INTERNATIONAL STANDARD

ISO 648

Second edition
2008-10-15

Laboratory glassware — Single-volume pipettes

Verrerie de laboratoire — Pipettes à un volume

Reference number
ISO 648:2008(E)

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Published in Switzerland

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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 648 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 648:1977), which has been technically revised to incorporate the following modifications:

a) single-volume pipettes with two marks have been added;

b) the waiting time for pipettes Class AS has been reduced to 5 s;

c) dimensions have been modified;

d) the nominal volume of 200 ml has been deleted.

Laboratory glassware — Single-volume pipettes

1 Scope

This International Standard specifies metrological and constructional requirements for volumetric pipettes with one mark (total delivery) and for volumetric pipettes with two marks, both of which are adequate for general laboratory purposes.

The details specified are in conformity with the principles of design and construction of volumetric glassware given in ISO 384.

NOTE For graduated pipettes, see ISO 835. For piston-operated pipettes, see ISO 8655-2.

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 384:1978, *Laboratory glassware — Principles of design and construction of volumetric glassware*

ISO 719, *Glass — Hydrolytic resistance of glass grains at 98 °C — Method of test and classification*

ISO 1769, *Laboratory glassware — Pipettes — Colour coding*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
delivery volume
volume of liquid discharged from the pipette

NOTE Due to retention of liquid on the inner surface of the volumetric instrument, the volume of liquid delivered is not identical with the volume of liquid contained by the volumetric instrument.

3.2
delivery time
time required for the descent of the liquid meniscus from the graduation line to the point at which the meniscus appears to come to rest in the jet for one-mark pipettes and from the upper graduation line to the lower graduation line for two-mark pipettes

3.3
waiting time
time to be observed after apparent completion of the liquid delivery of the volumetric instrument

NOTE A waiting time applies for Class AS single-volume pipettes (see Clause 5 and 7.8).

4 Basis of adjustment

4.1 Unit of volume

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

4.2 Delivery volume

Single-volume pipettes shall be adjusted with water of grade 3 quality, in accordance with to ISO 3696, to deliver their nominal volume (Ex). The delivery should be under gravity and unrestricted. For details, see 7.7 and 7.8.

4.3 Reference temperature

The standard reference temperature, i.e. the temperature at which the pipette is intended to deliver its nominal volume, shall be 20 °C.

When the pipette 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.

5 Types and classes of accuracy

5.1 Classes of accuracy

Two classes of accuracy are specified:

— Class A and AS for the higher grade;

— Class B for the lower grade.

5.2 Types of single-volume pipette

The following two types of single-volume pipettes are specified:

— those for which no waiting time is specified (Classes A and B);

— those for which a waiting time of 5 s is specified (Class AS).

6 Maximum permissible errors

Maximum permissible errors in the delivered volume shall not exceed the limits specified in Table 1.

Table 1 — Nominal volumes and maximum permissible errors

Nominal volume	Maximum permissible error	
	Class A and AS	Class B
ml	± ml	± ml
0,5	0,005	0,010
1	0,008	0,015
2	0,010	0,02
5	0,015	0,03
10	0,02	0,04
20	0,03	0,06
25	0,03	0,06
50	0,05	0,10
100	0,08	0,15

The relationships between maximum permissible error and nominal volume, as well as between maximum permissible error and meniscus diameter as given in ISO 384:1978, Annex A and Annex B, shall be observed.

For the maximum permissible errors of single-volume pipettes with intermediate nominal volumes between those given in Table 1, the value for the nearest nominal volume shall apply. If the intermediate volume is exactly halfway between those given in Table 1, the value for the next greater nominal volume shall apply.

7 Construction

7.1 Material

Single-volume pipettes shall be manufactured from glass of chemical resistance and thermal properties at least to HGB3 in accordance with ISO 719, shall be as free as possible from visible defects and reasonably free from internal stress.

7.2 Shape

Pipettes of 0,5 ml nominal volume shall consist of a straight tube with a jet at the lower end.

