml/min".
- Results:** A dark blue header section.
- Text:** "Criteria is 20 ml/min (+/-) 5%" and "Results: Not Ran".
- Buttons:** "Report" and "Cancel" buttons at the bottom right.

### Sample Flow Rate Test

After clicking the Start Test and Stop Test buttons, as detailed above, enter the fill time in seconds and then click on the Calculate Result button.

Sample Flow Rate

**Directions**

The syringe is used to control the flow rate.  
Use a stop watch to measure the time the syringe takes to fill.  
Put a container with clean liquid on the stage. Use arrow keys to position the platform.

**Measure time it takes to fill syringe.**

Press the "Start Button" and start the timer at the same time. Start Test

When the syringe is full, press the Stop button and stop the timer at the same time. Stop Test

**Enter measured time.**

Enter the fill time, in seconds. Than click "Calculate Result"  Calculate Result

**Calculations**

Flow Rate Calculation is  $60 \text{ (seconds)} * \text{Syringe Size (10 ml)} / \text{Fill Time}$ .  
Calculated Flow Rate = 20.00 ml/min

**Results**

Criteria is 20 ml/min (+/-) 5%  
Results: Passed

Report Cancel

### Sample Flow Rate Test Results

The Calculated Flow Rate will be displayed.

The Results will be calculated and displayed as Passed or Failed.

A report is generated after the result is calculated.

Click on the Report button to display the Sample Flow Rate Test Report.

Or, select Cancel to cancel the test.



**LIGHTHOUSE**  
WORLDWIDE SOLUTIONS

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| Sample Flow Rate Test Report   |                      |
|--|----------------------|
| Instrument Parameters  | Test Parameters      |
| Particle Counter: LS-20  | Username: LWSService |
| Serial Number: 3932168   |                      |
| Flow Rate: 20 ml/m   |                      |
| View Volume: 100%  |                      |
| Last Calibrated: 1/16/2018   |                      |
| Syringe: 10 ml   |                      |
| Test Results   |                      |
| Flow Rate Calculation is $(60 * \text{Syringe Size}) / \text{Fill Time}$ . |                      |
| Fill Time:   | 30.00 s              |
| Syringe Size:  | 10 ml                |
| Calculated Flow Rate:  | 20.00 ml             |
| Criteria is Target Flow Rate +/- 5%  |                      |
| Target Flow Rate:  | 20.00 ml             |
| Upper Limit:   | 21.00 ml             |
| Lower Limit:   | 19.00 ml             |
| Result:  | Passed               |

### Sample Flow Rate Test Report

The Sample Flow Rate Test Report contains details about the test, the criteria used to determine the result, and the result.

Sample Flow Rate report names end in “\_SFR.pdf”.

## SENSOR RESOLUTION

The Sensor Resolution Test measures the resolution of the sensor using the method described in **ISO 21501-3:2007**.

The Sensor Resolution Test requires 10 µm NIST traceable Certified Size Standard particles. The test looks for the size, above and below 10 µm which have the target particle ratios. Once the target is achieved using a 1 ml sample (which should be greater than 1000 particles), the software finds the sizes using a sample which contains more than 10,000 particles.

Enter supplied polymer particle size in µm. Enter standard deviation. Enter manufacturer. Enter the Lot ID. Enter the expiration date.

Click on the Start Scanning button.

Please enter the information from the bottle of polymer microspheres in water.

Particle Size (µm):  Standard Deviation:

Manufacturer:  Lot:  Expiration Date:

Scan.

Start using the voltage associated with the entered particle size.  
Scan voltages near entered particle size.

Start Scanning

Scanning Results

| Sample # | 168% OF TARGET |     | TARGET CHANNEL |      | 32% OF TARGET |      | RAW COUNTS |      |    |    |    |
|----------|----------------|-----|----------------|------|---------------|------|------------|------|----|----|----|
|          | P1%            | P3% | Voltage        | Size | Voltage       | Size | Voltage    | Size | P1 | P2 | P3 |
|          |                |     |                |      |               |      |            |      |    |    |    |

Results

Report Cancel

### Sensor Resolution Test

✕

Please enter the information from the bottle of polymer microspheres in water.

|                     |                 |                     |         |                  |           |
|---------------------|-----------------|---------------------|---------|------------------|-----------|
| Particle Size (um): | 10.00           | Standard Deviation: | 1.00    | um               | ▼         |
| Manufacturer:       | Small Particles | Lot:                | LOT 101 | Expiration Date: | 11/1/2018 |

**Scan.**

Start using the voltage associated with the entered particle size.

