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Methods for

Use and testing of capacity of volumetric glassware —

[ISO title: Laboratory glassware —
Volumetric glassware — Methods for
use and testing of capacity]

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National foreword

This British Standard has been prepared under the direction of the Laboratory Apparatus Standards Committee. It is identical with ISO 4787-1984 *“Laboratory glassware — Volumetric glassware — Methods for use and testing capacity”*, prepared by Subcommittee 1 of Technical Committee TC 48 “Laboratory glassware and related apparatus”, of the International Organization for Standardization (ISO), with the active participation and approval of the United Kingdom.

Terminology and conventions. The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

In British Standards it is current practice to use the symbol “L” for litre (and its submultiples) rather than “l”, and to use the spelling “sulphur”, etc. instead of “sulfur” etc.

Wherever the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

Cross-references

International standards	Corresponding British Standards
ISO 384-1978	BS 5898:1980 Specification for principles of design and construction of volumetric glassware for laboratory use (Identical) BS 700 Graduated pipettes
ISO 835/1-1981	Part 1:1982 Specification for general requirements (Identical)
ISO 835/2-1981	Part 2:1982 Specification for pipettes for which no waiting time is specified (Identical)
ISO 835/4-1981	Part 3:1982 Specification for blow-out pipettes (Identical)
ISO 1042-1983	BS 1792:1982 Specification for one-mark volumetric flasks (Identical)
ISO 3507-1976	BS 733 Pyknometers Part 1:1983 Specification (Identical)
ISO 4788-1980	BS 604:1982 Specification for graduated glass measuring cylinders (Identical)

BS 1583:1985 “Specification for one-mark pipettes” is related to ISO 648-1977.
BS 846:1985 “Specification for burettes” is related to ISO 385/1-1984 and ISO 385/2-1984. There are no British Standards corresponding to ISO 385/3-1984 and ISO 835/3-1981. All of these ISO Standards are referred to in the text for information only.

Additional information

- 1) Water complying with BS 3978 “Water for laboratory use”, is suitable for use in 5.4 and 9.1.
- 2) The cleaning methods recommended in A.2 are effectively not employed in the UK, especially as they use hazardous chemicals. The most often used method is one using a suitable surfactant.
- 3) The status of the annexes has not been stated. Annex A does not form an integral part of this British Standard. Annex B does form an integral part of this British Standard.

Textual errors. When adopting the text of the international standard, the textual errors listed below were discovered. They have been marked in the text and have been reported to ISO in a proposal to amend the text of the international standard.

- 1) In B.1.1 in the definition of ρ_A “,obtained from Table 4 at the temperature and atmospheric pressure of the test” should be inserted after “millimetre”.
- 2) In the penultimate line of B.2.2, “ $25 \times 10^{-6} \text{ }^\circ\text{C}^{-1}$,” should be inserted before “or”.
- 3) In Table 5, the entry “10” for borosilicate glass should read “10 to 15”. The entry “25” for soda-lime glass should read “25 to 30”.
- 4) In Table 8, the following should be inserted at the end of the title: “(for example soda-lime glass)”.

NOTE The following typographical errors were also discovered.

- 1) In B.2.1, line 15, “1,2 kg/m³” should read “0,0012 g/mL”.
- 2) In B.2.1, line 16, “8 000,0 kg/m³” should read “8,0 g/mL”.
- 3) In Table 5, in the title and the column heading, “ δ ” should read “ γ ”.
- 4) In Table 6, in line 2 of the title, the first “cubical thermal” should be deleted.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 16, an inside back cover and a back cover.

This Standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope and field of application

This International Standard provides methods for the testing of volumetric glassware in order to obtain the best accuracy in use.

The International Standards for the individual articles include clauses on the definition of capacity, which describe the method of manipulation in sufficient detail to define the capacity without ambiguity. This International Standard is supplementary to the information contained in these definitions.

The procedures are applicable to small-capacity ware, usually defined as items with capacities in the range of 0,1 to 2 000 ml. These include transfer and one-mark pipettes without subdivisions; graduated measuring pipettes and dilution pipettes, with partial or complete subdivisions; burettes; volumetric flasks; graduated measuring cylinders. The procedures are not recommended for testing of apparatus with capacities below 0,1 ml, such as microglassware, for example.

NOTE 1 Testing is the process by which the conformity of the individual article with the appropriate standard is determined, culminating in the determination of its error at one or more points.

NOTE 2 This International Standard does not deal specifically with pyknometers as specified in ISO 3507. However, the procedures specified below for the determination of volume of glassware can, for the greater part, also be followed for the calibration of pyknometers.

