Improvements of the dynamic Gravimetric Flow Standard (dGFS) below 0.2 mg/s of nitrogen (10 sccm)

Jean Barbe [1], Casey Rombouts [2]

[1]LNE, 1 rue Gaston Boissier, 75724 Paris cedex 15, France
[2]Fluke Calibration Phoenix (FCP), Arizona
E-mail (corresponding author): jean.barbe@lne.fr

Abstract:

In 2011, LNE installed a primary gas flow standard (dGFS) based on the dynamic gravimetric method. The dGFS developed by Fluke Calibration-Phoenix (FCP) was initially designed to calibrate molbloc laminar flow elements in the range from 0.2 mg/s to 200 mg/s of nitrogen (10 sccm to 10 slm) with a manufacturers expanded uncertainty (k = 2) on the order of 0.06% of reading (variant with mass depleted). An LNE uncertainty analysis of the dGFS components using the GUM approach has given an expanded uncertainty on the reference mass flowrate of 0.06 % of reading + 3.10^{-4} mg/s in this flow range. This uncertainty has been validated through different international comparisons using commercial transfer standards such as molbloc LFE's or portable volumetric devices.

LNE and FCP use the dGFS outside the working range to measure flowrates below 0.2 mg/s. The system as delivered has issues with accurate and repeatable leak determinations and stable measurements in this lower flow range leading to results that are not as satisfactory and with higher uncertainties.

This paper presents the work being done to significantly reduce or reliably quantify the dGFS leakage and to measure stable and repeatable flowrates between 0.02 mg/s and 0.2 mg/s of nitrogen (1 sccm to 10 sccm) with an associated uncertainty never achieved with the dynamic gravimetric method.

An international low flow key comparison is in the early stages of development with NIST (USA), CMS (Taiwan), INRIM (Italy) and LNE (France), where improvements in the dynamic gravimetric method would be valuable to LNEs collection of data and the overall comparison.