Scan voltages near entered particle size.

**Scanning Results**

| Sample # | P1%     | P3%    | 168% OF TARGET |      | TARGET CHANNEL |      | 32% OF TARGET |       | RAW COUNTS |       |      |
|----------|---------|--------|----------------|------|----------------|------|---------------|-------|------------|-------|------|
|          |         |        | Voltage        | Size | Voltage        | Size | Voltage       | Size  | P1         | P2    | P3   |
| 1        | 168.00% | 32.00% | 1255           | 8.82 | 1395           | 10   | 1534          | 10.66 | 2520       | 1500  | 480  |
| 2        | 168.00% | 32.00% | 1255           | 8.82 | 1395           | 10   | 1534          | 10.66 | 25200      | 15000 | 4800 |

**Results**

|   |  |
|---|--|
| <b>Concentration Limits:</b><br>Target counts between 1000 and 5000 counts per ml<br>Results : Passed | <b>Sensor Resolution:</b><br>Criteria: less <= 10.00%<br>Sensor Resolution 6.26%<br>Results : Passed |
|---|--|

### Sensor Resolution Test Results

The example Sensor Resolution Test Results screen, above, shows the Sensor Resolution Test Results from using the certified 10 µm size particles.

Note, before running this test, double check the particles expiration date. Make sure the particles have not expired.



**LIGHTHOUSE**  
WORLDWIDE SOLUTIONS

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| Sensor Resolution Test Report                     |         |        |                |      |         |                                |               |       |            |       |      |
|---|---------|--------|----------------|------|---------|--------------------------------|---------------|-------|------------|-------|------|
| Instrument Parameters                             |         |        |                |      |         | Test Parameters                |               |       |            |       |      |
| Particle Counter: LS-20                           |         |        |                |      |         | Username: LWSService           |               |       |            |       |      |
| Serial Number: 3932168                            |         |        |                |      |         | Manufacturer: Small Particles  |               |       |            |       |      |
| Flow Rate: 20 ml/m                                |         |        |                |      |         | Particle Size: 10.00µm         |               |       |            |       |      |
| View Volume: 100%                                 |         |        |                |      |         | Std Dev: 1                     |               |       |            |       |      |
| Last Calibrated: 1/16/2018                        |         |        |                |      |         | Lot ID: LOT 101                |               |       |            |       |      |
| Syringe: 10 ml                                    |         |        |                |      |         | Expiration Date: November 2018 |               |       |            |       |      |
| Samples Taken                                     |         |        |                |      |         |                                |               |       |            |       |      |
| #   | P1%     | P2%    | 1.68 of Target |      | Target  |                                | .32 of Target |       | Raw Counts |       |      |
|   |         |        | Voltage        | Size | Voltage | Size                           | Voltage       | Size  | P1         | P2    | P3   |
| 1   | 168.00% | 32.00% | 1255           | 8.82 | 1395    | 10.00                          | 1534          | 10.66 | 2520       | 1500  | 480  |
| 2   | 168.00% | 32.00% | 1255           | 8.82 | 1395    | 10.00                          | 1534          | 10.66 | 25200      | 15000 | 4800 |
| #   | P1%     | P2%    | 1.68 of Target |      | Target  |                                | .32 of Target |       | Raw Counts |       |      |
|   |         |        | Voltage        | Size | Voltage | Size                           | Voltage       | Size  | P1         | P2    | P3   |
|   |         |        | 1.68 of Target |      | Target  |                                | .32 of Target |       | Raw Counts |       |      |
| Test Results                                      |         |        |                |      |         |                                |               |       |            |       |      |
| <b>Concentration Limits:</b>                      |         |        |                |      |         |                                |               |       |            |       |      |
| Target counts between 1000 and 5000 counts per ml |         |        |                |      |         |                                |               |       |            |       |      |
| Results : Passed                                  |         |        |                |      |         |                                |               |       |            |       |      |
| <b>Sensor Resolution:</b>                         |         |        |                |      |         |                                |               |       |            |       |      |
| Criteria: less <= 10.00%                          |         |        |                |      |         |                                |               |       |            |       |      |
| Sensor Resolution 6.26%                           |         |        |                |      |         |                                |               |       |            |       |      |
| Results : Passed                                  |         |        |                |      |         |                                |               |       |            |       |      |

**Sensor Resolution Test Report**

The Sensor Resolution Test Report contains details about the test, the criteria used to determine the result, and the result.

