
SmartBatch+

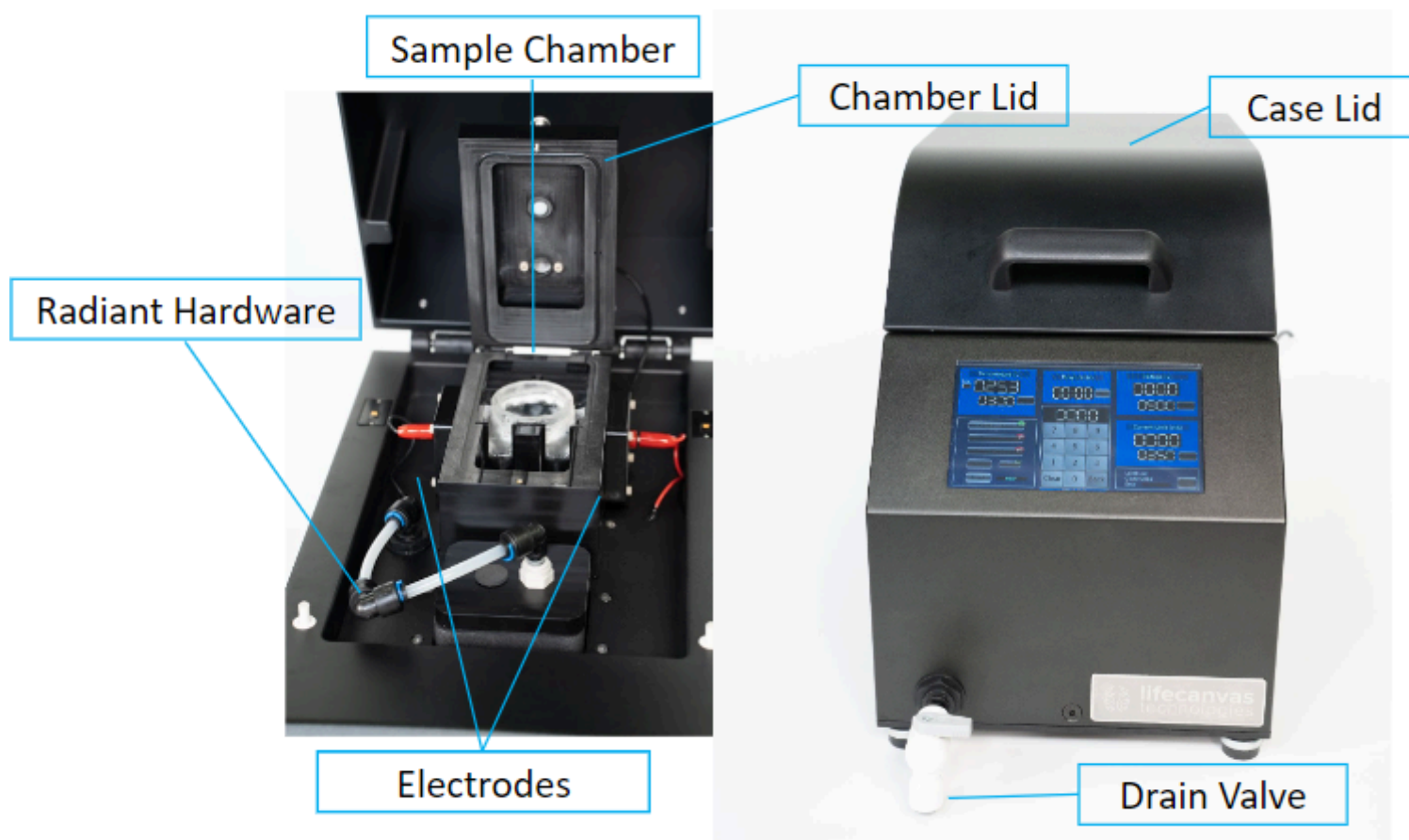
User's Manual v2

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Components & Accessories

The SmartBatch+ is a single device that electrophoretically delipidates and immunolabels biological samples. During processing the samples are loaded into the Sample Chamber, where an electric field is formed between the Electrodes to drive charged molecules into the samples. For each operation, unique buffers are poured into the Sample Chamber (and drained out using the Drain Valve). Finally, electrophoresis can only be applied once the Case Lid is closed.



