

BS EN ISO 4787:2011



BSI Standards Publication

# Laboratory glassware — Volumetric instruments — Methods for testing of capacity and for use (ISO 4787:2010, Corrected version 2010-06-15)

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**National foreword**

This British Standard is the UK implementation of EN ISO 4787:2011. It is identical to ISO 4787:2010. It supersedes BS EN ISO 4787:2010 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee LBI/36/1, Laboratory Glass and Plastics Apparatus.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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**Compliance with a British Standard cannot confer immunity from legal obligations.**

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English Version

Laboratory glassware - Volumetric instruments - Methods for  
testing of capacity and for use (ISO 4787:2010, Corrected  
version 2010-06-15)

Verrerie de laboratoire - Instruments volumétriques -  
Méthodes de vérification de la capacité et d'utilisation (ISO  
4787:2010, Version corrigée 2010-06-15)

Laborgeräte aus Glas - Volumenmessgeräte -  
Prüfverfahren und Anwendung (ISO 4787:2010, korrigierte  
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This European Standard was approved by CEN on 31 January 2011.

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## Foreword

The text of ISO 4787:2010, Corrected version 2010-06-15 has been prepared by Technical Committee ISO/TC 48 “Laboratory equipment” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 4787:2011 by Technical Committee CEN/TC 332 “Laboratory equipment” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2011, and conflicting national standards shall be withdrawn at the latest by September 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 4787:2010.

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### Endorsement notice

The text of ISO 4787:2010, Corrected version 2010-06-15 has been approved by CEN as a EN ISO 4787:2011 without any modification.

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4787 was prepared by Technical Committee ISO/TC 48, *Laboratory equipment*, Subcommittee SC 6, *Laboratory and volumetric ware*.

This second edition cancels and replaces the first edition (ISO 4787:1984), which has been technically revised to incorporate the following changes:

- a) the potassium dichromate cleaning method in Annex A has been deleted;
- b) new tables for calculation of test results have been added to Annex B;
- c) the description of the test (calibration) methods has been modified to be more precise;
- d) test methods have been separated from recommendations for use.

This corrected version of ISO 4787:2010 incorporates the following corrections:

- Figure 1 on page 5 has been corrected to show the correct setting of the meniscus as described in the text;
- Figure 2 on page 5 has been improved to better illustrate what the user of the instrument really sees when setting the meniscus.

# Laboratory glassware — Volumetric instruments — Methods for testing of capacity and for use

## 1 Scope

This International Standard provides methods for the testing, calibration and use of volumetric instruments made from glass in order to obtain the best accuracy in use.

**NOTE** Testing is the process by which the conformity of the individual volumetric instrument with the appropriate standard is determined, culminating in the determination of its error of measurement at one or more points.

The International Standards for the individual volumetric instruments include clauses on the definition of capacity; these clauses describe the method of manipulation in sufficient detail to define the capacity without ambiguity. This International Standard contains supplementary information.

The procedures are applicable to volumetric instruments with nominal capacities in the range of 0,1 ml to 10 000 ml. These include: single-volume pipettes (see ISO 648) without subdivisions; graduated measuring pipettes and dilution pipettes, with partial or complete subdivisions (see ISO 835); burettes (see ISO 385); volumetric flasks (see ISO 1042); and graduated measuring cylinders (see ISO 4788). The procedures are not recommended for testing of volumetric instruments with capacities below 0,1 ml such as micro-glassware.

This International Standard does not deal specifically with pycnometers as specified in ISO 3507. However, the procedures specified below for the determination of volume of glassware can, for the most part, also be followed for the calibration of pycnometers.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 385, *Laboratory glassware — Burettes*

ISO 648, *Laboratory glassware — Single-volume pipettes*

ISO 835, *Laboratory glassware — Graduated pipettes*

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 4788, *Laboratory glassware — Graduated measuring cylinders*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC Guide 99 apply.

### 4 Summary of method

The general procedure is based upon a determination of volume of water, either contained in or delivered by the volumetric instrument. This volume of water is based upon knowledge of its mass under consideration of buoyancy and its tabulated density (gravimetric method).

### 5 Volume and reference temperature

#### 5.1 Unit of volume

The unit of volume shall be the millilitre (ml), which is equivalent to one cubic centimetre (cm<sup>3</sup>).

#### 5.2 Reference temperature

The standard reference temperature, i.e. the temperature at which the volumetric instrument is intended to contain or deliver its volume (capacity), shall be 20 °C.