## PARTICLE COUNTING ACCURACY TEST

This test requires USDA bottles of 15 micron NIST traceable polymer microspheres, with known particle counts. This test confirms the LS20 can count the correct number of particles and sort them into the correct channel bins. The test criteria come from USP standards. Other particle count vendors may have different count/ml limits and 10µm/15µm particle count ratio targets.

Follow the on screen directions.

### Enter the identification information for the Particle Counts Reference Standard.

Enter the particle count manufacturer name.

Enter the Lot ID number.

Enter the Expiration date of the fluid with the particles.

Particle Counting Accuracy

**Directions**

Particle Count Reference Standard (15.0 micron particles) and blank solution are needed to complete this test.  
Do not open bottles until directed.

Enter the identification information for the Particle Count Reference Standard.

Manufacturer:  Lot:  Expiration Date:

**Confirm Sample Limits (Values default to those for PHARM-TROL CS3800-15 and USP Lot J0D067)**

10 micron particle counts between:  and  particles/ml

Ratio of counts at 10 micron to counts at 15 micron:  and

Samples (default is 3 samples but some standards require 4 samples):

Count Control contains blank solution. (PHARM-TROL has no blank solution)

**Take the blank solution run.**

The first run uses the blank solution. Open the blank solution.  
Press the Blank button when blank solution is positioned with the input tube just above the bottom of the bottle.

**Take the particle count reference standard (15.0 micron) solution run.**

Shake Bottle 25 times than open "Reference Standard Bottle" and test immediately.  
Press button when particle count solution is positioned with the input tube just above the bottom of the bottle.

**Results**

### Particle Counting Accuracy Screen

**Confirm Sample limits** (values default to PHARM-TROL CS3800-15 and USP Lot J0D067)

Confirm or change the Sample Limits for 10 micron particle counts.

Confirm or change the Sample Ratio of counts at 10 µm to ratio of counts at 15 µm.

Confirm or change number of samples (default is 3).

### Take the blank solution run

The Count Control radio button must be checked if including a blank solution run. The first run uses the blank solution. Open the blank solution and position it on the platform with the input tube just above the bottom of the bottle.

Click to enable the Count Control with blank solution radio button.

The screenshot shows the 'Particle Counting Accuracy' software window. It includes a 'Directions' section with instructions, a form for 'Enter the identification information for the Particle Count Reference Standard' (Manufacturer, Lot, Expiration Date), and a 'Confirm Sample Limits' section with dropdown menus for 10 micron particle counts (3,381 to 4,298 particles/ml), ratio of counts (1.29 to 3.24), and samples (3.00). The 'Count Control contains blank solution' checkbox is checked. Below this, there are two main sections: 'Take the blank solution run.' with a 'Start Blank Sample' button, and 'Take the particle count reference standard (15.0 micron) solution run.' with a 'Start Reference Standard Sample' button. At the bottom, there are 'Report' and 'Cancel' buttons.

Then press the Start Blank Sample button to start the blank sample.

### Take the particle count reference standard 15 µm solution run.

Shake the bottle 25 times and then let it sit for 5 minutes. Then open the “Reference Standard Bottle” and test immediately. Place the bottle on the platform with the input tube just above the bottom of the bottle.

Note a non-USP count standard may have additional requirements about how fast the included stirrer needs to spin, how long it needs to spin, or how close to the bottom of the bottle the input hose needs to be positioned. Follow these additional requirements.



# Liquid Batch Sampler and LS Software Operators Manual

Press the Start Reference Standard Sample button to start the run.

Particle Counting Accuracy

**Directions**

Particle Count Reference Standard (15.0 micron particles) and blank solution are needed to complete this test. Do not open bottles until directed.

Enter the identification information for the Particle Count Reference Standard.

Manufacturer:  Lot:  Expiration Date:

Confirm Sample Limits (Values default to those for PHARM-TROL CS3800-15 and USP Lot J0D067)

10 micron particle counts between:  and  particles/ml

Ratio of counts at 10 micron to counts at 15 micron:  and

Samples (default is 3 samples but some standards require 4 samples):

Count Control contains blank solution. (PHARM-TROL has no blank solution)

**Take the blank solution run.**

The first run uses the blank solution. Open the blank solution. Press the Blank button when blank solution is positioned with the input tube just above the bottom of the bottle.

