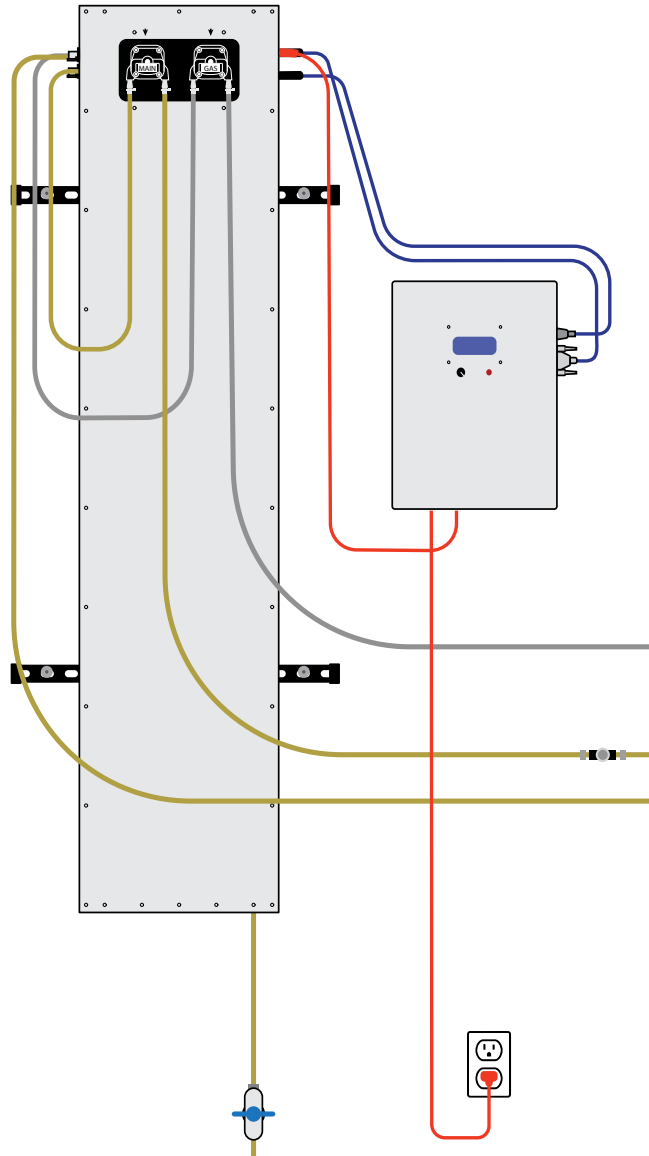




# BRIGHTWATER TOOLS

*Technologies for Regenerative Sanitation*



## The Brightwater Pasteurizer Manual Version 1.4

SERIAL NUMBER: \_\_\_\_\_

SOLD TO: \_\_\_\_\_

SHIP DATE: \_\_\_\_\_

QUESTIONS?

Contact BrightWater Tools:  
[info@brightwatertools.com](mailto:info@brightwatertools.com)