SmartBatch+ comes with the following accessories:

- 1 x Clearing Cup (A)
- 1 x Single Sample Staining Cup (B)
- 1 x Medium Staining Cup (C)
- Power cord (D)
- 1 x Batch Staining Cup (E)
- 2 x Incubation Jar (F)
- 1 x Extended Drain Tube (G)
- 2 x Ring Stand (H)
- 2 x Sample Ring and 2 x Lock Ring (I)
- 2 x Extra Fuses (J)
- 2 x Mesh Bag Set (K) - 2 x 12 bags for mouse brain size samples
- 2 x Large Mesh Bag Set (L) - 2 x 4 bags for rat brain size samples
- 1x Bag of Misc. Sample Spoons (M)
- 1x Radiant Column (N)



Installation

Please take note of the following before installation:

- Do not use the instrument for purposes other than those indicated by the manufacturer.
- At least two people are required to move the instrument.
- The instrument must be placed in a stable and level location on a non-metal surface.
- The instrument must be placed such that the power cord and switch are easily accessible at any time.
- Follow instructions contained in the manual when setting up and operating the instrument, and when changing consumables.
- If deemed necessary, ask the manufacturer or your sales agent for help when setting up the system.
- Connect the instrument to an electrical outlet according to local or country standard.
- Do not switch on the instrument without having waited at least 10 seconds after switching it off.
- Only use buffers, sample cups, and parameter ranges provided by LifeCanvas Technologies. See product warranty for further information.
- Use the volumes recommended by LifeCanvas Technologies.
- Do not leave the instrument in humid or wet conditions, as doing so could cause an electrical short.
- Do not use the instrument outdoors.
- Leave at least 1 foot (30 cm) of space on the left and right sides of the device to allow for proper airflow.
- Power requirements: 100-240 VAC, 50-60Hz, 5A

Note: In the event of unexpected problems, please contact your service representative or LifeCanvas Technologies immediately:

support@lifecanvastech.com

1. Carefully remove the device from the box, using one hand to grab the front of the device and another hand to grab the back.
2. Remove the foam side panels and place the device down on a stable, level surface with at least one foot of space (~30cm) on each side to allow for proper airflow. Set the foam aside and save for shipping the device in the future.
3. Open the device lid and remove the foam from the top of the device. Remove carefully by pulling away from IR sensor on chamber lid. This can be disposed of.



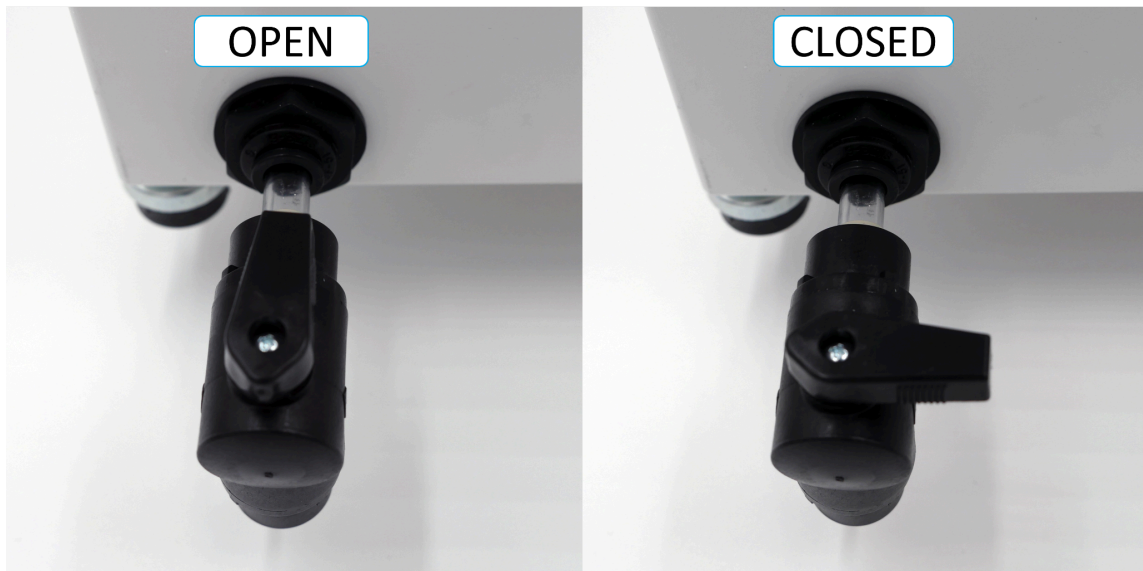
4. Remove the nozzle from the accessories box and install in the orientation shown below with the gray handle on top. Press firmly into the front of the SmartBatch+ until it depresses into place.



5. Plug the power cord into the power entry module on the back of the device and then plug it into the appropriate wall outlet.
6. Flip the power switch to the On position. The device will startup and the screen will turn on.