**Take the particle count reference standard (15.0 micron) solution run.**

Shake Bottle 25 times then open "Reference Standard Bottle" and test immediately. Press button when particle count solution is positioned with the input tube just above the bottom of the bottle.

**Results**

## Start Reference Standard Sample

Particle Counting Accuracy

**Directions**

Particle Count Reference Standard (15.0 micron particles) and blank solution are needed to complete this test. Do not open bottles until directed.

Enter the identification information for the Particle Count Reference Standard.

Manufacturer:  Lot:  Expiration Date:

Confirm Sample Limits (Values default to those for PHARM-TROL CS3800-15 and USP Lot J0D067)

10 micron particle counts between:  and  particles/ml

Ratio of counts at 10 micron to counts at 15 micron:  and

Samples (default is 3 samples but some standards require 4 samples):

Count Control contains blank solution. (PHARM-TROL has no blank solution)

**Take the blank solution run.**

The first run uses the blank solution. Open the blank solution. Press the Blank button when blank solution is positioned with the input tube just above the bottom of the bottle.

**Take the particle count reference standard (15.0 micron) solution run.**

Shake Bottle 25 times then open "Reference Standard Bottle" and test immediately. Press button when particle count solution is positioned with the input tube just above the bottom of the bottle.

**Results**

**Concentration Limits:**  
Total 10 micron particles / ml is between 3381 and 4298.  
10 micron particle = 3798  
Results: Passed

**Ratio Test:**  
Ratio of counts at 10 micron to counts at 15 micron is between 1.294 and 3.242.  
Ratio: 1.781  
Results: Passed

## Particle Counting Accuracy Results

Results are displayed when the test is complete.

# Liquid Batch Sampler and LS Software Operators Manual

**Particle Counting Accuracy**

**Directions**

Particle Count Reference Standard (15.0 micron particles) and blank solution are needed to complete this test. Do not open bottles until directed.

Enter the identification information for the Particle Count Reference Standard.

Manufacturer: Particle Supplier      Lot: ABC-123      Expiration Date: 12/1/2018

Confirm Sample Limits (Values default to those for PHARM-TROL CS3800-15 and USP Lot J0D067)

10 micron particle counts between: 3,381 and 4,298 particles/ml

Ratio of counts at 10 micron to counts at 15 micron: 1.29 and 3.24

Samples (default is 3 samples but some standards require 4 samples): 3.00

Count Control contains blank solution. (PHARM-TROL has no blank solution)

**Take the blank solution run.**

The first run uses the blank solution. Open the blank solution. Press the Blank button when blank solution is positioned with the input tube just above the bottom of the bottle. Start Blank Sample

**Take the particle count reference standard (15.0 micron) solution run.**

Shake Bottle 25 times then open "Reference Standard Bottle" and test immediately. Press button when particle count solution is positioned with the input tube just above the bottom of the bottle. Start Reference Standard Sample


**Results**

|  |  |
|--|--|
| <b>Concentration Limits:</b><br>Total 10 micron particles / ml is between 3381 and 4298.<br>10 micron particle = 3798<br>Results: Passed | <b>Ratio Test:</b><br>Ratio of counts at 10 micron to counts at 15 micron is between 1.294 and 3.242.<br>Ratio: 1.781<br>Results: Passed |
|--|--|

Report      Cancel

## Particle Counting Accuracy Test Report

Press the Report button to view the Report pdf file.

|  |                             |
|--|-----------------------------|
|  <b>LIGHTHOUSE</b><br>WORLDWIDE SOLUTIONS | Date: 10/10/2018 4:50:55 PM |
|  | Software: 2.0.9             |
|  | Pages: 1 of 1               |

**Particle Counting Accuracy Test Report**  
Standard: USP33 - NF28

| Instrument Parameters      | Test Parameters                 |
|----------------------------|---------------------------------|
| Particle Counter: LS-20    | Username: LWSService            |
| Serial Number: 3932168     | Manufacturer: Particle Supplier |
| Flow Rate: 20 ml/m         | Particle Size: 15.00µm          |
| View Volume: 100%          | Lot ID: ABC-123                 |
| Last Calibrated: 1/16/2019 | Expiration Date: December 2018  |
| Syringe: 25 ml             |                                 |

**Test Results**

**Concentration Limits:**  
Total 10 micron particles / ml is between 3381 and 4298.  
Results : Passed

**Ratio Test:**  
Ratio of counts at 10 micron to counts at 15 micron is between 1.294 and 3.242.  
Ratio: 1.781  
Results : Passed

## Particle Counting Accuracy Test Report

The Particle Counting Accuracy Test Report contains details about the test, the criteria used to determine the result, and the result.