(802) 255-4708

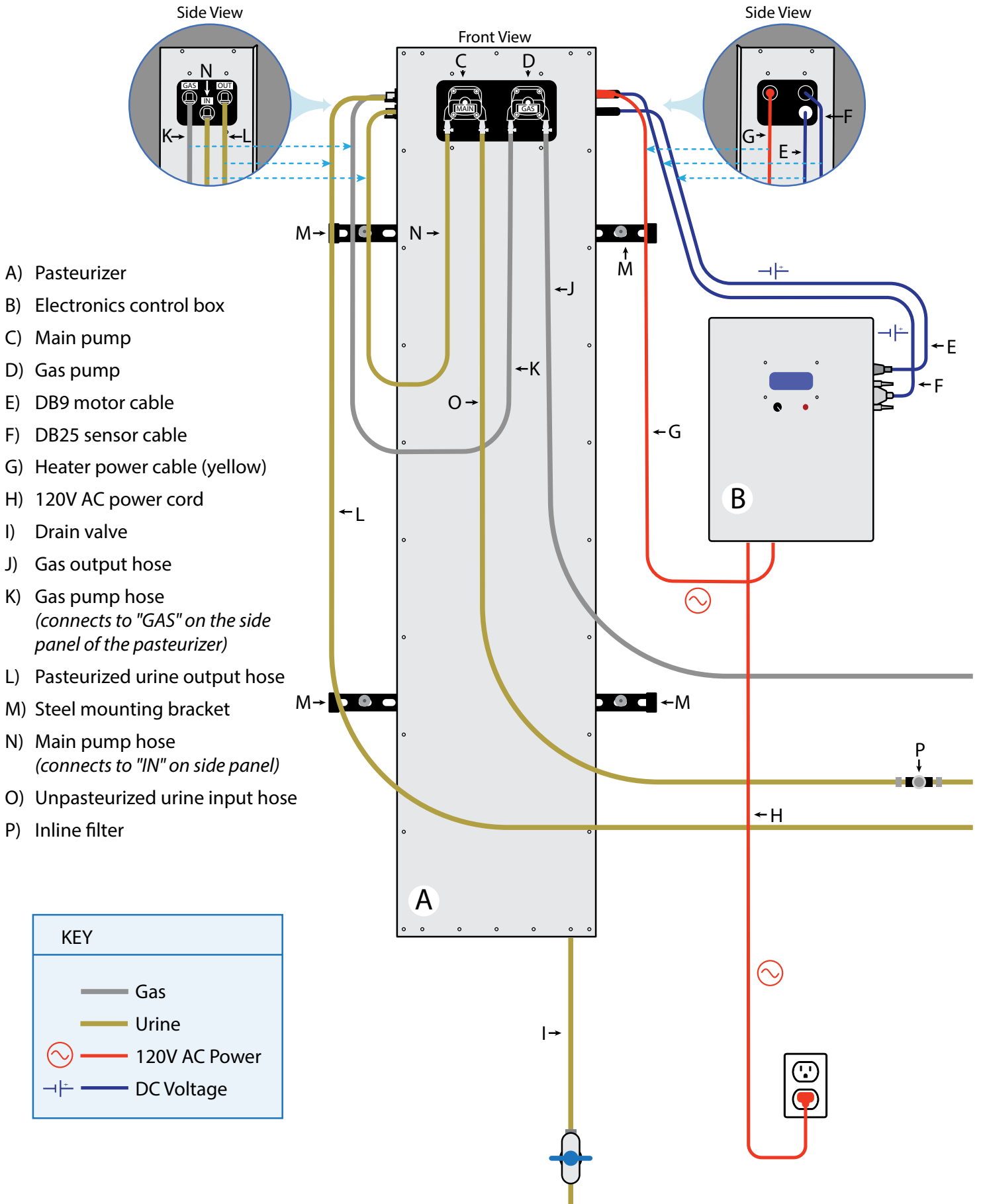
355 Old Ferry Road

Brattleboro, VT 05301

# TABLE OF CONTENTS

<i>Figure 1. The Brightwater Pasteurizer [Patent Pending]. . . . .</i>	3
<b>PRODUCT SPECIFICATIONS . . . . .</b>	<b>4</b>
Size. . . . .	4
Power requirement . . . . .	4
Operating environment . . . . .	4
Device capabilities, purpose, limitations. . . . .	4
Operating notes . . . . .	4
<b>INSTALLATION AND SETUP . . . . .</b>	<b>5</b>
Unpack . . . . .	5
Package contents and system components . . . . .	5
Not included but necessary . . . . .	5
Mounting on wall. . . . .	5
<b>Mounting the Main Pasteurizer . . . . .</b>	<b>5</b>
<i>Mounting Parts - Main Pasteurizer. . . . .</i>	<i>5</i>
<b>Mounting the Electronics Control Box. . . . .</b>	<b>7</b>
<i>Mounting Parts - Electronics Control Box . . . . .</i>	<i>7</i>
<b>Making connections between control box and main unit . . . . .</b>	<b>7</b>
<i>Mounting Parts - Cables . . . . .</i>	<i>7</i>
<i>Figure 2. Connect pumps to in/outfeed tanks, main unit . . . . .</i>	<i>8</i>
Tubing Connections - Front of pasteurizer case . . . . .	9
Tubing Connections - Left side of pasteurizer case . . . . .	9
<i>Figure 3. Pasteurizer Connections and Fluid Flow Directions . . . . .</i>	<i>10</i>
<b>STARTUP GUIDE . . . . .</b>	<b>11</b>
Power-up procedure . . . . .	11
Navigate control menus . . . . .	11
<b>SHUTDOWN PROCEDURE . . . . .</b>	<b>11</b>
<b>REQUIRED MAINTENANCE. . . . .</b>	<b>12</b>
<b>SOFTWARE . . . . .</b>	<b>12</b>
Operating Modes. . . . .	12
<b>WARRANTY - TWO YEARS . . . . .</b>	<b>14</b>
This warranty covers. . . . .	14
This warranty does not cover . . . . .	14
<b>SERVICES . . . . .</b>	<b>14</b>

**Figure 1. The Brightwater Pasteurizer [Patent Pending]**



# PRODUCT SPECIFICATIONS

## Size

**Main unit:** 60" high, 14" wide, and 7" deep. Weighs 45 pounds when empty.

**Electronics control box:** 16" high, 12" wide, and 6" deep.

## Power requirement

120V AC, 150-200 Watts typical, 350 Watts max.

## Operating environment

- Keep out of direct sunlight, and at room temperature (ideally between 18-25 °C).
- Build secondary containment in case of spills, to contain up to 50 gallons of liquid. The pasteurizer itself holds roughly 2L of liquid when full (about 0.5 gallons), but extra capacity should be factored in to contain overflow from in/outfeed tanks in case of accident or emergency.
- Install in a location with adequate ventilation to prevent overheating (i.e., not inside a cabinet). Under normal operating conditions, the outside of the pasteurizer will become warm to the touch (up to 40 °C), but will not present a hazard to those who come into contact with it.
- Install in a location where potential spills will not pose a hazard.

