

Manufacturing and Characterization of the Low Volume Fixed Point of Carbon Dioxide (CO₂)

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In recent years, a significant effort was invested in the development and characterization of a novel low temperature fixed-point cell that would replace the currently used ITS-90 defining fixed-point cell of mercury (Hg). These attempts were dominantly motivated by the restriction of use of heavy metals in multiple countries. The European Union mercury regulation 2017/852 can be used as an example of these restrictions. In order to have a minimal effect on the current International Temperature Scale of 1990, several materials with similar triple point temperatures were considered. These were CO₂ (216.59 K) and SF₆ (223.555 K). In this contribution we will be focusing on the performance of a low volume CO₂ cell with a total volume close to 0.05 L. This cell has been specifically designed to enable simultaneous calibration of capsule and long stem type of SPRTs (Standard Platinum Resistance Thermometers) in different cooling apparatuses (cryostats, baths etc.). The conducted measurements that are going to be presented and discussed were realized at both adiabatic and quasi-adiabatic conditions. Simultaneous multiple realizations with capsule type SPRTs and long stem SPRTs have been done with subsequent evaluation of suitability of this type of fixed-point cell for routine calibrations. The description of methods used for the optimal realization of the CO₂ fixed-point cell will be discussed. Furthermore, the definition of key metrological parameters like realization repeatability and stability as well as the triple point temperature value will be presented. This research was made possible thanks to the project 18SIB02 - Realising the redefined kelvin, which has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.