MOVING WINDOW

Use the Moving Window to confirm the calibration is correct, and tweak the calibration if necessary. This test requires certified size standard particles. This test works best if a stirrer bean is used to keep the particles suspended. This test will not work for channel 1 calibration's particle size (1.0µm or 1.5µm).

The Value in P2 should be above 1000 but below 3000 for particle sizes 25µm and under. When the particles are larger, the P2 value can be less ~500, and the stirrer bean should be set to a faster speed. Add particles or water then run MW until you see a good result in P2.

- Enter the **Particle Size:** (µm) The voltage associated with this particle size will be used.
- Enter the **Standard Deviation:** (µm)
- Enter the **Manufacturer:** (Particle supplier company name)
- Enter the **Lot number:** (Lot number of the particles manufactured)
- Enter the **Expiration Date:** (of the polymer microspheres in water).

Moving Window

Please enter the information from the bottle of polymer microspheres in water.

Particle Size (µm): 10.00      Standard Deviation: 0.90 µm

Manufacturer: New Particle Supplier      Lot: LOT-A-1001      Expiration Date: 12/1/2018

Scan.

Start using the voltage associated with the entered particle size.  
Scan voltages near entered particle size.      Start Scanning

Scanning Results

| Sample # | P1% | P2% | Diff% | 64% OF TARGET |      | TARGET CHANNEL |      | 144% OF TARGET |      | DIFFERENTIAL COUNTS |    |    |
|----------|-----|-----|-------|---------------|------|----------------|------|----------------|------|---------------------|----|----|
|          |     |     |       | Voltage       | Size | Voltage        | Size | Voltage        | Size | P1                  | P2 | P3 |
|          |     |     |       |               |      |                |      |                |      |                     |    |    |

Results

Report      Cancel

Moving Window Screen

Click on the Start Scanning button to start the Moving Window Test.

# Liquid Batch Sampler and LS Software Operators Manual

Moving Window

Please enter the information from the bottle of polymer microspheres in water.

Particle Size (um):  Standard Deviation:

Manufacturer:  Lot:  Expiration Date:

Scan.

Start using the voltage associated with the entered particle size.  
Scan voltages near entered particle size.

Scanning Results

| Sample # | P1%    | P2%    | Diff%   | 64% OF TARGET |      | TARGET CHANNEL |       | 144% OF TARGET |       | DIFFERENTIAL COUNTS |      |     |
|----------|--------|--------|---------|---------------|------|----------------|-------|----------------|-------|---------------------|------|-----|
|          |        |        |         | Voltage       | Size | Voltage        | Size  | Voltage        | Size  | P1                  | P2   | P3  |
| 1        | 59.90% | 40.10% | 19.80%  | 892           | 5.76 | 1395           | 10    | 2008           | 12.93 | 2941                | 1969 | 18  |
| 2        | 60.68% | 39.32% | 21.37%  | 955           | 6.29 | 1493           | 10.47 | 2149           | 13.6  | 2860                | 1853 | 141 |
| 3        | 39.03% | 60.97% | -21.93% | 1023          | 6.86 | 1599           | 10.97 | 2302           | 14.33 | 1381                | 2157 | 103 |
| 4        | 50.34% | 49.66% | 0.67%   | 988           | 6.57 | 1545           | 10.72 | 2224           | 13.96 | 1500                | 1480 | 109 |

Results


**Concentration Limits:**  
Target counts between 1000 and 5000 counts per ml  
Results: Passed

**Particle Size:**  
Observed Size: 10.72 Expected Size: 10  
Observed Voltage: 1545 mv Expected Voltage: 1395 mv  
Size Error: 7.20% Required: 10.00%  
Results: Passed

## Moving Window Test Results

Click on the Report button to view the Moving Window Report .pdf file.

Or click on Cancel to close the Moving Window report screen.

|  <b>LIGHTHOUSE</b><br>WORLDWIDE SOLUTIONS |        | Date: 10/11/2018 12:43:17 PM<br>Software: 2.0.9<br>Pages: 1 of 1 |         |                |      |                                     |       |                |       |             |      |     |
|--|--------|--|---------|----------------|------|-------------------------------------|-------|----------------|-------|-------------|------|-----|
| Moving Window Test Report  |        |  |         |                |      |                                     |       |                |       |             |      |     |
| Instrument Parameters  |        |  |         |                |      | Test Parameters                     |       |                |       |             |      |     |
| Particle Counter: LS-20  |        |  |         |                |      | Username: LWSService                |       |                |       |             |      |     |
| Serial Number: 3932168   |        |  |         |                |      | Manufacturer: New Particle Supplier |       |                |       |             |      |     |
| Flow Rate: 20 ml/m   |        |  |         |                |      | Particle Size: 10.00µm              |       |                |       |             |      |     |
| View Volume: 100%  |        |  |         |                |      | Std Dev: 0.9                        |       |                |       |             |      |     |
| Last Calibrated: 1/16/2019   |        |  |         |                |      | Lot ID: LOT-A-1001                  |       |                |       |             |      |     |
| Syringe: 25 ml   |        |  |         |                |      | Expiration Date: December 2018      |       |                |       |             |      |     |
| Samples Taken  |        |  |         |                |      |                                     |       |                |       |             |      |     |
| #  | P1%    | P2%  | Diff %  | 64 % of Target |      | Target                              |       | 144% of Target |       | Diff Counts |      |     |
|  |        |  |         | Voltage        | Size | Voltage                             | Size  | Voltage        | Size  | P1          | P2   | P3  |
| 1  | 59.90% | 40.10%   | 19.80%  | 892            | 5.76 | 1395                                | 10.00 | 2008           | 12.93 | 2941        | 1969 | 18  |
| 2  | 60.68% | 39.32%   | 21.37%  | 955            | 6.29 | 1493                                | 10.47 | 2149           | 13.60 | 2860        | 1853 | 141 |
| 3  | 39.03% | 60.97%   | -21.93% | 1023           | 6.86 | 1599                                | 10.97 | 2302           | 14.33 | 1381        | 2157 | 103 |
| 4  | 50.34% | 49.66%   | 0.67%   | 988            | 6.57 | 1545                                | 10.72 | 2224           | 13.96 | 1500        | 1480 | 109 |
| #  | P1%    | P2%  | Diff %  | 64 % of Target |      | Target                              |       | 144% of Target |       | Diff Counts |      |     |
| Test Results   |        |  |         |                |      |                                     |       |                |       |             |      |     |
| <b>Concentration Limits:</b>   |        |  |         |                |      |                                     |       |                |       |             |      |     |
| Target counts between 1000 and 5000 counts per ml  |        |  |         |                |      |                                     |       |                |       |             |      |     |
| Results: Passed  |        |  |         |                |      |                                     |       |                |       |             |      |     |
| <b>Particle Size:</b>  |        |  |         |                |      |                                     |       |                |       |             |      |     |
| Observed Size: 10.72 Expected Size: 10   |        |  |         |                |      |                                     |       |                |       |             |      |     |
| Observed Voltage: 1545 mv Expected Voltage: 1395 mv  |        |  |         |                |      |                                     |       |                |       |             |      |     |
| Size Error: 7.20% Required: 10.00%   |        |  |         |                |      |                                     |       |                |       |             |      |     |
| Results: Passed  |        |  |         |                |      |                                     |       |                |       |             |      |     |

### Moving Window Test Report

The Moving Window Test Report contains details about the test, the criteria used to determine the result, and the result.

