INTERNATIONAL STANDARD 648

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Laboratory glassware — One-mark pipettes

Verrerie de laboratoire — Pipettes à un trait

First edition — 1977-12-15

UDC 542.3 **Ref. No. ISO 648-1977 (E)**

Descriptors : laboratory equipment, laboratory glassware, volumetric measurement, pipettes, specifications, dimensions, capacity, precision, marking, calibrating.

Price based on 7 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 648 was developed by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, and was circulated to the member bodies in February 1976.

It has been approved by the member bodies of the following countries :

Australia	Hungary	Romania
Austria	India	South Africa, Rep. of
Belgium	Israel	Spain
Canada	Italy	United Kingdom
Chile	Mexico	U.S.A.
Czechoslovakia	Netherlands	U.S.S.R.
Germany	Poland	

The member body of the following country expressed disapproval of the document on technical grounds :

France

This International Standard cancels and replaces ISO Recommendation R 648-1968, of which it constitutes a technical revision.

Printed in Switzerland

Laboratory glassware — One-mark pipettes

1 SCOPE AND FIELD OF APPLICATION

This International Standard provides details of an internationally acceptable series of one-mark pipettes, adequate for general laboratory purposes.

The details specified are in conformity with ISO 384.

2 REFERENCES

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

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

3 BASIS OF ADJUSTMENT

3.1 Unit of volume

The unit of volume is the cubic centimetre (cm^3), for which the name millilitre (ml) may be used.

NOTE — The term millilitre (ml) is commonly used as a special name for the cubic centimetre (cm^3), in accordance with the International System of units (SI).

3.2 Reference temperature

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

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

4 VOLUMETRIC ACCURACY

There shall be two classes of accuracy :

- class A for the higher grade;
- class B for the lower grade.

5 SERIES OF CAPACITIES

The series of capacities of one-mark pipettes is as follows :

0,5 — 1 — 2 — 5 — 10 — 20 — 25 — 50 — 100 and 200 ml

Of these, the 0,5 ml size is specified without bulb, the 1 ml size is specified both with and without bulb and the 2 ml size is specified with bulb for class A accuracy, and both with and without bulb for class B accuracy.

All the remaining sizes are specified with bulbs.

All the sizes may be provided with a safety bulb above the graduation line, if required.

NOTE — If other capacities are required than those listed above, it is recommended that they shall conform to the essential requirements of this International Standard.

6 DEFINITION OF CAPACITY

The capacity of a one-mark pipette is defined as the volume of water at 20 °C, expressed in millilitres, delivered by the pipette at 20 °C, when emptied as described below.

NOTE — Where, exceptionally, the standard reference temperature is 27 °C, this value shall be substituted for 20 °C.

The pipette in a vertical position shall be filled to a few millimetres above the graduation line and any drop adhering to the jet shall be removed. The falling meniscus shall then be adjusted to the line by one of the two methods detailed below :

a) the meniscus is set so that the plane of the upper edge of the graduation line is horizontally tangential to the lowest point of the meniscus, the line of sight being in the same plane;

b) the meniscus is set so that the plane of the centre of the graduation line is horizontally tangential to the lowest point of the meniscus. The eye is raised towards the plane and observes the front and back portions of the line apparently meeting the lowest point simultaneously.

Any drop adhering to the jet of the pipette shall then be removed by bringing the surface of a glass vessel into contact with the tip of the jet.

Delivery shall then be made, still holding the pipette vertically, into another glass vessel 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 and waiting periods.

The pipette shall be allowed to empty until the meniscus comes to rest in the jet. To ensure that delivery is complete, a waiting period of approximately 3 s should be observed before removing the pipette from the receiving vessel in the case of pipettes where a definite waiting time is not specified.

NOTE — The waiting period of approximately 3 s is specified only for the purpose of definition. In use, it is unnecessary to adhere closely to this period; it is sufficient to be certain that the meniscus has come to rest in the jet before removing the pipette from contact with the receiving vessel.

In the case of pipettes where a waiting time of 15 s is specified, this period shall be observed before removing the pipette from the receiving vessel.

NOTE — Pipettes of class A accuracy may either be :

a) without definite waiting time, in which case a waiting period of approximately 3 s is observed;

b) with a waiting time of 15 s.

Pipettes of class B accuracy should be without definite waiting time as described under a).

7 LIMITS OF VOLUMETRIC ERROR

7.1 Errors in the volume delivered shall not exceed the limits shown in table 1.

7.2 Limits of error for class A pipettes are shown in relation to capacity in annex A and in relation to diameter of meniscus in annex B.

TABLE 1 — **Limits of error**

Values in millilitres

Nominal capacity	Limit of error	
	Class A ±	Class B ±
0,5	0,005	0,01
1	0,008	0,015
2	0,01	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	0,1
100	0,08	0,15
200	0,1	0,2

8 CONSTRUCTION

8.1 Material

One-mark pipettes shall be constructed of glass of suitable chemical and thermal properties, shall be as free as possible from visible defects and shall be reasonably free from internal stress.

8.2 Shape

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

Pipettes of 1 ml capacity and, in class B, of 2 ml capacity may be of similar straight pattern or may alternatively be of bulb pattern, as described herein for the larger sizes.

All the larger pipettes consist of a bulb with suction and delivery tubes, the three portions being straight and co-axial. The general form of the pipettes shall be as shown in the figure.

If a safety bulb is provided, it should be of approximately spherical form and be situated between the graduated line and the top of the pipette, in accordance with the dimensions given in table 3.

FIGURE — **Example of a bulb pattern one-mark pipette**

8.3 Dimensions

Dimensions shall comply with the dimensional requirements shown in tables 2 and 3.

