



Standards and Scales for atmospheric CO₂ measurements: A New Reference Facility

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A reference facility, based on manometry is presented that has been developed to compare CO₂ in air standards produced by National Metrology Institutes as well as the WMO's Central Calibration Laboratory on an on-going basis (a comparison series to be denoted BIPM.QM-K2). The advantage of using a primary manometric method for the comparisons is that: the comparisons can be carried out on-demand; gas use is minimal; and measurements can be completed in a short period of time. This requires a reference system operating with low uncertainty (with the aim of being below 0.1 $\mu\text{mol/mol}$), and that has demonstrated stability. The reference system developed at the BIPM system is in Silconert-treated stainless-steel, providing much increased mechanical stability over glass systems, whilst reducing as much as possible adsorption/desorption of carbon dioxide on surfaces. Such effects have indeed been highlighted in recent publications, both inside gas cylinders and with o-rings used in glass manometer systems. The performance of the system was compared with reference values determined from 44 primary CO₂ in air standards in 2017 (CCQM-P188), with good agreement between measured values. Further validation studies are underway to reduce the measurement uncertainty of the system by better characterizing of the cryogenic extraction efficiency of CO₂, adsorption effects, and the influence of residual water on measurements. The stability of the facility is being studied with two ensembles of nine CO₂ in air mixtures, provided by MPI Jena (over the range 380 $\mu\text{mol/mol}$ to 800 $\mu\text{mol/mol}$). Final validation of the facility is expected by 2021, which will be followed by the start of the BIPM.QM-K2 comparison service.