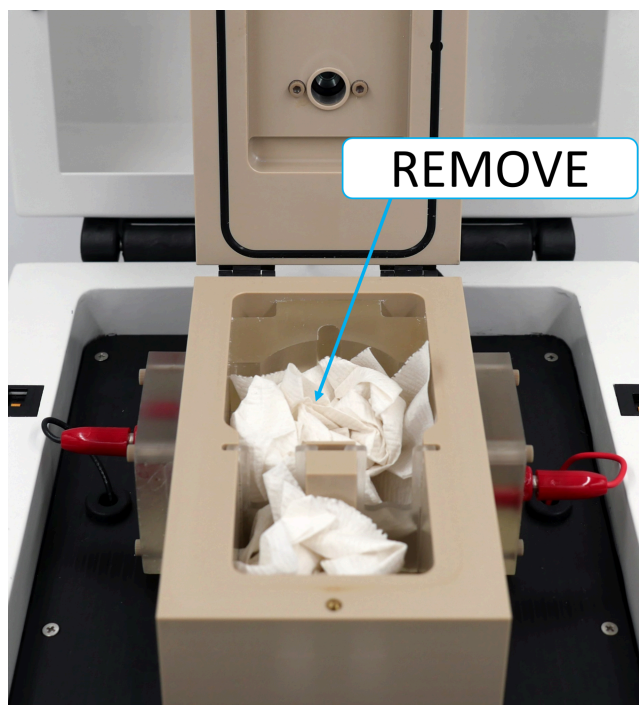


7. Ensure that the drainage tube is in the closed position (the valve handle is perpendicular to the tube as in image below):

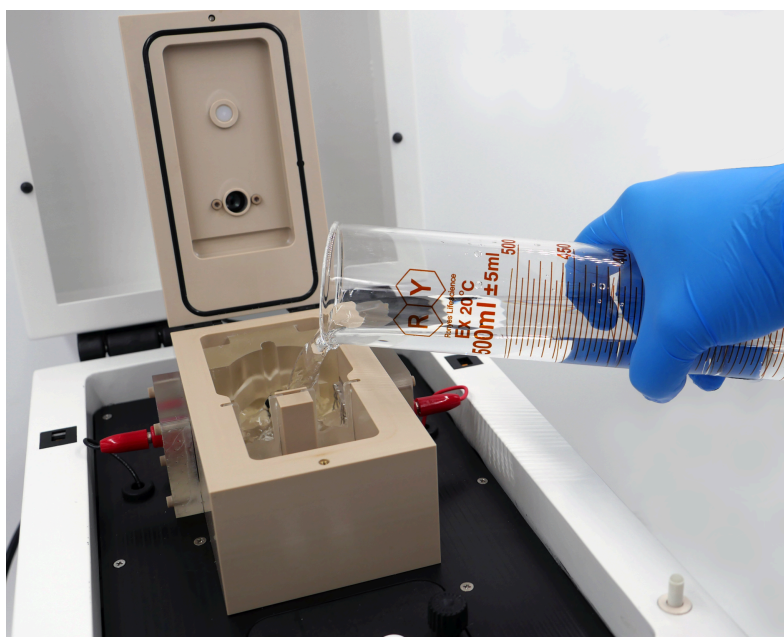


Note: Nozzle may have a gray handle instead of black

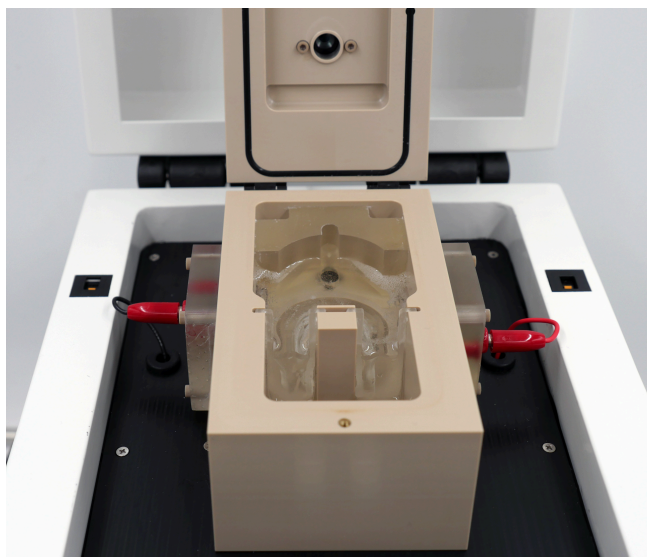
8. Remove the paper towels from the chamber and dispose of them. These are only here to soak up any remaining liquid during shipping. **Chamber color may be different than shown below.**



9. Pour ~400 mL distilled water directly into the Chamber.



10. **Ensure that there is water in the device and do not run the pump dry.** Press “Auxiliary Power” on the touchscreen. This will turn on the liquid pump, sample cup mixing, and sample cup rotation. Upon startup the Chamber Hex Piece will rotate faster than normal for 5 seconds to allow you to visually verify that the Hex Piece is indeed rotating. The software will also deactivate so that power cannot be cycled too quickly for some components.