## Device capabilities, purpose, limitations

- The Brightwater Pasteurizer is designed to continuously pump source-separated urine or high-strength wastewater through a heat treatment process, resulting in a pasteurized product that can be used as a safe and legal fertilizer (in the USA) with no further treatment. Pasteurization involves heating the continuously pumped urine or wastewater to at least 80 °C, and holding it at that temperature for at least 90 seconds. In doing so, the treated liquid is in compliance with the wastewater treatment standard in the EPA's 503(c) Biosolids Rule.
- The heat exchange mechanism built into the Brightwater Pasteurizer decreases energy use by bringing incoming liquid up to temperature while cooling treated liquid on its way out of the system.
- The Brightwater Pasteurizer is designed to pump at a rate of up to 3mL/second, or about 50 gallons per day. It is designed to operate continuously for optimum efficiency, and the pumping rate is automatically adjusted to optimize energy use while maintaining treatment temperature.
- Preheating the unit is required before starting the pasteurization process, to ensure that the internal temperature of the pasteurizer is at least 80 degrees Celsius.

## Operating notes

- The miniature pasteurizer is designed to heat wastewater to between 80-85 °C to complete its time-temperature treatment regime. Numerous fail-safe checks are built into the device to prevent overheating and to prevent any pumping of unpasteurized urine. Automated sensors and a feedback system continuously monitor flow rates, temperatures and gas evacuation to ensure optimal performance.
- As wastewater is heated up to 80 °C, gas bubbles will form as dissolved gasses are expelled due to rising temperature. Our GAS pump is designed to sense and expel these gas bubbles (mostly consisting of ammonia), and the GAS output should be plumbed into the bottom of your infeed tank to give the expelled gas an opportunity to cool, condense, and be reabsorbed.
- It is inevitable that some nitrogen losses will occur during the pasteurization process, but independent lab tests show that these nitrogen losses are negligible. Lab tests of source-separated, stored urine both before and after our pasteurization process show that TKN remained the same, within the lab's measurable uncertainty of 0.03% TKN.
- Each pasteurizer is tested prior to shipping, and only passes our quality control inspection once we determine that the unit is completely sealed and leak-free. **Reminder: the pasteurizer should always be operated in an environment with secondary spill containment.**

## INSTALLATION AND SETUP

### Unpack

The Brightwater Pasteurizer comes shipped in two separate boxes. The main pasteurizer unit is shipped in a wooden crate. The pasteurizer weighs 45 pounds when empty of urine, so please use caution when lifting and use more than one person to lift as needed. The electronics control box, pasteurizer mounting bars, other hardware and tubing ship in a cardboard box.

### Package contents and system components

- Pasteurizer (ships in wooden crate)
- Electronics control box (ships in cardboard box)
- Control box mounting feet (4x) and screws (4x)
- Pasteurizer mounting bars, steel (2x)
- Pasteurizer mounting bar bolts (4x) and washers (4x), stainless steel
- 1x inline filter for infeed line, with  $\frac{3}{8}$ " hose barbs pre-installed
- Spools of  $\frac{3}{8}$ " and  $\frac{3}{4}$ " tubing for plumbing connections
- Hose clamps for securing tubing to barbed fittings

### Not included but necessary

- 4x screws and washers to attach mounting bars to your wall or stand
- 4x screws and washers to attach control box mounting feet to your wall or stand, adjacent to the pasteurizer case
- Various plumbing fittings to connect the pasteurizer to your infeed and outfeed tanks (NOTE: the exact fittings needed will depend on your installation).

### Mounting on wall

#### *Mounting the Main Pasteurizer*

The main pasteurizer case should be mounted vertically, on a wall or stand, using the supplied steel mounting beams. Attach steel mounting beams to pasteurizer case using 4x bolts (size  $\frac{5}{16}$ " - 18 x  $\frac{7}{8}$ ", stainless steel hex head) and 4x washers ( $\frac{5}{16}$ " x 1- $\frac{1}{4}$ " stainless steel fender washers) as shown below:

