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Applicability

Royal Oak

Standardization and Calibration of Thermometers -Royal Oak Blood Bank

Document Type: Procedure

I. PURPOSE AND OBJECTIVE:

This document provides procedure and guidance for the standardization and calibration of liquid-in-glass thermometers and digital thermometers.

II. POLICIES:

- A. Thermometers used during laboratory testing, processing, and storing of reagents, supplies and blood components will be calibrated and standardized to ensure accurate indication of temperatures.
- B. Calibration will be performed at temperatures close to the temperature at which the thermometers will be used.
- C. Each thermometer will be calibrated before initial use and annually thereafter, as well as any time there is reason to suspect change or damage.
- D. Additional calibrations are not required for new thermometers (if there is proof of calibration performed by the manufacturer) until after the calibration expiration date.

III. DEFINITIONS / ACRONYMS:

- A. **NIST:** National Institute of Standards and Technology.
- B. **Sub-Zero Thermometer Containers:** Thermometer containers that are filled with sand (or an equivalent material) and used in environments that are too cold to use water or glycerol as a temperature buffer.

- C. **IR:** Infrared

IV. EQUIPMENT / SUPPLIES:

- A. NIST-Certified thermometer or thermometer with NIST-Traceable Calibration Certificate.
- B. Thermometers to be calibrated.
- C. A suitable container to hold water.
- D. A suitable container to place digital thermometers.
- E. 37°C water bath.
- F. 37°C incubator.
- G. Beaker
- H. Scrub brush
- I. Deionized Water.
- J. Tap Water
- K. Crushed ice.
- L. Dry ice.
- M. Isopropyl alcohol.
- N. Temperature-buffered medium (i.e., glycerol, sand, or equivalent material).

V. EQUIPMENT / MAINTENANCE:

Recertification of NIST-Certified thermometers will be done on an annual basis by an outside source or replaced if applicable.

VI. PROCEDURE:

A. Thermometer Inspection and Preparation:

1. Inspect all liquid-in-glass thermometers for any split in the column that may cause inaccurate readings. Acceptable appearance is an intact column of liquid.
 - a. When separation in an indicator column is noticed, the thermometer cannot be used until it is resolved and there is no longer a separation. If separation occurs at the upper portion of the thermometer, heat the bulb slowly until the separated segments and a portion of the main intact column enter the expansion chamber, the liquid should rejoin. Examine the column as it cools and retracts to be sure it is intact. Be careful not to overfill the expansion chamber.
 - b. When separation is in the lower portion of the thermometer, cool the bulb in a mixture of dry ice and isopropyl alcohol so that the column retreats slowly into the bulb. Cool the bulb only. Continue until the main column and the separated portion retreats into the bulb. Remove and swing the thermometer in a short arc, forcing all the liquid into the bulb. Allow the bulb to come to room temperature and examine the

column as it warms to confirm there is no separation.

- c. Document the separation repair in the *Corrective Action* section of the *Thermometer Calibration Log*. After the corrective action, verify the calibration of the thermometer using this procedure and record the *Thermometer Calibration Log*.
2. Inspect all digital thermometers and make sure the display is clear and free of obstructions. Replace the batteries within the digital thermometer if the display appears weak or inconsistent.
3. Follow the manufacturer's instructions for proper immersion of liquid-in-glass thermometers in use.
4. When using a NIST-Certified thermometer, read and follow the applicable notes. Be sure to include any correction factors noted on the certificate for the NIST-Certified thermometer and apply them in calculations.
5. Be sure that the NIST certification has not expired.
6. Group the thermometers together based on what temperature they are used for.
 - a. Some thermometers may be calibrated at multiple temperature points, such as room temperature and 37°C.
7. Record each thermometer's manufacturer serial number (or assigned number if no manufacturer serial number is available) on the *Thermometer Calibration Log*.
8. Verify the certification of the NIST-Certified thermometer being used for calibration is not expired. Document the NIST-Certified thermometer's serial number on the *Thermometer Calibration Log* as well as its certification expiration date.

B. Preparation of 5% Glycerol Solution for the Cooler Containers

1. Measure 150 mL of glycerol into a flask.
2. Pour the glycerol into a clean 24 hour urine container obtained from the STAT lab.
3. Using the measurements on the side of urine container, add enough DI water to measure 3000 mL.
4. Document the 5% glycerol container with the tech initials, date the solution was made, and make sure it is clearly labeled "5% glycerol solution".
5. Place the 5% glycerol into the walk-in refrigerator overnight to ensure that its temperature is between 1- 6°C.