Pipettes of nominal volume 1 ml and 2 ml may be of similar straight tube pattern or may alternatively be of bulb pattern, as described herein for the larger sizes.

All larger pipettes shall consist of a bulb with suction and delivery tubes, the three portions being straight and coaxial.

7.3 Bulb

The main portion of the bulb shall be cylindrical, except that 1 ml and 2 ml nominal-volume pipettes may have an oval bulb if desired. The two ends of the bulb shall merge gradually into the suction and delivery tubes, the junctions being of tapered formation to facilitate drainage.

7.4 Dimensions

Single-volume pipettes shall comply with the dimensional requirements shown in Tables 2, 3 and 4.

Table 2 — Dimensions

Dimensions mm		Nominal volume ml								
		0,5	**1**	**2**	**5**	**10**	**20**	**25**	**50**	**100**
Overall length	max.	300	325	350	410	450	520	530	550	600
Internal diameter at the graduation line	max.	2,5	3,5	4,5	4,5	5	5,5	5,5	6	7,5
Length of suction tube — valid only for bulb pattern pipettes	min.	—	150	150	150	160	170	170	170	170
Length of delivery tube — valid only for bulb pattern pipettes	min.	—	110	125	145	160	210	220	230	240
External diameter of delivery tube — valid only for bulb pattern pipettes	±1	—	5	6	6,5	7	7	7	8	9
External diameter of bulb — valid only for bulb pattern pipettes	max.	—	9	9	12	16	22	24	30	38
External diameter of tube — valid only for straight pattern pipettes	max.	5	6	7	—	—	—	—	—	—

Table 3 — Dimensions applying to all nominal volumes of one-mark pipettes

Dimension	Size mm	
Distance of graduation line from top of pipette	min.	100
Distance from graduation line to top of bulb[a]	min.	10
Distance from graduation line to tip of jet — valid only for straight pattern pipettes	min.	110
Wall thickness — bulb pattern pipettes — straight pattern pipettes	 min. min.	 0,6 0,8

[a] Top of bulb relates to the point at which the suction tube begins to expand into the bulb.

Table 4 — Dimensions applying to all nominal volumes of two-mark pipettes

Dimension	Size mm	
Distance of upper graduation line from top of pipette	min.	100
Distance from upper graduation line to top of bulb[a]	min.	10
Distance from upper graduation line to tip of jet — valid only for straight pattern pipettes	min.	110
Distance from lower graduation line to bottom of bulb[a]	min.	20
Distance from lower graduation line to tip of jet	min.	30
Wall thickness		
— bulb pattern pipettes	min.	0,6
— straight pattern pipettes	min.	0,8

[a] Top of bulb and bottom of bulb relate to the points at which the suction tube and the delivery tube begin to expand into the bulb.

7.5 Top of pipette

The top of the single-volume pipette shall lie in a plane at right angles to the axis of the pipette and shall be free from any blemishes which might interfere with the required accurate control by a mechanical device or by the finger in setting the meniscus. The end may be lightly fire-polished or smoothly ground with a slight bevel on the outside.

7.6 Delivery jet

The lower end of the pipette shall terminate either in a delivery jet having a smooth and gradual taper or in a capillary end, both without sudden constriction at the orifice which could give rise to turbulent outflow.

The end of the jet may be finished by grinding or machine tooling and may be fire-polished.

7.7 Delivery time

For testing of the delivery time, the clean pipette shall be held in a vertical position and filled with de-ionized water to a few millimetres above the (upper) graduation line; the falling meniscus shall then be set to this line. Any drop adhering to the jet of the pipette shall be removed by bringing the surface of a glass vessel into contact with the tip of the jet.

Delivery shall then be made into another glass vessel which is slightly inclined so that the tip of the jet is in contact with the inside of the vessel, but without movement of one against the other throughout the delivery period. For one-mark pipettes, delivery shall be made from the graduation line down to the jet of the pipette. For two-mark pipettes, delivery shall be made from the upper graduation line down to the lower graduation line.

IMPORTANT — It is important that a glass receiving vessel be used. Capillary effects influencing the delivery time depend considerably on the material down which the water runs.