#### *Mounting Parts - Main Pasteurizer*

x2

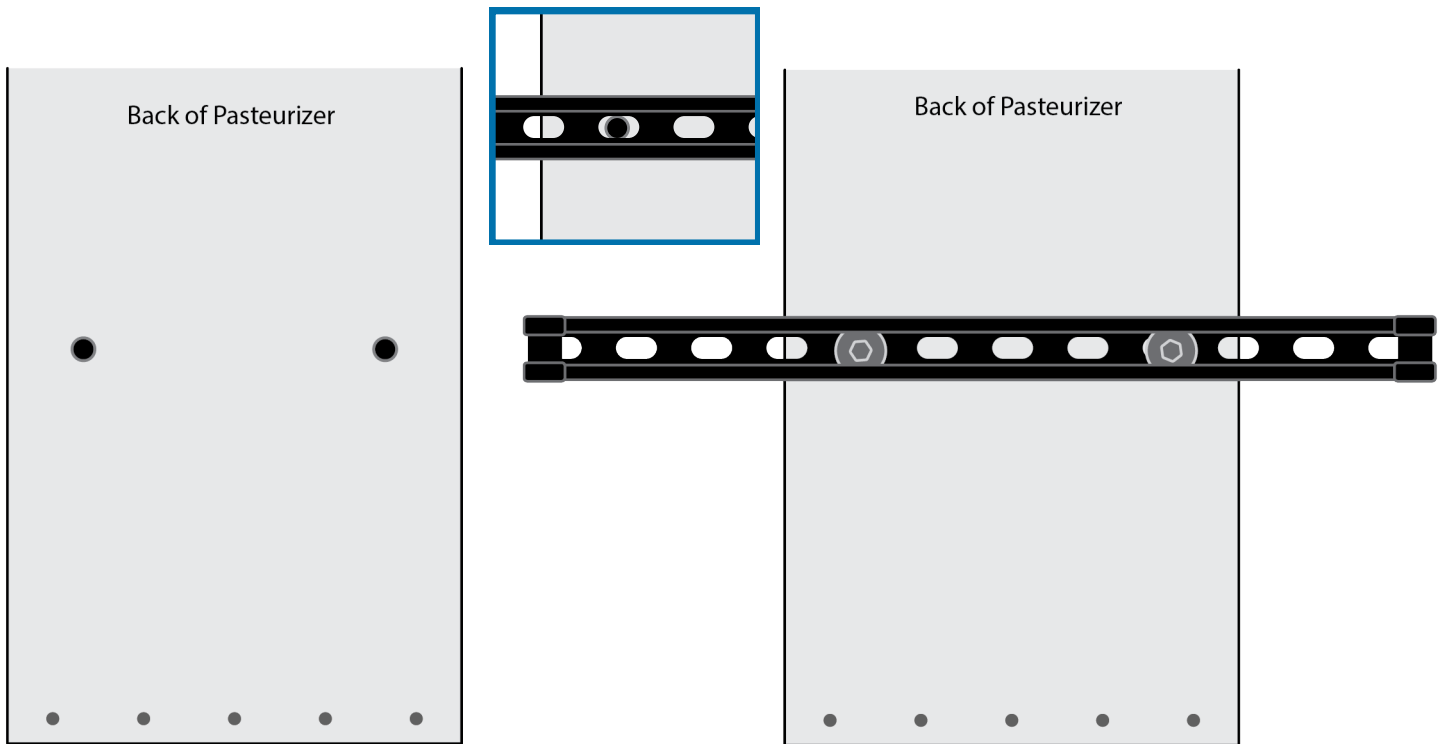


x4



x4

## Installation and Set Up Cont.

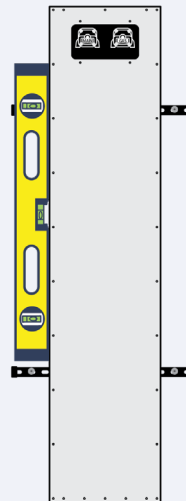


**1**



Next, use appropriate hardware (not supplied, large flat washer and T-25 deck screw shown in photo at left) to mount the pasteurizer mounting beams to the wall or stand. If mounting onto a wall, make sure that the steel mounting beams are securely mounted to wall studs that can handle the weight of the full pasteurizer (approximately 60 pounds).

**2**



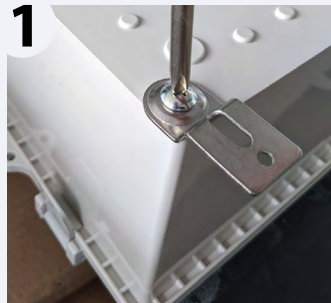
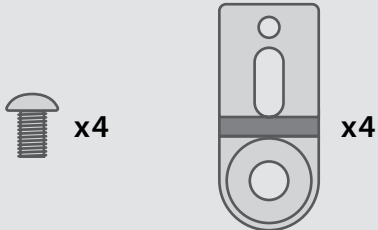
Use a level to ensure that the pasteurizer case is mounted vertically to the wall or stand. This will aid in the rapid and complete evacuation of gas bubbles as urine or wastewater heats up, which will help the system achieve optimal performance. See illustration near left for details.

## Installation and Set Up Cont.

### Mounting the Electronics Control Box

The electronics control box should be mounted adjacent to the pasteurizer, close enough so that all cable connections can be made without straining any wires or connectors. Also note that the control box LCD and controls should be easily readable and accessible for all users.

#### Mounting Parts - Electronics Control Box



**1** Install the 4 steel brackets (using a Phillips head screwdriver) onto the back of the control box

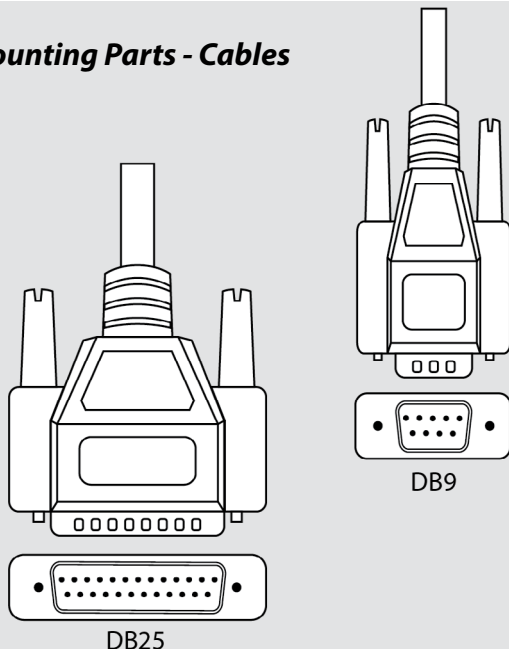
**2** Using appropriate hardware (not supplied), secure the control box to the wall or stand near the pasteurizer using the brackets attached in the previous step.

The pasteurizer and control box should be mounted in a location that is climate controlled for optimal operation. Please keep out of direct sunlight and inside an area that can contain any possible spillage. Urine infeed and outfeed tanks can be positioned nearby.