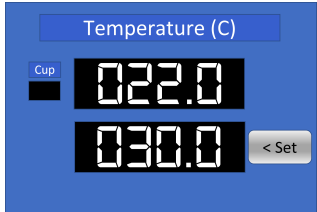
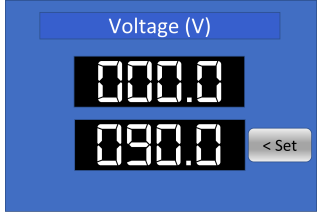


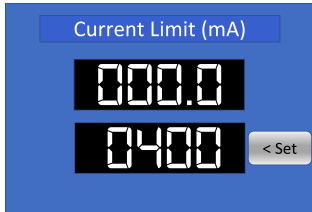
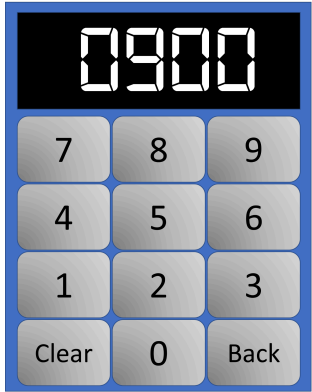
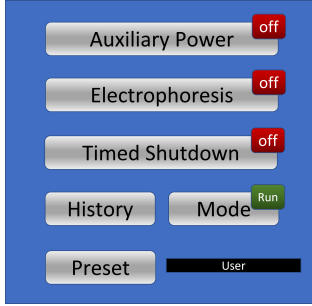
11. If you wish to use the optional Extended Drain Tube, simply press the hard plastic end into the bottom of the Drain Valve.
12. The device is now fully installed and you are ready to proceed!
13. If you will not be using the device immediately, turn off the Auxiliary Power, main power switch and drain out the liquid in the chamber using the Drainage Valve.

User Interface

The screen displays set values and present readings for various parameters of device functionality. From this screen, the user can view and has control of: **Voltage, Current Limit, Timer Settings, and Temperature**. The user can change between preset values for clearing and labeling by pressing the “**Preset**” button. A display to the right of that button will indicate the preset setting. To customize any of these settings, the user can enter a number into the main keypad and press the “**Set**” button in the region of interest. Be aware of the number of decimal places when changing these values for temperature, and the hours : minutes template for changing the timer.

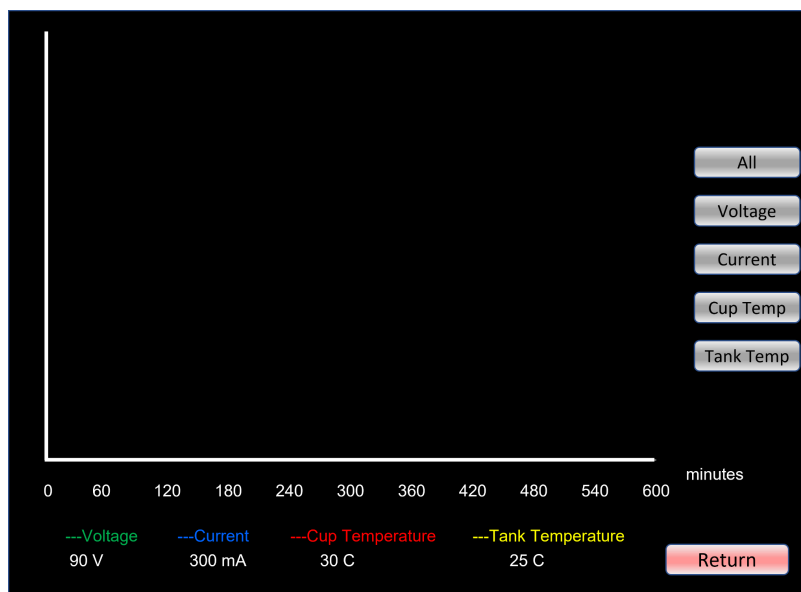
Complete description of UI used to control SmartBatch+ operation:

	This is the Temperature panel. The top number shows the current temperature reading as measured by the IR sensor on the lid on top of the chamber. This directly measures the temperature of the surface of the liquid underneath it. The device displays a rolling average of measured temperatures, so it will take several seconds to display the correct value on startup. The bottom number shows the Set Temperature of the system. The “Set” button will change the Set Temperature to the value that is currently displayed in the keypad. If an invalid temperature setting is input, a sound will play and the value will not change. Note: The device is only heated by the electrophoresis, so without that turned on the temperature will not increase. If the temperature exceeds 60°C, the electrophoresis power will turn off to prevent overheating.
	This is the Voltage panel. The top number indicates the voltage that is presently being applied across the electrodes. The bottom number is the Set Voltage. The device normally operates in voltage set, current limit mode. So, it will apply the Set Voltage unless the current exceeds the Current Limit. If that is the case the Voltage will decrease such that the Current Limit is not exceeded. To change the Set Voltage, enter in the desired value in the keypad and then press the “Set” button. If an invalid Set Voltage is input, a sound will play and the value will go to the maximum allowable value. Note: The amount of heat generated is dependent on the power of the electrophoresis. Exceeding the recommended values can increase the thermal load too much and lead to overheating.

