

ISO/TR 16153:2023-02 (E)

Determination of uncertainty for volume measurements of a piston-operated volumetric apparatus using a photometric method

| Contents | | Page |
|------------------------------|---|-------------|
| Foreword | | iv |
| Introduction | | v |
| 1 | Scope | 1 |
| 2 | Normative references | 1 |
| 3 | Terms and definitions | 1 |
| 4 | Modelling the measurement | 1 |
| 5 | General procedure for the uncertainty calculation | 4 |
| 6 | Standard uncertainty components associated with the measuring system (photometric measurement procedure) | 4 |
| 6.1 | General information on the estimation of standard uncertainty components | 4 |
| 6.2 | Standard uncertainty of the copper(II) chloride solution volume | 5 |
| 6.3 | Standard uncertainty of the cuvette mixture absorbance at 520 nm | 5 |
| 6.4 | Standard uncertainty of the cuvette starting absorbance at 730 nm | 6 |
| 6.5 | Standard uncertainty of the cuvette starting absorbance at 520 nm | 6 |
| 6.6 | Standard uncertainty of the volume of Ponceau S and copper(II) chloride solutions used in calibrators | 7 |
| 6.7 | Standard uncertainty of the absorbances of the calibrator solutions | 7 |
| 7 | Standard uncertainty components associated with the POVA | 9 |
| 7.1 | Standard uncertainty of the resolution | 9 |
| 7.2 | Standard uncertainty of the setting | 9 |
| 7.3 | Standard uncertainty related to air cushion effects | 9 |
| 7.4 | Standard uncertainty of the cubic expansion coefficient | 9 |
| 8 | Standard uncertainty components associated with the liquid delivery process | 10 |
| 8.1 | Repeatability (experimental standard deviation) | 10 |
| 8.2 | Reproducibility | 10 |
| 9 | Combined standard uncertainty of measurement associated with the systematic error of mean volume | 11 |
| 10 | Sensitivity coefficients | 12 |
| 11 | Coverage factor k | 13 |
| 12 | Expanded uncertainty of measurement associated with the volume \bar{V} | 14 |
| 13 | Example for determining the uncertainty of the volume measurement of POVA | 14 |
| 13.1 | Measurement conditions | 14 |
| 13.2 | Results | 16 |
| 13.2.1 | Standard uncertainty of the POVA mean volume | 16 |
| 13.2.2 | Expanded uncertainty of the measurement | 17 |
| 13.2.3 | Result of measurement | 17 |
| 13.2.4 | Uncertainty in use and corrections for pressure changes | 17 |
| 13.2.5 | General remarks | 17 |
| 13.2.6 | Note on the conformity with ISO/IEC Guide 98-3 | 17 |
| Annex A (informative) | Approaches for the estimation of uncertainty in use of a single delivered volume | 19 |
| Annex B (informative) | Volume correction due to pressure changes | 22 |
| Bibliography | | 24 |