### Making connections between control box and main unit

Screw the two black plastic cable strain relievers onto their respective housings on the right side of the pasteurizer case. These are "corkscrew"-shaped spirals, pre-installed onto the DB25 and DB9 cables. These can be hand-tightened, no wrench necessary.

#### Mounting Parts - Cables



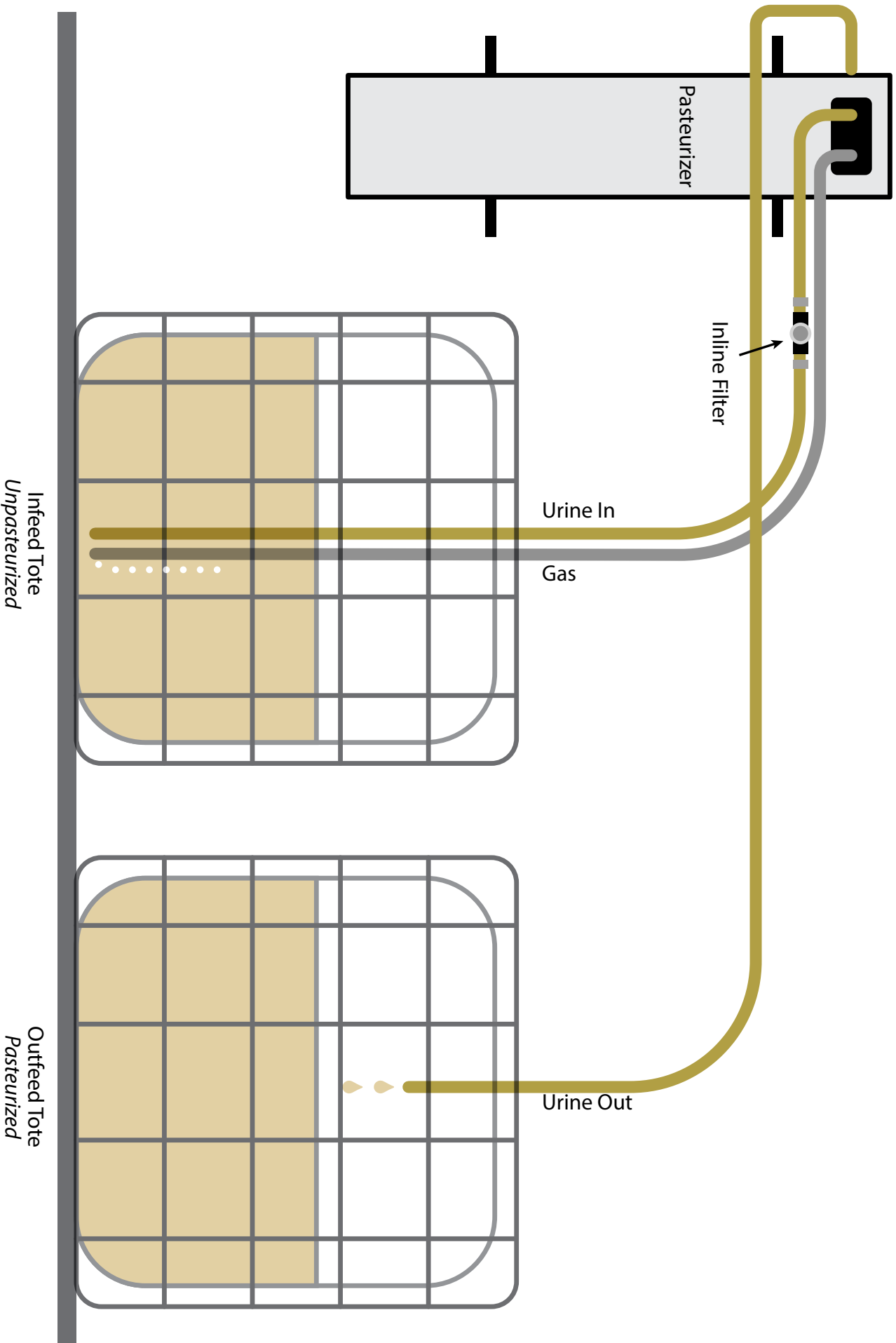
**1** Plug the DB25 cable from the pasteurizer into the DB25 port on the control box and fully tighten the two thumbscrews.

**2** Plug the DB9 cable from the pasteurizer into the DB9 port on the control box and fully tighten the two flat head screws.



**3** Plug the yellow power cable from the control box into the power port on the pasteurizer and tighten the threaded ring fully.

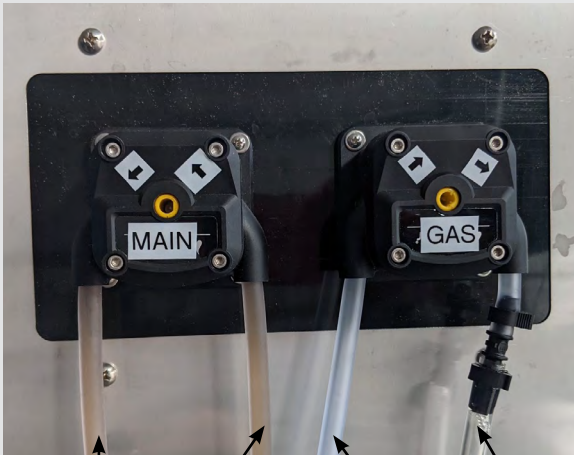
Figure 2. Connect pumps to in/outfeed tanks, main unit