 The screenshot shows a blue panel with the text 'Current Limit (mA)' at the top. Below it, a digital display shows '000.0' on the top line and '0400' on the bottom line. To the right of the bottom display is a button labeled '< Set'.	This is the Current panel. The top number indicates the current that is currently passing through the chamber. The bottom number is the Current Limit. During operation the device will apply the Set Voltage unless the current exceeds the Current Limit. If that is the case the Voltage will decrease such that the Current Limit is not exceeded. If an invalid Current Limit is input, a sound will play and the value will go to the maximum allowable value. Note: The amount of heat generated is dependent on the power of the electrophoresis. Exceeding the recommended values can increase the thermal load too much and lead to overheating.
 The screenshot shows a blue panel with the text 'Timer (H:M)' at the top. Below it, a digital display shows '00:00'. To the right of the display is a button labeled '< Set'.	This is the Timer panel. The number indicates the current time remaining on the timer when using the Timed Shutdown function. The number displays in HH:MM format. To change the Timer, enter in the desired value in the keypad and then press the "Set" button. If an invalid Timer value is input, a sound will play and the value will go to the maximum allowable value.
 The screenshot shows a keypad interface. At the top, a large digital display shows '0900'. Below the display is a 3x3 grid of buttons labeled 7, 8, 9, 4, 5, 6, 1, 2, 3. At the bottom are three buttons labeled 'Clear', '0', and 'Back'.	This is the Keypad. The number at the top is the current value stored in the keypad. Pressing the numbers will modify this value. The "Clear" button will erase that value, and the "Back" button will erase the last number entered.
 The screenshot shows a blue panel with several controls. At the top are three buttons: 'Auxiliary Power' (with a red 'off' indicator), 'Electrophoresis' (with a red 'off' indicator), and 'Timed Shutdown' (with a red 'off' indicator). Below these are two buttons: 'History' and 'Mode' (with a green 'Run' indicator). At the bottom are two buttons: 'Preset' and 'User' (which is highlighted in black).	This is the main functions panel. The "Auxiliary Power" button will turn on the liquid pump, sample rotation and sample mixing. Note: Do not turn on the Auxiliary Power unless there is liquid in the tank. Doing so with a dry tank could damage the pump. The "Electrophoresis" button turns on the Electrophoresis Power. It cannot be turned on unless the Auxiliary Power is already turned on. The "Timed Shutdown" button will activate the timed shutdown based on the value shown in the Timer panel. It will count down the timer, and upon reaching 00:00 will turn off the Electrophoresis Power. The Auxiliary Power will remain on to keep the sample cups hydrated.

	The “History” button will bring up a graph showing the values from the current experiment. The “Mode” button will allow the user to toggle between Run Mode and Calibration Mode. This is used to calibrate the temperature sensors. See the Temperature Calibration section for more information. The “Preset” button allows the user to toggle between preset Clearing, Labeling 1, and Labeling 2 modes. The current preset will be displayed to the right of the button. If the user changes any of the values, the mode will automatically update to User.
	This is the Faults Panel. When the Case Lid is open, the “Cover Open” indicator will light up. When the lid is open, the device will halt any Electrophoresis Power. To turn this back on, close the lid and press the “Reset Faults” button. Any other errors will be indicated the the “Error” indicator. See the Troubleshooting section for more information on displayed errors.

Graphing & History



SmartBatch+ stores the **Voltage**, **Current**, **Cup Temperature** and **Tank Temperature** for each active experiment and displays them in a rolling graph like an oscilloscope. To see each value in more detail with labeled axes, press on their individual buttons. This data is overwritten each time the electrophoresis is switched on.

Operation

Clearing Mode

For more detailed information regarding sample preparation, please refer to our wiki <https://sites.google.com/lifecanvastech.com/protocol/outline>. The below guide will highlight the basic information on running the system to delipidate samples.



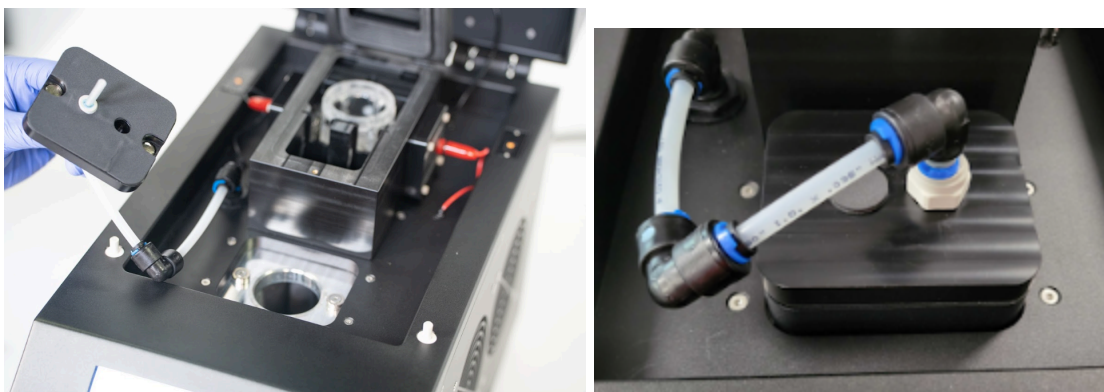
1. Insert SHIELD fixed samples in the **Mesh Bags**, taking note of which sample is in which bag. When inserting mouse brains into the bags put the cerebellum facing down to avoid damaging olfactory bulbs.
2. Place the **Sample Ring** on the **Ring Stand**.
3. Hang the **Mesh Bags** on the **Sample Ring** and secure them with the **Lock Ring**.
4. Place **Ring Stand** in **Incubation Jar** and incubate samples in Delipidation Buffer overnight at 45C.
5. [Wash the device](#) and turn off the **Auxiliary Power**.
6. [Drain out any liquid from the device](#) and ensure the **Drainage Valve** is closed. Soak up any remaining liquid from the **Chamber** using a paper towel.
7. Pour a whole bottle of SmartBatch+ Conduction Buffer into the **Chamber**.
8. Remove the **Clearing Cup** from its storage container, and wash carefully with a gentle stream of water.

