# Calibration of Lab Thermometers using a Constant Temperature Calibration Bath

## 1.0 SCOPE AND APPLICATION

This SOP describes the use of a constant temperature calibration bath to calibrate lab thermometers. The temperature reading of a lab thermometer is compared to that of a NIST traceable, calibrated reference thermometer at a fixed temperature to determine its accuracy. This procedure is applicable to the calibration of digital thermometers with thermocouple probes and analog, liquid-filled glass thermometers. This SOP does not apply to Infra-Red radiation thermometers (IR guns).

**Note:** Some inexpensive digital thermometers are used to monitor temperatures in refrigerators, freezers and ovens (TDS, TSS) in the lab. These thermometers come with year-long manufacturer calibration certificates. Since these thermometers are replaced on an annual basis, they need not be independently calibrated at the lab using this bath.

Several refrigerators, freezers, incubators and ovens in the lab are monitored by the lab's *CheckPoint* wireless monitoring system. The system uses thermocouple probes for monitoring the temperature. These probes are also recalibrated using this procedure on an annual basis. Thermometer and thermocouple calibrations are good for a year.

## 2.0 APPARATUS AND EQUIPMENT

2.1 Fluke 7103 Temperature Calibration Micro-Bath. Temperature range: –30°C to +125°C.

2.2 Delrin Access Cover with pre-drilled holes for thermocouple probes and glass, liquid-filled thermometers.

2.3 Fisher Scientific Traceable High-Accuracy Platinum Digital Thermometer, Cat. No. 15-081-108 with a 0.2" O.D. stainless steel probe. Temperature range: –80 °C to +190°C.

## 3.0 REAGENTS AND SUPPLIES

3.1 Dow Corning Silicone Oil, Type 200.05.

3.2 *Kimwipes* paper wipes.


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## 4.0 CALIBRATION BATH OPERATION

Lab thermometers need to be calibrated at two discrete temperatures that bracket their range of use. For exceptions, see the note below. The calibration bath can be set to heat or cool to a selected temperature (set point). The bath then heats or cools the silicone oil in the bath until it reaches equilibrium at the set point. **Do not move/relocate the calibration bath while it is on, or when the bath fluid is at an elevated temperature.**

**Note:** *If the thermometer or thermocouple is used over a range of 10°C or less (microbiology incubators for example), then a single point verification within the range of use is acceptable.*

**A Fisher Scientific NIST Traceable Platinum Reference Thermometer, (Cat. No. 15-081-108) is in the drawer next to the microbath. This thermometer may be used as the reference thermometer for the calibration of lab thermometers.**

**Note:** The calibration bath is filled with Silicone Oil bath fluid to the proper level during installation. At room temperature, the fluid level should be about 1 inch below the second ring of the probe basket. A stir bar sits in the bottom of the well for mixing the fluid and providing better accuracy, uniformity, and stability. Cooling fans in the bath turn on when the instrument is powered. The fans are quite loud.

4.1 Record your name and date in the Calibration Bath logbook beside the instrument.

4.2 Lift the brown, plastic dust cap that covers the access cover and set it aside. The access cover is a translucent, threaded, Delrin disk that covers the well containing the bath fluid. The cover has holes for the insertion of thermocouple probes or glass, liquid-filled thermometers. Three, small, 3/16” holes are for thermocouple probes. The large 3/8” hole can accommodate an analog, glass liquid-filled thermometer. The 1/4" hole in the center can be used for either a thermocouple probe or a slim analog liquid-filled thermometer. The diameters of the holes were chosen to accommodate the diameters of probes and thermometers used in the lab.

4.3 The power switch to the bath is located at the rear of the instrument. Switch on the instrument. When the Micro-Bath is turned on, it will begin to heat (or cool) to the previously programmed temperature set-point. The front panel LED displays the bath temperature.

4.4 The control panel of the bath is shown in **Figure 1**. To set the temperature of the bath, do the following:

4.4.1 Press “SET” twice to access the set-point value.

4.4.2 Press and hold the “UP” or “DOWN” to change the set-point value.

4.4.3 Next, press “SET” to store the new set-point value.

4.4.4 Press “EXIT” to return to the current temperature display.


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4.5 When the set-point temperature is changed, the controller switches the well-heater on or off to raise or lower the temperature. The fan speed also changes accordingly. The displayed well temperature gradually changes until it reaches the set-point temperature. The well may require up to 90 minutes to reach the set-point depending on the temperature span. Another 10 to 15 minutes is required to stabilize within ±0.04°C of the set-point.




**Figure 1**

4.6 Once the bath had stabilized, insert the thermocouple probe of the reference thermometer and probe(s) of the lab thermometer(s) that need to be calibrated. Wait another 15 minutes for the thermometers or probes to reach equilibrium and record the readings from the reference and lab thermometer(s). If there are multiple thermometers or probes in the bath, it may take longer (20-25 min) to reach equilibrium.

4.7 Next, change the temperature set-point to the second bracketing temperature as described in section 4.4 and repeat the process. Suggested calibration temperature settings for thermometers used by different groups in the lab are shown in Table 1. Some thermometers, such as those used in incubators also need to be calibrated at the temperature/set-point of the incubator.

**TABLE 1:** Suggested Calibration Temperature Set-points for Lab Thermometers

| Thermometer Application | Lower Calibration Temperature* (°C) | Upper Calibration Temperature* (°C) | Accuracy (°C) |
|---|---|---|---|
| Lab Refrigerators | 0 | 10 | ±0.5 |
| Lab Freezers | –15 | –5 | ±0.5 |
| Lab Freezers (Organic Standards) | –25 | –5 | ±1.0 |
| Autoclaves | 50 | 125 | ±1.0 |
| Incubators – Toxicity | 10 | 30 | ±0.5 |
| Incubators – Microbiology | Single temperature depending on test | | ±0.2 |

***** The calibration bath's temperature range is –30°C to +125°C.


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## 5.0 CALIBRATION BATH SHUT DOWN

5.1 After the thermometers have been calibrated, remove and wipe the probes or thermocouples with a clean *Kimwipe*.

5.2 Reset the temperature of the bath to 25°C following the procedure in section 4.4. Wait for 30–90 minutes for the bath to reach ambient (25°C) temperature. Turn the calibration bath off.

5.3 Wipe off any oily residue on the top surface of the access cove with a clean *Kimwipe*. Replace the dust cover over the access cover to prevent dust from entering the bath and contaminating the bath fluid.

5.4 Make sure that the instrument is switched off and the Calibration Bath logbook is initialed and dated before leaving.

## 6.0 REFERENCES

6.1 Fluke 7103 Micro-Bath User's Guide, December 2013.

## Appendix of Significant Changes

11/29/2016 This SOP was edited and checked for 508 compliance.


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