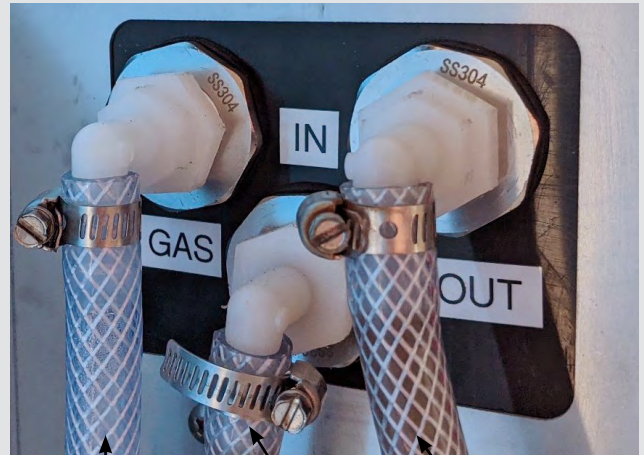
Using supplied tubing, connect the two pumps on the front of the pasteurizer case, and the barbed, right-angle bulkheads on the side of the main pasteurizer case, to your tanks. There are several tubing connections to be made:

**Tubing Connections - Front of pasteurizer case**



To "IN" on Side Panel      From inline filter on Infeed Tank line      From "GAS" on side Panel      Gas out, plumbed to bottom of infeed tank to bubble

**Tubing Connections - Left side of pasteurizer case**



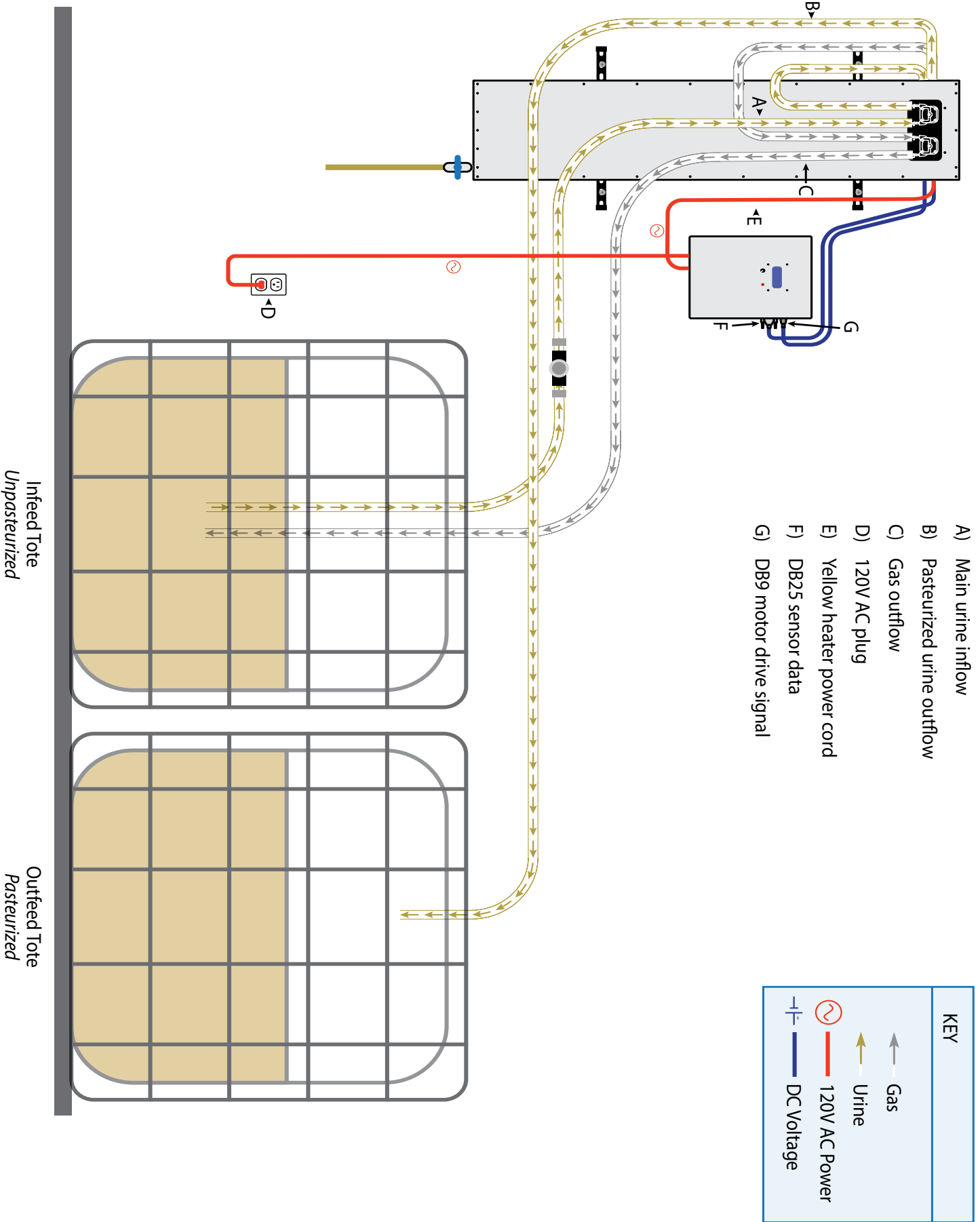
To "GAS" Pump, left pump hose      From main pump      To outfeed tank

Be sure to include the inline filter on your infeed hose, between the infeed tank and the main pump. The filter can be placed anywhere on the hose that is convenient. It should be accessible to enable periodic inspection and cleaning.