C. Cleaning the Thermometer Containers Containing 5% Glycerol

1. Take 2 coolers out of service and removed the thermometers and glycerol container from each.
2. It is acceptable to move the coolers to the back of the walk-in refrigerator while cleaning the

- thermometer containers.
3. Pour the old 5% glycerol solution from the thermometer containers down a dirty sink and flush the containers with tap water.
 4. Rinse the thermometer off with tap water and wipe it down with isopropyl alcohol.
 5. Clean the inside and outside of the container cap with isopropyl alcohol.
 6. Fill the container with isopropyl alcohol and thoroughly scrub the inside of the container with a scrub brush.
 7. Rinse the container out with tap water.
 8. Rinse the container out with isopropyl alcohol.
 9. Take the container parts (top, bottom, and thermometer) into the walk-in refrigerator.
 10. Fill the container with the new 5% glycerol.
 11. Put the cap back onto the container with the thermometer inside.
 12. Make sure the thermometer container is labeled with the cooler number to which it belongs, as well as the thermometer serial number that is inside the container.
 13. Let it equilibrate for approximately 10 minutes until the thermometer reads about 4-5°C.
 14. Put the container back into the cooler and put the cooler back into use.
 15. Record the cooler number, thermometer number, date, and technologist who cleaned the container on Cleaning Thermometer Containers in the Coolers.

D. Verifying Laser Thermometers, Data Loggers, and NIST-Certified Thermometers before Being Placed Into Service

1. Verifying Laser Thermometers:

To verify a laser thermometer, take the temperature of 3 blood products (1 red blood cell, 1 thawed plasma, and 1 platelet) using the laser thermometer and compared to a NIST-certified thermometer reading of the same blood products.

- a. Use the the *Thermometer Calibration Log* to document the readings.
- b. The red blood cell and thawed plasma should be 1-6°C and the platelet should be 20-24°C.
- c. Verify the laser thermometer being verified and the NIST-certified thermometer is in agreement within 1°C (after correction factors are applied).
- d. Upon completion attach the *Thermometer Calibration Log* to the calibration report provided by the outside source.

2. Verifying Data Loggers:

To verify a data logger, take the temperature of 3 blood products (1 red blood cell, 1 thawed plasma, and 1 platelet) i using the data logger and compared to a NIST-certified thermometer reading of the same blood products.

- a. Use the the *Thermometer Calibration Log* to document the readings.
 - b. The red blood cell and thawed plasma should be 1-6°C, while the platelet should be 20-24°C.
 - c. Verify the data logger being verified and the NIST-certified thermometer is in agreement within 1°C (after correction factors are applied).
 - d. Upon completion attach the *Thermometer Calibration Log* to the calibration report provided by the outside source.
3. **Verifying NIST-Certified Thermometers:**
Using the same procedural steps as described in Standard Thermometer Calibration, the NIST-certified thermometer that is being verified is compared to another NIST-certified thermometer that is already verified and in-use in the Blood Bank.
4. The NIST-certified thermometers are compared at 37°C, room temperature (18-25°C), refrigerated temperature (1-6°C), and sub-zero temperatures (-20°C and below).
 5. Use the the *Thermometer Calibration Log* to document the readings.
 6. Verify the thermometer being verified and the NIST-certified thermometer is in agreement within 1°C (after correction factors are applied).
 7. Upon completion attach the *Thermometer Calibration Log* to the calibration report provided by the outside source.

E. Standard Thermometer Calibration

1. Perform the thermometer calibration based on the temperature in which it is being used:
 - a. **For calibration of liquid-in-glass thermometers at 1-6°C, 20-24°C, or 37°C:**
 - i. Place the NIST-Certified thermometer and all thermometers that are being calibrated into a container filled with water that is a similar temperature to the intended calibration temperature (e.g., 1-6°C, 20-24°C, 37°C).
 - a. For 1-6°C calibrations, fill the container with a mixture of water and crushed ice.
 - b. For 20-24°C calibrations, fill the container with room temperature water.
 - c. For 37°C calibrations, use a 37°C water bath or 37°C incubator.
 - ii. Make sure the bulbs of all thermometers are properly immersed and at the same level within the water.
 - a. If the thermometers are being calibrated at 1-6°C, ensure the thermometer bulbs are kept in the liquid and not in the upper layer of ice.
 - iii. Stir the water to become a uniform temperature and allow the thermometers to equilibrate for approximately 5-15 minutes.
 - iv. Record the temperature of the NIST-Certified thermometer and all thermometers being calibrated on the *Thermometer Calibration Log*.

