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# C3Po1E-04: A protocol for accurately calibrating thermocouples at cryogenic temperatures

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To study the quenching characteristics of different materials in cryogenic liquid baths, transient temperature measurements of high accuracy are necessary. Thermocouple is an ideal tool for these applications because of their low self-heat capacity. However, they require calibration before usage. Typically multiple fixed point temperatures are used. The common fixed point temperatures are water-ice bath melting temperature, dry ice sublimation temperature, and boiling temperature of liquid nitrogen. It is important to note that there are uncertainties associated with dry ice and liquid nitrogen temperature inherent to the heat and mass transport phenomenon at their phase-changing interface or inside the bulk medium. The dry ice temperature is influenced by the mass transport phenomenon occurring at the interface between dry ice and the ambient surrounding it. In a typical lab environment, dry ice temperature is significantly lower than the commonly quoted sublimation temperature of -78.5 ℃. In the case of liquid nitrogen stored in a cryostat, temperature gradients are present in the liquid bath. This paper describes a protocol for calibrating thermocouples by accurately defining and using fixed point temperatures of liquid nitrogen slush and dry ice in a saturated environment.

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