2 References

ISO 384, *Laboratory glassware — Principles of design and construction of volumetric glassware.*

ISO 385/1, *Laboratory glassware — Burettes — Part 1: General requirements.*

ISO 385/2, *Laboratory glassware — Burettes — Part 2: Burettes for which no waiting time is specified.*

ISO 385/3, *Laboratory glassware — Burettes — Part 3: Burettes for which a waiting time of 30 s is specified.*

ISO 648, *Laboratory glassware — One-mark pipettes.*

ISO 835/1, *Laboratory glassware — Graduated pipettes — Part 1: General requirements.*

ISO 835/2, *Laboratory glassware — Graduated pipettes — Part 2: Pipettes for which no waiting time is specified.*

ISO 835/3, *Laboratory glassware — Graduated pipettes — Part 3: Pipettes for which a waiting time of 15 s is specified.*

ISO 835/4, *Laboratory glassware — Graduated pipettes — Part 4: Blow-out pipettes.*

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

ISO 3507, *Pyknometers.*

ISO 4788, *Laboratory glassware — Graduated measuring cylinders.*

3 Summary of method

The general procedure is based upon a determination of volume of water either contained in or delivered by the vessel. This volume of water is based upon knowledge of its mass and its tabulated density.

4 Definitions

For the purpose of this International Standard, the following definitions apply (see also ISO 384).

4.1 unit of volume

the unit of volume shall be the cubic centimetre (cm³) or, in special cases, the cubic decimetre (dm³) or cubic millimetre (mm³) for which the names millilitre (ml), litre (l) or microlitre (μl) may be used

NOTE The term millilitre (ml) is commonly used as a special name for the cubic centimetre (cm³) [and, similarly, the litre (l) for the cubic decimetre (dm³) and the microlitre (μl) for the cubic millimetre (mm³)], in accordance with a decision of the twelfth Conférence Générale des Poids et Mesures. The term millilitre is acceptable, in general, for references in International Standards to capacities of volumetric glassware and it is used, in particular, in the present text.

4.2 reference temperature

the standard reference temperature, i.e. the temperature at which the article of volumetric laboratory ware is intended to contain or deliver its nominal volume (nominal capacity) shall be 20 °C

NOTE When it is necessary in tropical countries to work at an ambient temperature considerably above 20 °C, and these countries do not wish to use the standard reference temperature of 20 °C, it is recommended that they adopt a temperature of 27 °C.

5 Apparatus and materials

5.1 Balance

A laboratory balance is required with sufficient capacity to weigh the loaded vessel. The discrimination of the balance will be a limiting factor in the accuracy of the measurements. Either a single-pan, self-indicating instrument or an equal-arm balance of adequate discrimination and capacity may be used. The balance shall have a discrimination not greater than 1/10 of the limits of error of the instrument to be tested. In either case, the instrument shall be calibrated with adequate accuracy (see 9.3). The balance shall have dimensions to accept the size of the vessels which need to be weighed.

5.2 Thermometer

A thermometer is required to measure the temperature of the water. Its limits of error shall be 0,1 °C (see 9.5).

5.3 Barometer

A barometer capable of providing atmospheric pressure measurements consistent with appropriate tolerances is required.

NOTE The barometer should preferably have limits of error of 1 mbar.¹⁾

5.4 Water

Distilled or deionized water, suitable for general laboratory purposes, shall be used.

6 Factors affecting the accuracy of volumetric laboratory ware

6.1 General

The same sources of error are, naturally, inherent both in testing 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 article should be used as nearly as possible in the manner in which it is tested.

6.2 Temperature

6.2.1 Temperature of the vessel

The capacity of a glass vessel varies with change of temperature; the particular temperature at which a vessel is intended to contain or deliver its nominal capacity is the "reference temperature" of the vessel (see 4.2).

NOTE The coefficient of cubical thermal expansion of glass from which volumetric glassware is manufactured falls in the approximate range 10×10^{-6} to $30 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$. A vessel made of soda-lime glass having a coefficient of cubical thermal expansion of $30 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$, which was adjusted at 20 °C but used at 27 °C would, at the temperature of use, show an extra error of only 0,02 %, which is smaller than the limits of error for most articles of volumetric glassware. It follows, therefore, that the reference temperature is of minor importance in practical use of the glass vessel, but in order to provide a sound basis for adjustment (see B.1.4) it is important to specify a reference temperature and the vessel should be equilibrated at that temperature before testing.

6.2.2 Temperature of liquid

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

When using volumetric glassware ensure that all solutions used in connection with each other are close to a common temperature when their volumes are measured.

6.3 Cleanliness of glass surface

The volume contained in or delivered by a glass vessel depends on the cleanliness of the internal glass surface of the vessel. Lack of cleanliness can give rise to error through a badly shaped meniscus involving two defects:

- incomplete wetting of the glass surface, i.e. the liquid surface meets the glass at an appreciable 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.

In vessels used for delivery, lack of cleanliness can cause additional errors due to the film of liquid on the walls being irregularly distributed or incomplete.

In use, as distinct from testing, chemical contamination can introduce an error even though it has no influence on the accuracy of volume measurement.

NOTE Small residues of acid, for example, could impair the concentration of the alkaline solution with which the vessel is filled.

Therefore, where vessels are fitted with ground stoppers, special attention shall be paid to cleaning the ground zone.

¹⁾ 1 mbar = 100 pa