When the volumetric instrument is required for use in a country which has adopted a standard reference temperature of 27 °C (the alternative recommended in ISO 384 for tropical use), this figure shall be substituted for 20 °C.

### 6 Apparatus and calibration liquid

**6.1 Balance**, with a resolution and standard deviation appropriate to the selected volume of the apparatus under test (see Table 1).

The resolution of the display, the standard deviation and the linearity of the balance will be a limiting factor in the accuracy of the measurements. The balance shall be calibrated with adequate accuracy (see 9.4).

Table 1 — Recommended balance

| Selected volume under test <sup>a</sup>                                                    | Resolution | Standard deviation (repeatability) | Linearity |
|--------------------------------------------------------------------------------------------|------------|------------------------------------|-----------|
| $V$                                                                                        | mg         | mg                                 | mg        |
| 100 µl < $V$ ≤ 10 ml                                                                       | 0,1        | 0,2                                | 0,2       |
| 10 ml < $V$ < 1 000 ml                                                                     | 1          | 1                                  | 2         |
| 1 000 ml ≤ $V$ ≤ 2 000 ml                                                                  | 10         | 10                                 | 20        |
| $V$ > 2 000 ml                                                                             | 100        | 100                                | 200       |
| <sup>a</sup> For practical purposes, the nominal volume may be used to choose the balance. |            |                                    |           |

**6.2 Thermometer**, to measure the temperature of the calibration liquid (water) with a measurement error of maximum 0,2 °C for liquid volumes < 1 000 ml and with a measurement error of maximum 0,1 °C for liquid volumes ≥ 1 000 ml.

**6.3 Hygrometer**, to measure the humidity in the test room with a measurement error of maximum 5 % within the humidity range of 35 % to 85 %.

**6.4 Barometer**, to measure the atmospheric pressure in the test room with a measurement error of maximum 1 kPa.

**6.5 Calibration liquid**, distilled or deionized water complying with ISO 3696, Grade 3 should be used for testing.

**6.6 Receiving vessel**, conical flask with ground joint, manufactured from glass, e.g. in accordance with ISO 4797. The nominal volume of the conical flask shall correspond to the volume of liquid to be measured.

## 7 Factors affecting the accuracy of volumetric instruments

### 7.1 General

The same sources of error are, naturally, inherent both in calibration and use. In the former, every attempt is made to reduce these errors to a minimum; in the latter, the care needed is dependent upon the degree of accuracy required. When the greatest possible accuracy is desired, the volumetric instrument should be used as closely as possible to the manner in which it has been calibrated.

### 7.2 Temperature

#### 7.2.1 Temperature of the volumetric instrument

**7.2.1.1** The capacity of the volumetric instruments varies with change of temperature. The particular temperature at which a volumetric instrument is intended to contain or deliver its nominal capacity is the "reference temperature" of the instrument (see 5.2).

**7.2.1.2** A volumetric instrument which was adjusted at 20 °C, but used at 27 °C, would show an extra error of only 0,007 % if it is made of borosilicate glass having a coefficient of cubical thermal expansion of  $9,9 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$  and of 0,02 % if it is made of soda-lime glass having a coefficient of cubical thermal expansion of  $27 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$ . These errors are smaller than the limits of error for most volumetric instruments. It follows, therefore, that the reference temperature is of minor importance in practical use. However, when performing calibrations, it is important to refer to the reference temperature.

#### 7.2.2 Temperature of calibration liquid

The temperature of the water used for the calibration shall be measured to  $\pm 0,1 \text{ }^{\circ}\text{C}$ . Corrections for differences in temperature from the reference temperature shall be applied in accordance with Annex B.

### 7.3 Cleanliness of glass surface

The volume contained in, or delivered by, a volumetric instrument depends on the cleanliness of the internal glass surface. Lack of cleanliness results in errors through a poorly shaped meniscus involving two defects:

- incomplete wetting of the glass surface, i.e. the liquid surface meets the glass at an arbitrary angle instead of forming a curve such that it meets the glass tangentially;
- a generally increased radius of curvature, due to contamination of the liquid surface reducing the surface tension.

The ascending or descending liquid meniscus shall not change shape (i.e. it shall not crinkle at its edges). To ascertain whether a piece of glass apparatus is satisfactorily clean, it shall be observed during filling and dispensing. Additionally, an experienced operator can recognize the shape of an uncontaminated meniscus, in relation to its diameter.