- b. For calibration of sub-zero liquid-in-glass thermometers (-20°C and below):**
- i. Place all thermometers that are being calibrated into the appropriate freezer along with the NIST-Certified thermometer.
 - ii. Allow the temperature of the thermometers that are being calibrated and the NIST-Certified thermometer to equilibrate.
 - a. If the thermometers are kept in a temperature-buffered medium (i.e. glycerol, sand or equivalent material), it may take a prolonged period of time to equilibrate.
 - iii. Record the temperature of the NIST-Certified thermometer and all thermometers being calibrated on the *Thermometer Calibration Log*.
- c. For calibration of digital thermometers:**
- i. Place all digital thermometers that are being calibrated in a container along with the NIST-Certified thermometer.
 - a. The intention of this container is to prevent air flow over the thermometers that may cause erratic fluctuations in temperature.
 - ii. Allow the thermometers to equilibrate for approximately 5-15 minutes.
 - iii. Record the temperature of the NIST-Certified thermometer and all thermometers being calibrated on the *Thermometer Calibration Log*.
- d. For calibration of room temperature (18-25°C) thermometers:**
- i. Place all thermometers that are being calibrated into a dry beaker along with the NIST-certified thermometer.
 - ii. Allow the temperature of the thermometers to equilibrate for approximately 5-15 minutes.
 - iii. Record the temperature of the NIST-certified thermometer and all thermometers being calibrated on the *Thermometer Calibration Log*.
2. Verify the thermometers being calibrated and the NIST-Certified thermometer is in agreement within 1°C (after correction factors are applied).
- a. If the difference between thermometers being calibrated and the NIST-Certified thermometer is greater than 1°C, the thermometer that was being calibrated must be retired or returned to the supplier.
 - b. Retired thermometers will be given to a Lead Medical Technologist or supervisor for disposal.
 - i. The Safety Data Sheet (SDS) requirements and regulations for disposal will be followed.
 - ii. Non-mercury glass thermometers that are deemed environmentally safe will be discarded in a standard laboratory sharps container.

F. Calibration of the Infrared Thermometers

1. Fill a plastic container approximately 2/3 full with cold water, and add a small amount of ice so that the temperature is between 1° - 4 °C.
2. Prop/insert the NIST thermometer inside the container so that the tip of the thermometer is just below the surface.
3. Allow the NIST thermometer to equilibrate.
4. Take the temperature of the water surface with the IR (infrared) thermometer.
5. Read and record the NIST and IR thermometer temperatures for this range, on the *IR Thermometer Calibration Form*.
6. For 5 -10 °C point reading, add a small amount of warm water to allow water temperature to increase to 5° - 10 °C.
7. Repeat steps 2- 5 and record the NIST and IR thermometer temperatures for this range on the *IR Thermometer Calibration Form*.
8. For 10 -15 °C point reading, add sufficient ice/hot water to allow water temperature to increase to 10°-15 °C.
9. Repeat steps 2- 5 and record the NIST and IR thermometer temperatures for this range on the *IR Thermometer Calibration Form*.
10. For 20 - 24 °C point reading, add sufficient ice/hot water to allow water temperature to increase to 20°- 24 °C.
11. Repeat steps 2 -5 and record the NIST and IR thermometer temperatures for this range on the *IR Thermometer Calibration Form*.
12. Determine the calibration status of the thermometer.
 - a. Verify the thermometers being calibrated and the NIST-Certified thermometer is in agreement within 1°.
 - b. If the readings are acceptable document the calibration as Pass (Y) on the *IR Thermometer Calibration Form*.
 - c. If the readings are not acceptable document the calibration as Pass (N) on the *IR Thermometer Calibration Form* and remove the thermometer from service until an investigation is completed and resolved.

VII. NOTES:

- A. Mercury glass thermometers are no longer approved for use in the Laboratory. If a mercury glass thermometer is discovered it will be turned over to laboratory safety officer such that all SDS requirements and regulations for the safe disposal of hazardous waste are followed.

VIII. REFERENCES:

1. Barnstead/ERTCO Thermometer, package insert: Instructions for Reuniting Separated fluid column of your Spirit Filled Barnstead/Ertco Thermometers 08/03.

Attachments

[Cleaning Thermometer Containers In Coolers Form \(rev. 05/09/2024\)](#)

[IR Thermometer Calibration Form \(rev. 05/09/2024\)](#)

[Thermometer Calibration Log \(rev. 05/09/2024\)](#)

Approval Signatures

Step Description	Approver	Date
Policy and Forms Steering Committee (if needed)	Ann Marie Blenc: System Med Dir, Hematopath	6/6/2024
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	Kelly Sartor: Mgr, Division Laboratory	5/10/2024
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