9. Place the **Clearing Cup** into a beaker of distilled water for several minutes to finish washing the cup.
10. Remove the **Clearing Cup** from the liquid and dump out any water. Carefully use a kimwipe to soak up any remaining water inside the cup.
11. Leak test the **Clearing Cup** by filling to the brim with distilled water and letting it sit on a dry paper towel for several minutes. Confirm no leaks and proceed.
12. Fill the cup with 32mL of Delipidation Buffer.
13. Place the **Sample Ring** on top of the **Clearing Cup** with the samples inside. Add more Delipidation Buffer if the samples are not fully submerged.
14. Insert the cup in the **Chamber**, lining up the pegs on the bottom with those in the **Chamber Hex Piece**. The cup will fit in snugly.
15. Turn on the **Auxiliary Power**.
16. Close the **Chamber Lid** and secure it with the thumbscrew.
17. Close the **Case Lid**.
18. Press "**Preset**" until it indicates **Clearing Mode**. Change any settings or apply the timer if desired. The preset settings are the recommended settings for mouse brains.
19. Turn on the **Electrophoresis Power**.
20. Wait for your samples to clear.
21. Once fully delipidated, turn off **Electrophoresis Power** and **Auxiliary Power**.
22. Open the **Case Lid** and **Chamber Lid** and remove the **Clearing Cup** from the **Chamber**.
23. Remove **Sample Ring** from the **Clearing Cup** and wash samples with PBSN (PBS with 0.02% sodium azide) in the **Incubation Jar**. Carefully rinse the **Clearing Cup** with distilled water and store it in its storage solution. It is important to keep the membrane hydrated at all times.
24. When done clearing samples, or every 10 days (whichever comes first) wash the system and replace the buffer in the device. We recommend refreshing the Delipidation Buffer when adding new samples, or every ~3 days, whichever comes first.
25. Wash the device before turning it off to prevent detergent buildup.

Labeling Mode

1. Wash the device and turn off the **Auxiliary Power**.
2. Drain out any liquid from the device and ensure the **Drainage Valve** is closed. Soak up any remaining liquid from the Chamber using a paper towel.
3. For our standard protocol, pour a whole bottle of SmartBatch+ Primary Device Buffer into the **Chamber**. For our Radiant labeling protocol, pour 400mL, 385mL, or 365mL of Radiant buffer for **Single Sample Staining Cup**, **Medium Staining Cup**, or **Batch Staining Cup** respectively.

4. Remove the cup for the appropriate sample number from its storage container, and wash carefully with a gentle stream of water. The **Single Sample Staining Cup** can hold 1-2 mouse brain sized samples, the **Medium Staining Cup** can hold up to 6 mouse brain sized samples, and the **Batch Staining Cup** can hold up to 12 mouse brain sized samples.
5. Place the **Cup** into a beaker of distilled water to finish washing it.
6. Test the **Cup** by filling to the brim with distilled water and letting it sit on a dry paper towel for several minutes. Confirm no leaks and proceed.
7. Remove the **Cup** from the liquid and dump out any water. Carefully use a kimwipe to soak up any remaining water inside the cup.
8. Rinse out the cup twice with **Primary Sample Buffer or Radiant Buffer**.
9. For the Radiant Protocol, add a **Radiant Catalyst Bag** into the **Radiant Column** and insert into the device per below. You may skip this step for the Standard Protocol.



10. Fill the cup with 9mL, 20mL, or 40mL of **Primary Sample Buffer or Radiant Buffer** and add the appropriate molecular probes for either **Single Sample Staining Cup**, **Medium Staining Cup**, or **Batch Staining Cup** respectively.
11. Insert the **Sample Ring** into the **Batch Staining Cup or Medium Staining Cup** with the samples on their **Mesh Bags**. Ensure samples are properly pre-incubated. For a **Single Sample Staining Cup**, place the bag directly in the cup without a Sample Ring.
12. Insert the cup in the **Chamber**, lining up the pegs on the bottom with those in the **Chamber Hex Piece**. The cup will fit in snugly.

