This user's guide was developed to provide instructions for correctly using the PiAstra Pasteurization Monitor for flash-heat-like pasteurization of donor human milk. Flash-heat is a low-cost, simple pasteurization method used to pasteurize donor milk for vulnerable infants, who do not have access to their mother's breast milk. PiAstra uses user-friendly off-the-shelf, modular technology to guide the user throughout the pasteurization process.

The University of KwaZulu-Natal developed the system using elements of the FoneAstra foundational system developed by PATH and the University of Washington.

Research and development work on PiAstra has been made possible by GSK/Save the Children Health Innovation Award to UKZN, Department of Paediatrics and Child Health.

Purpose
Human Milk Flash Heating Pasteurization

"Giving Life a Chance"
Acknowledgements:

The PiAstra Pasteurization System development was made possible through a GSK/Save the Children Health Innovation Award to Prof Anna Coutsoudis (Department of Paediatrics & Child Health, University of KwaZulu-Natal (UKZN)).

The PiAstra system was developed by Noel Powell and Philip Barlow (both UKZN alumni).

The system was based on the initial FoneAstra system developed by PATH and the University of Washington (Seattle), Computer Science and Engineering Department and we gratefully acknowledge these contributions.

Project Partners

KZN Department of Health

iThemba Lethu Breastmilk Bank
PiAstra
Components

1. PiAstra base
2. PiAstra touch screen monitoring device
3. Temperature probe secured in the lid
4. Induction stove
5. Four 120ml- glass bottles with hard plastic lids—autoclavable
6. Bottle stand
7. 16 cm Pot- induction-compatible
8. Stainless steel ice water basin
9. Four frozen ice packs
10. Label-printer
11. Power Multi Plug Adaptor for label printer, PiAstra and stove
12. PiAstra Mini USB power cable. (See page 6)
13. Printer power cable. (See page 6)
14. Printer USB to PiAstra cable. (See page 6)
15. Probe Cable. (See page 6)
16. 1 litre plastic jug
17. Timer
PiAstra Details

Left Short Side
1. Temperature probe port
2. USB printer output
3. USB flash memory drive input and output

Top Long Side
4. Mini USB power connection

Right Short Side
5. Memory Card Slot

1 Temperature Probe Port
2 & 3 USB Ports

Temperature Probe Connection

Power Connection

5 Memory Card Slot
Step 1: Positioning the PiAstra Pasteurization Components

- Place the induction stove in the centre.
- Ensure that you use the supplied 16cm pot. Check for rust and that it is not damaged.
- Place the PiAstra unit and printer to the right of the induction stove.
- Place the ice water basin, jug, pot and bottle stand to the left of the induction stove.
Step 2: Connecting the PiAstra Pasteurization Components

N.B. When possible ensure there will be no power outage during the pasteurization process

- Wipe the PiAstra touch screen with a clean dry cloth
- Plug the following into the Mains Multi Plug Power Adaptor
  - PiAstra USB Power cable (A)
  - The Induction stove power cable (3 pin) (B)
  - The printer power cable (2 Pin) (C)
- Plug the following into the PiAstra unit
  - The printer USB cable from the printer (D)
  - The Mini USB from the Mains Multi Plug Power Adaptor (E)
  - The temperature probe from the probe holder bottle (F)

N.B. Do a final check to ensure that all the above is correctly connected
Step 3: Bottle Filling

- From the fridge remove the donor milk that was defrosted overnight.
- Also remove Full Cream Cow's Milk from the fridge (Hereafter called Full Cream Milk or FCC Milk).
- Ensure you have a supply of washed and autoclaved bottles and lids.
- Check that the bottle and lids are not cracked, cloudy or damaged.
- Wash hands well and put on clean gloves.
- Fill the first clean, autoclaved bottle with 110ml of and Full Cream milk. Fill the other three clean, autoclaved bottles with 110ml each of donor milk.
- If you fill the bottle to the base of the neck before it curves in, this is approximately 110ml (Fig.1).
- The Full Cream milk in the probe bottle must be similar in temperature to the donor milk. If the donor milk is cold from the fridge then the Full Cream milk in the probe bottle must also be cold from the fridge.
- If the donor milk is at room temperature then use room temperature Full Cream milk in the probe bottle.
- If there is not enough milk to fill three bottles, fill the extra bottles with water.
- All bottles should have the same volume of milk. If this is not possible, fill the Full Cream Cow's Milk probe bottle to the same volume as the fullest bottle.

N.B. This is the optimum level of Full Cream Cow's Milk in the probe bottle to ensure that the milk samples reach adequate heating temperatures for pasteurization.

N.B. Ensure that no moisture or liquids come into contact with the mains adaptor, the PiAstra unit, the printer and induction stove.

N.B. Homogenized Full Cream Cow's Milk is used in the probe bottle as its density and heating rate closely resembles breast milk.

Step 4: Pre-Labelling

- Ensure that the lids of the bottles are screwed on tight.
- Place a temporary masking tape strip on the lid of each bottle and write P or T (Pre-Term or Term), donor number and expression date.

N.B. Printed labels will be printed and secured on the bottles and lids after pasteurization.

N.B. No Full Cream Cow's Milk is shown in Fig. 2 so that the probe can be seen.

Step 5: Secure the temperature probe lid, onto the FCC Milk filled bottle.

- Ensure that the temperature probe is covered by the Full Cream Cow's Milk. This is essential to monitor that the correct pasteurization temperatures are reached.
- Place the temperature probe bottle in the stand.
- Secure the probe cable to handle as indicated. (Fig.2)
Step 6: Placing the stand and filling the pot

- Having placed the donor milk bottles and probe bottle in the stand, load the stand in the pot (Fig.3).
- Carefully fill the pot with tap water by pouring water down the inside of the pot, until the water just starts to overflow through the central hole in the stand (Fig.4a & 4b).
- Place the pot on the induction plate (Fig.3).

N.B. It is important to keep all wet works away from the induction plate, PiAstra and Printer.
Final Check

Step 7: Final Check
- Having followed all the previous instructions … check!
  - That the Probe is secured in the Full Cream milk bottle and plugged into the PiAstra.
  - N.B. If the Probe is not secured properly in the PiAstra then a "No Probe" warning message will appear below the clock. (Fig.5)
  - If the probe is properly secured in the PiAstra then a temperature reading will appear below the clock (Fig.7)
- Check that ….
  - The Probe is secured in the Full Cream milk bottle and plugged into the PiAstra.
  - N.B. If the Probe is not secured properly in the PiAstra then a "No Probe" warning message will appear below the clock. (Fig.5)
  - If the probe is properly secured in the PiAstra then a temperature reading will appear below the clock (Fig.7)
- The Power cable is plugged into the PiAstra (mini USB) and USB connector plugged into the Mains Multi Plug
- The printer power cable connected to the printer and the Mains Multi plug
- The printer Data cable connected to the PiAstra and USB
- The Induction power cable connected to the Mains Multi plug

N.B. Switch on the Mains Multi Plug Power Adaptor now!

Switch On

Data Entry

Step 8: Switch on
- If all the components are connected, Power On indicator lights will appear on the Mains Multi Plug Power Adaptor, the printer, the stove and the PiAstra.
- The PiAstra will take 30 seconds to load the main menu.
- Once loaded the main menu will appear. N.B. If no entries are made the PiAstra screen saver logo will appear (Fig. 6). Touch the screen and the main menu will appear.

Step 9: Start Data Entry
- Ensure that the clock time and date is correct. If not touch the clock face and set the correct time and date.
- Follow Instructions and then return to the main menu.
- Select Start then Add Donor (Fig.7 & 8)
- Select Term or Premature (Correct selection will be highlighted)
- Enter Donor ID. E.g. 012.16
  - N.B. All donor numbers must have 3 digits E.g. Donor No. 2 would be 002.16 (the last 2 digits 16 denote the year 2016) and similarly Donor No.21 would be No.021.16
- Enter the volume of the milk if it is more or less than the preset 110ml. If it is the preset volume of 110ml no entry is required.
- Set Expressed Date and Accept (Fig.9)
- The screen will return to the main menu - select Done.
- Repeat the process for the other 2 bottles, even if it is the same donor and the same details, enter the details again.

N.B. If data entries are incomplete the pasteurization process will not continue until the missing data entries are made.
Step 10: Start Pasteurization Process

- The waiting to start menu will appear. (Fig. 10)
- Switch the stove on by pressing the **On /Off** switch. (Fig. 11)
- Then select the **Hot Pot** setting and switch on. This will switch on the induction stove (Fig. 11) and immediately select the green **Start** button on the PiAstra. (Fig 10)
- The Pasteurization process has started.
- Add 2 litres of water (preferably chilled) into the stainless steel basin.

Step 11: Getting Ready to remove heated milk (Heating Process)

- Observe the PiAstra and it should be noted that the temperature will rise. If not ensure that the probe is pushed in securely.
- When the temperature reaches 66°C the PiAstra unit will begin to give a warning beep. (Fig. 12)
- Watch the temperature and as 71.5°C is reached the PiAstra will give long beeps and the PiAstra will also instruct you to remove the milk stand. Immediately remove the milk stand from the pot and place it in the 2 litres of water (preferably chilled) in the stainless steel ice water basin.
- Ensure that the cord of the temperature probe does not get caught on anything when transferring the stand with bottles over to the water basin. (Fig. 13a)
- Switch the induction stove off or remove the pot. When the pot is removed the induction stove automatically switches off.

N.B. This cooling waiting period is important as it allows the bottles to cool down. If they were immediately placed in the water with ice bricks the bottles would crack.

Step 12: Cooling Process

- During this cooling waiting period have the 4 plastic ice bricks ready.
- After approximately a minute the PiAstra will beep again when the temperature reaches 70°C and instruct you to add the 4 ice packs to the stainless steel basin.
- Carefully place the ice bricks around the milk stand placing them in the 2 litres of water in the basin. (Fig. 13b) If the water level is correct the water should once again just start to overflow through central hole in the stand. (Fig. 4. Pg. 9 ) If it doesn’t, carefully add water until it does.
Step 13: Completing the Pasteurization Process

- When the milk has reached the required minimum cooling temperature of 25°C, the PiAstra will beep and instruct you to remove the stand from the water basin.
- Press the PiAstra touch screen OK button to continue the process. (Fig. 14)
- Remove the stand from the water basin.
- Remove the milk bottles and wipe them dry, both the glass and the lids.
- Print the bottle labels. Select Print Labels menu option. (Fig. 15)
- Also select Print Lids menu option labels for the lids. N.B. This sticker must be cut in three.
- Adhere the bottle labels on the specific bottles as marked by the temporary masking tape. (Fig. 16)
- Adhere the lid labels one at a time after removing the temporary masking tape label. (Fig. 17)
- Store the pasteurized milk in the freezer.
- Print a batch report and graph and paste them on your log sheet.

Step 14: End of Pasteurization Procedure

- Switch off the induction stove.ovoltaic
- When the entire pasteurization process is complete wash the following in hot water and soap:
  - Wash the bottle stand
  - Wash the Pot
  - Wash the Basin
- Remove the probe from the bottle containing FCC Milk and spray the probe and the inside of the lid with 70% ethanol and then dry the probe and lid with a paper towel.
- Place a plain lid on the FCC Milk and write the date on a piece of masking tape and adhere it to the lid. The milk can be used for up to a week after the first time it is used, provided it is stored in the fridge.
Managing Database Log & Settings

View Logs Menu
- Select View Logs from the Main Menu (Fig. 18)
- To be specific select …… Sort o ID o Date or o None (Fig.19)
- If ID is selected a selection is made using Donor ID
  - Once selected an item can be deleted or if not deleted and selected a graph will be displayed for the selected item
- If Date is selected a selection is made using the Date
  - Once selected an item can be deleted or if not deleted a graph will be displayed for the selected item
- If None is selected, selecting Back will return to the Main Menu.

Print Batch Menu
- Select Print Batch from the main Menu. (Fig. 18)
- A new menu will appear. (Fig.19)
- To be specific select …… Sort o ID o Date or o None
- If ID or Date is selected a specific file can be selected and printed.
  - Print Label (Fig.20)
  - Print Graph (Fig.21)
  - Print Summary (Fig.22)
- Once selected the printer will print the specified selection
  - To Close Print operations select Close and return to main menu.

N.B. The Batch No. and centre will appear on the report, graph and labels. Batch = No. of batches processed at that centre with the specific PiAstra. It will add a single digit for every new batch done.

E.g. ITL 4 and the next would be ITL 5
Managing Database Log & Settings

N.B. This More Menu option is not intended for the usage of the PiAstra user in a specific Pasteurization centre but for the once off setting and operation by an authorized person.

In some instances the supplier might instruct the user to make changes in this section with specific detailed instructions.

If the More menu is selected two columns will appear (Fig. 23 & 24)

- Go to the right hand side column:
  - Settings (Fig. 24)
  - Copy Logs (Fig. 24)
- If Settings is selected four options are available (Fig. 25)
  - Set Location
  - Warning Level
  - Network Setup
  - Update Firmware
- If sub menu Set Location is selected
  - The location of the centre can be set
- If Warning Level is selected
  - This sets the temperature warning level
  - It’s default setting is 66°C
- If Update Firmware is selected
  - New Software can be downloaded to the PiAstra if a USB flash drive memory stick is connected in the USB port on the left of the PiAstra. N.B. Must be formatted to FAT32.
  - Make a selection if Firmware is found.
  - Once completed return to the Settings Menu
- If Copy Logs is selected
  - The data can be copied to a USB flash drive memory stick. N.B. Must be formatted to FAT32.
    - Two Options given
      1. Keep logs after copying
      2. Delete logs after copying
      3. Select option Copy
      4. Select OK and data will be copied to USB flash drive
      5. If Delete is selected a warning message will confirm your choice ...... Yes or No
  - Return to Shut Down menu and select if no further pasteurization is to take place.
  - Message Safe to remove power.
  - Unplug power cable from the PiAstra.

PiAstra Manual: HUMAN MILK FLASH HEATING PASTEURIZATION
Recommendations in Case of an Emergency:

In case of the PiAstra not functioning properly and the defrosted donor milk still needs to be pasteurized, do the following until you can get the PiAstra repaired or replaced.

Note that a timer will be required.

**Step 1:** Prepare the donor milk bottles: • Ensure that the lids of the bottles are screwed on tight. Follow original steps (page 8) however you will not need to place the temperature probe in the first bottle containing Full Cream Cow’s Milk – simply fill it with 110ml water and place an ordinary lid on.

**Step 2:** Pre-label the lids (page 8) and place each bottle in the stand in this order: Water control with ordinary lid, Donor milk, Donor milk or water, Donor milk or water.

**Step 3:** Having followed the instructions on page 8, switch the on/off button and the HOT POT buttons on the stove.

**Step 4:** While the water is starting to boil, fill up the water basin with 2 litres of chilled water.

Observe the water in the pot and once the water starts boiling vigorously with water droplets coming onto the stand. **Set the timer to start.** When the timer has reached 1.30 min remove the stand and bottles from the pot. (Timer Provided in the Kit)

**Step 5:** Place the bottle and bottles in the chilled water bath for 1 minute.

**Step 6:** Turn off the stove by pressing the top right ON/OFF button.

**Step 7:** As the milk is cooling, get the ice packs out of the freezer. After 1 minute of being in the chilled water bath (the timer will be at 2.30 min) add four ice packs to the water basin.

**Step 8:** After 5 minutes (the timer will be 7.30 min) turn the ice blocks. After another 4 minutes (the timer will be at 11.30 min) remove the bottle stand and bottles from the water basin. **(Reset Timer)**

**Step 9:** Because the pasteurization report cannot be printed this must be entered manually into the pasteurization log.

**Step 10:** Write out labels by hand and include the following:

- Pasteurized Donor Human Milk (Term or Pre-term)
- Donor Number ………
- Prem best before date: ……………………… (add 3 months to expression date)
- Term best before date: ………………………(add 6 months to expression date)
## Trouble shooting

### Problem 1: PiAstra “ON” indicator lights not illuminated

- Ensure that the power cable is connected at the back PiAstra connection and in the multi plug (See Fig. 26 below and Page 7. A... E).

![Fig.26](image1)

### Problem 2: Stove will not switch "ON"

- The stove will not switch on unless the supplied pot is used and placed on the heating circle.

### Problem 3: PiAstra not showing opening screen

- Ensure that the temperature probe is fully pushed in (See Fig. 27 below).

![Fig.27](image2)

### Problem 4: Printer will not print

- Check that the printer labels are not depleted.
- Check the power connection in the printer and multi plug (Page 7. C).

### Problem 5: Pi Astra showing a negative temperature reading on the screen

- Ensure that the temperature probe is fully pushed in. (See Fig. 27 above)
- Restart process

---

## Contact Information

**Ithemba Lethu Breastmilk Bank**

**Email:** breastmilkbank@ithembalethu.org.za