Verify that all connections are correct  
Refer to the diagram below to ensure that all connections are made before proceeding.

**Figure 3. Pasteurizer Connections and Fluid Flow Directions**



# STARTUP GUIDE

## Power-up procedure

- Plug the 3-prong, 120V AC power cord into a wall socket.
- Upon startup, the on-board computer will automatically enter “Mode: 0 = OFF” (see “Software” section for detailed mode descriptions).
- Using the knob on the front of the control box, push once to enable the menu, and rotate to select “Mode: 1 = FLOWBACK”. Push the knob again to engage this option. The pasteurizer pumps should turn on, and the pasteurizer should soon start filling up with wastewater from your infeed tank. The wastewater pasteurization process has begun!
- Under normal operating conditions, the control electronics of the pasteurizer will automatically transition from **Mode: 1 = FLOWBACK** → **Mode: 2 = FILL** → **Mode: 3 = PREHEAT** → **Mode: 4 = RUN**
- Once in Mode: 4, pasteurization has begun and you should notice fluid outflow. More information about the operating modes can be found in the “Software” section below.

## Navigate control menus

- Use the knob on the front of the electronics control box to navigate through the software menu. Push the knob once to enter the menu. Rotate the knob to cycle through menu options, and select your desired option by pressing on the knob again.
- The red button on the front of the electronics control box is an “interrupt” button that will send the unit into “Mode: 0 = OFF”. Be aware that once pressed, it may take several minutes before the unit can cycle through its modes and can be run again!

## SHUTDOWN PROCEDURE

- To manually shut down, simply use the knob on the control box to navigate to “Mode: 5 = SHUTDOWN”. Select this mode by pressing the knob once. Once the shutdown sequence has been completed, the unit will transition to “Mode: 0 = OFF”, where the heaters will shut off, and the pumps will stop running. The unit can be left in “Mode: 0 = OFF” indefinitely.
  - The pasteurizer will automatically shut down by entering “Mode: 6 = ERROR” in certain situations, including:
    - Overheat detected
    - Infeed running dry
    - Potentially unpasteurized outfeed detected
- Before unplugging the control box from the 120V AC wall outlet, it is best to make sure control box is in “Mode: 0 = OFF”.

## REQUIRED MAINTENANCE

- Every 2500L of fluid or gas pumped, the peristaltic pump hoses should be “rotated”. Peristaltic pumps work by deforming the pump hose, and as such the hose should be replaced periodically to prevent potential hose failure.
- 2500L = approximately 660 gallons. The screen on the control box will keep a running tally of liquid pumped through the pasteurizer in L. This tally can be reset to “0” at any time. See Mode: 8 = COUNTER RESET below for details.
- To “rotate” the hose, grasp the hose on either side of the pump head. Following the arrows on the pump label, pull one end of the hose while pushing the other end, working a fresh section of hose into the pump head. This can be done while the pump is running. Aim for approximately 10 cm of fresh hose rotated into place, to ensure that the pump head rollers are contacting a new portion of the hose.
- Every 2500L of urine pumped (i.e. every time you rotate the main pump hose), we recommend running a 10% citric acid and water solution through the pasteurizer to keep it clean.
  - To do this, mix your citric acid solution in a 5 gallon bucket or similar container. While the pasteurizer is in “RUN” mode, drop your infeed hose into the citric acid solution and allow it all to pump through the pasteurizer. Whether or not you divert the outfeed during this process is up to you.
  - Once the container is empty, follow this same procedure with a tap water rinse (can use the same 5 gallon bucket).
  - It is advisable to drain the contents of the pasteurizer once the water rinse is complete. To do this, place a suitable container underneath the pasteurizer case with the drain hose and valve directed into the container. With the pasteurizer in Mode: 0 = OFF, open the drain valve and allow the contents of the pasteurizer to drain into your container. When complete, close the drain valve, re-plumb your infeed hose to your infeed tank, and restart the pasteurization process. Draining the pasteurizer periodically will assist in the evacuation of larger mineral accretions.
  - It is important to keep the outfeed hose free and clear of any potential blockages. Draining the pasteurizer periodically can help prevent this possibility. A blocked outfeed can over-pressurize the pasteurizer, potentially damaging the pasteurizer and causing a leak.
- Replace the peristaltic pump hoses when you reach the end of the hose section in place and can no longer rotate to a new section. Contact us if you need more tubing.
- Every time you replace the tubing, lubricate peristaltic pump rollers and hoses with silicone grease.
- Periodically check the inline filter for clogging. Clean as necessary.
- Every 25,000L of fluid pumped, the 2 silicone maze gaskets should be replaced. These gaskets will degrade over time and should be replaced periodically. Please contact us for replacement gaskets.