13. Turn on the **Auxiliary Power**. The buffer should begin to flow and the stirrer should begin spinning. The cup will initially rotate relatively quickly but will slow down prior to the experimental run.
14. Close and seal the **Chamber Lid** and the **Case Lid**.
15. Press “**Preset**” until it indicates **Labeling 1 or Labeling 2 Mode** for primary and secondary antibodies accordingly. Change any settings or apply the timer if desired. The preset settings are the recommended settings.
16. From here, please follow the instructions in the Labeling section of the Full Pipeline Protocol to finish the experiment.
17. Always wash the device after use before turning off the power to prevent detergent buildup.

Switching Between Modes

It is simple to switch between labeling and clearing modes.

1. Remove any **Sample Cups** and samples from the system.
2. Wash the device.
3. Begin processing samples with your new mode following the instructions for that particular function.

Device Washing

Follow these steps to wash the device.

During these steps it is important to not run the **Auxiliary Power** without any liquid in the system. It could potentially damage the pump.

1. Turn off **Auxiliary Power**.
2. Drain any liquid out of the system with the **Drainage Valve** and close the valve.
3. Pour 400 mL distilled water into the **Chamber**.
4. Turn on **Auxiliary Power** and run the pump for several minutes.
5. Turn off **Auxiliary Power** and drain the liquid.
6. Repeat steps 3-5 at least 3 more times, or until the liquid in the **Chamber** has minimal bubbles.
7. Confirm cleanliness by turning on **Electrophoresis** with distilled water flowing and confirm the current is below 20mA.

Temperature Calibration

We recommend re-calibrating the temperature sensors every 6 months to maintain proper system function and to ensure the best results. For the best results, use a well calibrated digital thermometer to collect temperature measurements.

1. Fill the device with 400 mL distilled water and turn on the **Auxiliary Power**.
2. Open the **Case Lid** and **Chamber Lid**.
3. Put the thermometer into the **Chamber** at an angle and close the **Chamber Lid** such that the thermometer is still in the liquid, and the sensor on top of the **Chamber Lid** points down into the liquid.
4. Wait ~30 seconds for the temperature to stabilize.
5. Press the **"Mode"** button so the indicator shows **"Cal"**. This means that the device is in calibration mode.
6. Type the measured temperature into the keypad.
7. Press the **"Set"** button in the **Temperature** panel. This will set the current temperature to the value you are measuring.
8. Press the **"Mode"** button again to re-enter calibration mode.
9. Press the **"Cal Stats"** button.
10. Press the **"Save"** button.
11. Press **"Return"** to go back to the main screen.
12. The device temperature is now calibrated!
13. If there are any errors with temperature calibration, you can reset to the Factory Calibration from the **"Cal Stats"** page in calibration mode.

Replacing Electrodes

The platinum wire electrodes get thinner over time and eventually will form a break in the wire. This can take months - years but is expected behavior. Please contact LifeCanvas at info@lifecanvastech.com to purchase replacement electrodes. The replacement procedure is simple:

1. Power off the device and unplug the power cord from the wall. This will ensure that the electrode swap is safe.
2. Drain out any liquid from the device.
3. Pull the red or black wire out from the **Electrode Assembly**.
4. Unscrew the 4 bolts that secure the **Electrode Assembly** to the **Chamber**.
5. Wipe up any liquid with a paper towel.
6. Place the new electrode assembly in the **Chamber** slot.
7. Secure the **Electrode Assembly** with the bolts using a hex key. All 4 bolts should be finger tight.
8. Plug the wire into the new **Electrode Assembly**.

9. Power on the device and fill it with 400 mL of distilled water.
10. Turn on the **Auxiliary Power** and let the system run for ~5 minutes to confirm the electrode assembly is well sealed to the **Chamber**.

Replacing Fuse

Caution: Always unplug the power supply before replacing the fuse.

1. Power off the device and unplug the power cord from the device.
2. Remove the **Fuse Drawer** by pushing a small screwdriver into the slots on the left and pulling the drawer out.
3. Remove the defective fuse and replace it with the replacement fuse (T 10A 250V).
4. Reinsert the **Fuse Drawer** by pushing it into the slot until you hear it click into place.

Equipment Ratings

General Data:	
Temperature Control	20-50°C
Electrophoresis Voltage	0-90 VDC
Electrophoresis Current Limit	0-1500 mA
Sample Specimen Size	30mm x 30mm x 20mm
Sample Specimen Capacity	Up to 12 mouse brains or 4 rat brains
Ambient Conditions:	
Operating Temperature Range	18-26°C
Relative Humidity	80% Max
Storage Temperature	18-26°C
Storage Humidity	80% Max
Altitude	< 2,000 m
Electrical Data:	
Rated Voltage Range ($\pm 10\%$)	100-240 VAC
Rated Frequency ($\pm 10\%$):	50-60 Hz
Power Consumption:	500W Max
Power Fuses:	T 10A 250V
Pollution Degree:	2
Electrical Overload Protection:	Yes
Dimensions:	
L x W x H	250mm x 450mm x 350mm
Weight	~ 50 lbs

