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Experimental validation of a self-calibrating cryogenic mass flowmeter

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The Karlsruhe Institute of Technology (KIT) and the WEKA AG jointly develop a commercial flowmeter for application in helium cryostats. The flowmeter works according to a new thermal measurement principle, which eliminates all systematic uncertainties and enables self-calibration during real operation. Ideally, the resulting uncertainty of the measured flowrate is only dependent on signal noises, which are typically very small with regard to the measured value. Under real operating conditions, cryoplant-dependent flowrate fluctuations induce an additional uncertainty, which follows from the sensitivity of the method. This paper presents experimental results with helium at temperatures between 30 and 70 K and flowrates in the range of 4 to 12 g/s. The experiments were carried out in a control cryostat of the 2 kW helium refrigerator of the TOSKA test facility at KIT. Inside the cryostat, the new flowmeter was installed in series to a Venturi tube that was used for reference measurements. The self-calibration capability during real cryoplant operation has been demonstrated by the measurements. The influences of temperature and flowrate fluctuations on the self-calibration uncertainty are discussed.

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