## SOFTWARE

### Operating Modes

**Mode: 0** = OFF

**Mode: 1** = FLOWBACK

**Mode: 2** = FILL

**Mode: 3** = PREHEAT

**Mode: 4** = RUN (Normal operating mode)

**Mode: 5** = SHUTDOWN

**Mode: 6** = ERROR

**Mode: 7** = MANUAL (Not available through user interface, for back-end connection only)

**Mode: 8** = COUNTER RESET

**In Mode: 0**, all pumps and heaters are turned OFF. To get out of Mode 0, you must manually select the Mode of your choice using the control knob on the electronics control box.

**In Mode: 1**, or FLOWBACK mode, the pasteurizer will begin a sequence to empty itself of potentially unpasteurized (or “left over” from a previous run) wastewater. This is a precautionary step that should take place each time the pasteurizer is started from a “cool”, or room-temperature, state.

**In Mode: 2**, or FILL mode, the heaters remain OFF and both the main pump and the gas pump will run forwards. This will pump urine from the infeed tank into the pasteurizer while evacuating air. Sensors on the pasteurizer will be able to tell when the unit is full of urine, at which point the controls will automatically transition to Mode 3 = PREHEAT.

- If any liquid is detected at the output of the device during Mode 2 = FILL, this will stop the main pump and trigger Mode 6 = ERROR. This prevents the outflow of potentially unpasteurized urine.

**In Mode: 3**, or PREHEAT mode, the main pump will turn off, and all heaters will begin to heat the pasteurizer, up to at least 80 °C. The gas pump will run as needed, to evacuate gas bubbles that may form as urine heats up. Once temperatures inside the pasteurizer have reached at least 80 °C, the controls will automatically transition to Mode 4 = RUN.

**In Mode: 4**, or RUN mode, the main urine pump runs forwards, and the pump speed will be modulated automatically. The heaters will run in their most efficient mode, only turning on as needed to keep temperatures inside the treatment zone of the pasteurizer at or above 80 °C. The gas pump will run as needed to evacuate gas bubbles as they form.

- Temperatures within the pasteurizer are continually monitored, and the main urine pump speed will automatically adjust itself to ensure adequate treatment time (at least 90 seconds at 80 °C) while attaining maximum safe throughput.
- Our pasteurizer is designed to run in Mode: 4 continuously.
- You can manually transition to Mode: 5 = SHUTDOWN by using the control knob.
- If the infeed tank runs dry during Mode: 4 = RUN, our controls will sense that there is no longer any incoming fluid, and the unit will automatically transition to Mode: 6 = ERROR.

**In Mode: 5**, or SHUTDOWN mode, all heaters are shut off, and once temperatures drop below 45 °C (which may take some time), the main urine pump will run in REVERSE to empty one side of the pasteurizer. This may pump unpasteurized urine back into the infeed tank.

- If sensors detect that the main float switch at the pasteurizer input drops for >20 seconds, the unit will automatically transition to Mode: 0 = OFF.
- After Mode: 5 = SHUTDOWN transitions to Mode: 0 = OFF, some liquid may remain inside the pasteurizer. If you would like to completely drain the pasteurizer, place a suitable container underneath the drain port at the bottom of the pasteurizer, and open the drain valve. To ensure safe handling, any urine collected in this manner should be considered unpasteurized and put back into the infeed (unpasteurized) tank. Once empty, close the drain valve.

**MODE: 6** = ERROR. Heaters off, pumps off.

If Mode: 6 is triggered, the user must manually transition to another mode using the control knob.

**Mode: 7**, or MANUAL mode, can only be entered through a back-end wifi software connection for diagnostic purposes. Not for normal use.

**Mode: 8**, or COUNTER RESET mode. This allows the user to reset the fluid and gas L counters on the LCD to 0.0. This can be especially useful when determining when to clean the unit by resetting the counter to 0 after each cleaning to easily know when you have reached 2500L of fluid pumped.

## **WARRANTY — Two Years**

Brightwater Tools, Inc warrants the original purchaser that this pasteurizer is free from defects in material and workmanship under normal use.

### **This warranty covers**

- New parts for any part that fails within two years, provided that our inspection shows that the failure is due to defective material or workmanship.
- Any part supplied by us to replace another part is warranted for the balance of the original warranty period.
- Technical support for installation of new parts up to 5 hours annually.

### **This warranty does not cover**

- Damage resulting from neglect, abuse, alteration, or accident; or damage caused by fire, flood, acts of God or any other casualty.
- Parts and accessories not supplied or manufactured by Brightwater Tools, Inc, or any damage resulting from the use of such items.
- Damage or failure resulting from the failure of the purchaser to follow normal operating procedure, including regularly scheduled maintenance outlined in the Owner's Manual or in any other printed or video instructions.
- Labor and service charges incurred in the removal and replacement of any parts found defective under the terms of this warranty.
- All returns to the factory must be made freight prepaid. All shipments from the factory are made "free on board" from the factory.

This warranty is in lieu of all other warranties expressed or implied, and no person is authorized to enlarge our warranty responsibility, which is limited to the terms of this statement. Brightwater Tools, Inc reserves the right to change, improve or modify its products without obligation to install these improvements on equipment previously manufactured.

## **SERVICES**

- Contact us at Brightwater Tools any time with questions, or if any service is needed.
- Telephone or video calls will be available for assistance with replacing parts, servicing or maintenance.
- Included in the product warranty is up to 5 hours of technical support per year, for the duration of the warranty period. Technical support beyond that included in the warranty will be billed at an hourly rate.