
Determination of uncertainty for volume measurements made using the gravimetric method

Détermination de l'incertitude de mesure pour les mesurages volumétriques effectués au moyen de la méthode gravimétrique



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Foreword

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1 Scope

This Technical Report gives the detailed evaluation of uncertainty for volume measurements according to the *Guide to the Expression of Uncertainty in Measurement* (GUM) [1]. It uses the gravimetric method specified in ISO 8655-6 [2] as the reference method for calibrating piston-operated volumetric apparatus. It has been arranged in paragraphs to facilitate direct access to different aspects of this kind of evaluation as follows:

- modelling the measurement by describing the physical equations necessary to calculate the volume using the gravimetric method of measurement;
- determination of the standard uncertainty of measurement associated with the volume V_{20} by describing the calculation procedure according to the GUM;
- determination of the sensitivity coefficients, with an example of the calculation of all sensitivity coefficients by using complete equations, approximations of equations and by giving numerical values for standard conditions;
- determination of the standard uncertainty associated with the volume delivered by a piston-operated volumetric apparatus giving the combination of the standard uncertainty associated with the volume V_{20} measured using the gravimetric measuring system and the experimental standard deviation associated with the volume delivered by the apparatus;
- determination of the standard uncertainties of measurement with a brief insight into the calculation of uncertainties of measuring devices according to GUM;
- determination of the expanded uncertainty of measurement associated with volume V_{20} ;
- example of the determination of the uncertainty for volume measurements.

2 Modelling the measurement

The equation for the volume V_{20} of the delivered water at 20 °C is given by

$$V_{20} = m \times Z \times Y \quad (1)$$

with

$$m = m_2 - m_1 - m_E \quad (2)$$

where

m is the balance reading of delivered water;

m_1 is the balance reading of the weighing vessel before delivery of the measured volume of water;