Blank Page

**A LIMITED WARRANTY**

**LIMITATION OF WARRANTIES:**

- A.** Lighthouse Worldwide Solutions (LWS) warrants that all equipment shall be free from defects in material and workmanship under normal use for a period of two years from date of shipment to Buyer except that LWS does not warrant that operation of the software will be completely uninterrupted or error free or that all program errors will be corrected. Buyer shall be responsible for determining that the equipment is suitable for Buyer's use and that such use complies with any applicable local, state, or federal law. Provided that Buyer notifies LWS in writing of any claimed defect in the equipment immediately upon discovery and any such equipment is returned to the original shipping point, transportation charges prepaid, within two years from date of shipment to Buyer and upon examination LWS determines to its satisfaction that such equipment is defective in material or workmanship, i.e. contains a defect arising out of the manufacture of the equipment and not a defect caused by other circumstances, including, but not limited to accident, misuse, unforeseeable use, neglect, alteration, improper installation, improper adjustment, improper repair, or improper testing, LWS shall, at its option, repair or replace the equipment, shipment to Buyer prepaid. LWS shall have reasonable time to make such repairs or to replace such equipment. Any repair or replacement of equipment shall not extend the period of warranty. If the Instrument is modified or in any way altered without the explicit written consent of LWS then the warranty is null and void. This warranty is limited to a period of two years, except as noted below, without regard to whether any claimed defects were discoverable or latent on the date of shipment. Batteries and accessories with all products are warranted for one (1) year. Fuses and purge filters carry no warranty. If a third party battery is used in the product, the product warranty is null and void. If the battery is charged by a third party battery charger the battery warranty is null and void.
- B.** If Buyer shall fail to pay when due any portion of the purchase price or any other payment required from Buyer to LWS under this contract or otherwise, all warranties and remedies granted under this Section may, at LWS's option, be terminated.
- C.** THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER REPRESENTATIONS, WARRANTIES AND COVENANTS, EXPRESS OR IMPLIED WITH RESPECT TO THE EQUIPMENT AND ANY DEFECTS THEREIN OF ANY NATURE WHATEVER, INCLUDING AND WITHOUT LIMITATION WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. LWS SHALL NOT BE LIABLE FOR, AND BUYER ASSUMES ALL RISK OF, ANY ADVICE OR FAILURE TO PROVIDE ADVICE BY LWS TO BUYER REGARDING THE EQUIPMENT OR BUYERS USE OF THE SAME. UNDER NO CIRCUMSTANCES SHALL LWS BE LIABLE TO BUYER UNDER ANY TORT, NEGLIGENCE, STRICT LIABILITY, OR PRODUCT LIABILITY CLAIM AND BUYER AGREES TO WAIVE SUCH CLAIMS. LWS'S SOLE AND EXCLUSIVE LIABILITY AND BUYERS SOLE AND EXCLUSIVE REMEDY, FOR ANY NONCONFORMITY OR DEFECT IN THE PRODUCTS OR ANYTHING DONE IN CONNECTION WITH THIS CONTRACT, IN TORT, (INCLUDING NEGLIGENCE), CONTRACT, OR OTHERWISE, SHALL BE AS SET FORTH IN THE SUBSECTION A HEREOF AS LIMITED BY SUBSECTION B HEREOF. THIS EXCLUSIVE REMEDY SHALL NOT HAVE FAILED OF ITS ESSENTIAL PURPOSE (AS THAT TERM IS USED IN THE UNIFORM COMMERCIAL CODE) PROVIDED THAT THE SELLER REMAINS WILLING TO REPAIR OR REPLACE DEFECTIVE EQUIPMENT (AS DEFINED IN SUBSECTION A) WITH A COMMERCIALY REASONABLE TIME AFTER RECEIVING SUCH EQUIPMENT. BUYER SPECIFICALLY ACKNOWLEDGES THAT SELLER'S PRICE FOR THE EQUIPMENT IS BASED UPON THE LIMITATIONS OF LWS'S LIABILITY AS SET FORTH IN THIS CONTRACT.

**WARRANTY OF REPAIRS AFTER INITIAL TWO (2) YEAR WARRANTY:**

- A.** Upon expiration of the initial two-year warranty, all parts and repairs completed by an authorized Lighthouse repair technician are subject to a six (6) month warranty.
- B.** Other than the above, LWS makes no warranty of any kind, expressed or implied, except that the products manufactured and sold by LWS shall be free from defects in materials and workmanship and shall conform to LWS's specifications; Buyer assumes all risk and liability resulting from use of the products whether used singly or in combination with other products. If sampler is modified or in any way altered without the explicit written consent of LWS, the warranty is null and void.
- C.** WARRANTY REPAIRS SHALL BE COMPLETED AT THE FACTORY, BY AN AUTHORIZED SERVICE LOCATION, BY AN AUTHORIZED SERVICE TECHNICIAN, OR ON SITE AT BUYER'S FACILITY BY A LIGHTHOUSE AUTHORIZED EMPLOYEE. BUYER PAYS FREIGHT TO FACTORY; SELLER WILL PAY STANDARD RETURN FREIGHT DURING THE WARRANTY PERIOD. BUYER MAY SELECT A FASTER METHOD OF SHIPMENT AT ITS OWN EXPENSE.

Service and Support  
Tel. 1-800-945-5905 (USA Toll Free)  
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