Troubleshooting

Errors during device operation are displayed in the **Faults Panel** in the lower right corner of the screen. The table below shows the possible faults:

Error	Observation	Function	Fix
Lid 1 / Lid 2	Case Lid is open.	Electrophoresis Power turns off when Case Lid is opened for safety.	Close Case Lid and press “Reset Faults” button to turn electrophoresis back on.
Overheat	Measured tank temperature is above 50°C.	Auxiliary Power and Electrophoresis Power are turned off to prevent further heating.	Contact support at: info@lifecanvastech.com
No spin	Sample mixing is not happening.	Stirring motor is stalled or unable to rotate.	Contact support at: info@lifecanvastech.com

Citing SmartBatch+

Please refer to the below for guidance when citing the SmartBatch+ and our protocols.

Paraformaldehyde-fixed samples were preserved with using SHIELD reagents (LifeCanvas Technologies) using the manufacturer's instructions (Park et al., 2018) . Samples were delipidated using LifeCanvas Technologies Clear+ delipidation reagents. Following delipidation samples were labeled using eFLASH (Yun et al., 2019) technology which integrates stochastic electrotransport (Kim et al., 2015) and SWITCH (Murray et al., 2015), using a SmartBatch+ device (LifeCanvas Technologies). After immunolabeling, samples were incubated in 50% EasyIndex (RI = 1.52, LifeCanvas Technologies) overnight at 37°C followed by 1 d incubation in 100% EasyIndex for refractive index matching.

Warranty

We warrant the product you have purchased for one calendar year after the date of delivery. In the case of any manufacturer-originated malfunctions that arise during this period of time, LifeCanvas Technologies will be responsible for repair or replacement of failed parts. However, this warranty is guaranteed when only LifeCanvas consumables (buffers, sample holders, and any other consumables) are used with the SmartLabel Pro system and excludes the following conditions:

- When the system is used outside of recommended setting ranges (temperature higher than 50° C, voltage higher than 90V, current higher than 1500mA).
- Any damages due to fire, earthquake, rainstorm, or other catastrophic events, as well as damages arising from pollution or abnormal electrical supply.
- Any damages due to unofficial repair, adjustment, calibration, and modification.
- Any damages due to improper usage or mishandling.
- Any damages caused by moving, dropping, or transporting of the instrument.
- Repair of expendables and consumables.

For service, please contact the agent that you have purchased the instrument from or LifeCanvas Technologies. LifeCanvas Technologies offers direct support.

Warranty is valid only if the installation is done by trained people and in accordance with instructions provided in this manual.



EU Declaration of Conformity

Manufacturer: LifeCanvas Technologies, Inc.
1035 Cambridge St. Suite 16C Cambridge, MA 02141 USA

European Representative: Cairn GmbH,
Heidebuckelweg 5, 69118 Heidelberg, Germany

Object of the declaration: SmartBatch+ Series.

The object of the declaration described above is in conformity with the relevant Union harmonization legislation:

Low Voltage 2014/35/EU
EMC Directive 2014/30/EU
RoHS Directive 2011/65/EU

The object of the declaration complies with the following harmonized standards:

Directive	Standard(s)		
LVD 2014/35/EU	EN 61010-1:2010/A1:2019		
EMCD 2014/30/EU	EN 61326-1:2013		
RoHS 2011/65/EU	EN IEC 63000:2018		

Signed for and on behalf of:



Signature

11/02/2022

Date

Name: Rhie Lim
Title: Chief Operating Officer, LifeCanvas Technologies
Place of signing: Cambridge, MA

Signed for and on behalf of:



Signature

11/24/2022

Date

Name: Dr Jan Felix Evers
Title: Geschäftsführer (CEO) of Cairn GmbH
Place of signing: Heidelberg



UK Declaration of Conformity

Manufacturer: Life Canvas Technologies, Inc.
1035 Cambridge St. Suite 16C Cambridge, MA 02141 USA

UK Representative: Cairn Research Ltd
Faversham, Kent, United Kingdom

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Object of the declaration: SmartBatch+ Series.

The object of the declaration described above is in conformity with the relevant Union harmonization legislation:

The Electrical Equipment (Safety) Regulations, 2016 No. 1101

The Electromagnetic Compatibility Regulations, 2016 No. 1091

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations, 2012 No. 3032

The object of the declaration complies with the following harmonized standards:

Regulation	Standard(s)
LVD - 2016 No. 1101	EN 61010-1:2010
EMC – 2016 No. 1091	EN 61326-1:2013
RoHS - 2012 No. 3032	EN IEC 63000:2018

Signed for and on behalf of:



Signature

11/02/2022

Date

Name: Rhie Lim
Title: Chief Operating Officer, LifeCanvas Technologies
Place of signing: Cambridge, MA

Signed for and on behalf of:



24/11/2022

Name: Jeremy Graham
Title: CEO Cairn Research Ltd
Place: Faversham, Kent, United Kingdom: