JL- P3.1 – Warm Bath Reference Procedure (WIP).

Introduction:

This procedure is for a quasi-fixed point liquid bath at 35 to 40°C. (verify the BIOS range in user guide). This procedure is part of the three-point calibration process for the TDL device. It can be replicated by the user to verify the calibration. The procedure was made using at BIOS 16C2 but other ovulation thermometer could work as wel. The ovulation thermometer is used to monitor the mouth temperature of women in order to detect the ovary cycle and enhance pregnancy chances of success. Due to its medical use, the ovulation thermometer is a reliable product, with high resolution (0.01°C) and good accuracy (+/-0.1°C) in its limited temperature range, which is the body temperature range. The analog-to-digical (ADC) converter being applied to a narrow range of temperature, the uncertainty related to numeric conversion is reduced with this type of thermometer. This help make the thermometer affordable. These type of thermometer are affordable (30$US) and can be found easily in most drug stores. The BIOS company still has not answered me about the confidence interval for their 0.1C uncertainty.

Required material:

- Insulated vessel with a lid, with at least a 300 mm in height and 70 mm in diameter.
- Ovulation thermometer, such as the BIOS 16C2
- Tap water
- Clean temperature probe to be calibrated (ex: Thermistor from Jericho)
- Clean 30 cm plastic ruler
- Scotch tape

Disclaimer: Jericho Laboratory is not responsible for damage or safety if you attempt to reproduce this procedure.

Procedure:

- Heat some water on the stove until warm (around body temperature)
- Test the water temperature with the BIOS
- Put 2L of the warm water into the clean thermos
- Put the lid on the pot for 5 min (so that the thermos reaches thermal equilibrium)
- Tape the probes on the ruler.
- The other side of the ruler should contain the BIOS thermometer
- The pointe of the thermistor should be 5 cm from the bottom
- Open the thermos
- Put the ruler in the center
- Insert probe in the water-ice mix at a minimum depth of 20 cm to reduce the thermal leak from the electric wire. Let sit for one (1) minute. The probe must be at least 5 cm from the bottom and 2 cm from the side walls at all time.
- Measure first the BIOS, you will hear the bip bip through the water.
- Note the temperature (ex: 37.21°C).
- Measure the thermistor for 30s (at 1s interval)
- Measure a second time the water temperature with the BIOS thermometer, you will hear the bip bip

- Note the temperature (ex: 37.15°C)
- average the beginning and ending temperatures. (ex: (37.21 + 37.15)/2 = 37.18). This value is the reference temperature of the experiment.
- that's it.

Comments

1. According to previous measurements, the Coleman recipient when containing water at 37°C looses approximately X.XXC per minute.
2. The BIOS thermometer will retain the highest temperature registered. It will take X sec before beeping once the temperature is stable.
3. A non-insulated vessel gives the same temperature point with less accuracy due to a less homogeneous bath temperature. An insulated vessel also last longer (a few hours).
4. Figure X1X shows the temperature spatial distribution inside the ice bath. This was made with probes already calibrated. With a 15x10cm vessel, the optimal calibration zone is X x X cm.
5. Make sure that no bare metal wire is exposed to water.
6. Calibration procedures in general are delicate procedures and may take a few tries to master. If you are unsure of the results, the calibration should be repeated and generate very similar data.
7. Do not stir during the measurements, as this will increase heat losses.
8. This procedure is not based on any official procedure (e.g. ASTM, NIST). (Is there something similar , such as a procedure for electrical liquid baths ?)
9. The bath could be replaced by an electrically heated bath.
10. Although the temperature of a cooling object evolves logarithmically, on a very narrow range (0.1C), it is reasonable to approximate a linear relationship.
11. It is not necessary to use distilled water or gloves for this procedure.
12. The thermistor must be immersed deeply enough to avoid perturbation of the temperature by radiation or thermal conduction along the electrical wire.
13. The Joule effect bias is reduced by taking a 5 mS measurement every 1 second. The heating is therefore negligible.
14. At Jericho Lab, the resistance value of the thermistors is not measured with a TDL device, but with a similar device of higher precision that incorporates an Arduino Mkr Zero.
15. It is possible to test more than one probe at the same time. HOWEVER, THIS WILL INCREASE THE THERMAL LEAK AND REDUCE THE ACCURACY, STABILITY OF THE ICE BATH.
16. The pot cannot be glass. Otherwise, the probe will radiate heat through the glass and will give the wrong answer.
17. It is normal that during measurements, probe temperature will vary. This is why we average.
18. A plastic structure could be inserted to reduce the convection within the column of liquid, leaving a hole in the center for the probes.

Reference

1. BIOS User guide.