8.4 Top of pipette

The top of the pipette shall be finished square with the axis of the pipette and shall be free from any blemishes which might interfere with the required accurate control by the finger in setting the meniscus. The end may be lightly fire-polished or smoothly ground with a slight bevel on the outside.

8.5 Bulb

The main portion of the bulb shall be cylindrical, except that 1 and 2 ml capacity 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.

TABLE 2 — **Dimensions**

Dimensions in millimetres

Dimensions		Nominal capacity, ml									
		0,5	1	2	5	10	20	25	50	100	200
Overall length	max.										
Straight pattern pipette		280	280	280	–	–	–	–	–	–	–
Bulb pattern pipette		–	325	350	410	450	520	530	550	600	650
Length of suction tube[1]	min.	–	150	150	150	160	170	170	170	170	170
Length of delivery tube[1]	min.	–	110	125	145	160	210	220	230	240	240
Internal diameter at the graduation line[2]	max.	2,3[3]	3	3,5	4	4,5	5,5	5,5	6	7,5	8,5
External diameter of delivery tube[1]	± 1 mm	–	5	5,5	6,5	6,5	7	7	7,5	8	9
Diameter of bulb[1]	max.	–	9	9	12	16	22	24	30	38	49
Diameter of tube, straight pattern pipette	max.	5	6	7	–	–	–	–	–	–	–

1) Valid only for bulb pattern pipettes.

2) For straight pattern pipettes : maximum internal diameter; for bulb pattern pipettes : maximum internal diameter of the suction tube.

3) Calculated from minimum distance of 120 mm from graduation line to tip of jet (see table 3).

TABLE 3 — **Dimensions applying to all capacities**

Dimensions in millimetres

Distance of graduation line from top of pipette	min.	100
Distance from graduation line to top of bulb	min.	10
Distance from graduation line to tip of jet		
Straight pattern pipettes	min.	120
Wall thickness		
Bulb pipettes of 1 and 2 ml	min.	0,7
Other pipettes	min.	1,0
Diameter of safety bulb, if fitted	approx.	25
Distance from top of pipette to bottom of safety bulb	max.	70
Distance from top of pipette to top of safety bulb	min.	30

8.6 Delivery jet

8.6.1 The delivery jet shall be strongly constructed with a smooth and gradual taper without any sudden constriction at the orifice.

8.6.2 The end of the jet shall be finished by one of the methods listed below in order of preference :

a) smoothly ground square with the axis, slightly bevelled on the outside and fire-polished;

b) smoothly ground square with the axis and slightly bevelled on the outside.

A fire-polished finish reduces the danger of chipping in use, but should not result in constriction as indicated in 8.6.1, or in undue stress.

8.7 Delivery time

The delivery time is defined as the time occupied by the descent of the water meniscus from the graduation line to the point at which it appears to come to rest in the jet.

The delivery time is determined with the pipette in a vertical position and with the receiving vessel 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.

The delivery time thus determined shall be within the limits shown in table 4.

9 GRADUATION LINE

The graduation line shall be a clean, permanent, uniform line completely encircling the tube, except that a gap, not exceeding 10 % of the circumference, may be permitted.

The line shall lie in a plane at right angles to the longitudinal axis of the pipette. The line thickness shall not exceed 0,4 mm or one-half of the limit of volumetric error, whichever is smaller (see ISO 384).

Dimensions limiting the position of the graduation line on the pipette are included in table 2.

10 INSCRIPTIONS

10.1 The following inscriptions shall be marked on all pipettes :

a) a number indicating the nominal capacity and, adjacent or subjacent to this number, the symbol "cm^3" or the symbol "ml" to indicate the unit in terms of which the pipette is graduated (see note to 3.1);

b) the inscription "20 °C" to indicate the standard reference temperature;

NOTE – Where, exceptionally, the reference temperature is 27 °C, this value shall be substituted for 20 °C.

c) the letters "Ex" to indicate that the pipette has been adjusted to deliver its indicated capacity;

d) the inscription "A" or "B" to indicate the class of accuracy for which the pipette has been adjusted;

e) the maker's and/or vendor's name or mark;

f) the waiting time, if specified, in the form : "Ex + 15 s".

TABLE 4 – **Delivery times**

Times in seconds

Class of accuracy		Nominal capacity, ml									
		0,5	1	2	5	10	20	25	50	100	200
Class A, no definite waiting time	min.	10	10	10	15	15	25	25	30	40	50
	max.	20	20	25	30	40	50	50	60	60	70
Class A, waiting time 15 s	min.	4	5	5	7	8	9	10	13	25	
	max.	8	9	9	11	12	13	15	18	30	
Class B	min.	4	5	5	7	8	9	10	13	25	40
	max.	20	20	25	30	40	50	50	60	60	70
Maximum permissible difference between observed and marked delivery times*		2	2	2	3	3	4	4	5	5	5

* When the delivery time is marked on a pipette in accordance with 10.2 b), then the observed delivery time and the marked delivery time shall both be within the limits given in this table and shall not differ by more than the values shown.

10.2 The following additional inscriptions shall be marked on class A pipettes intended for official verification or certification, if required by legal metrology; they should preferably be marked on other class A pipettes and may also be used, if desired, on class B pipettes :

a) an identification number;

b) the delivery time in seconds.

10.3 The limit of volumetric error according to table 1 may be marked on all pipettes, for example by the inscription ± . . . ml.

11 VISIBILITY OF GRADUATION LINE, FIGURES AND INSCRIPTIONS

11.1 All figures and inscriptions shall be of such size and form as to be clearly legible under normal conditions of use.

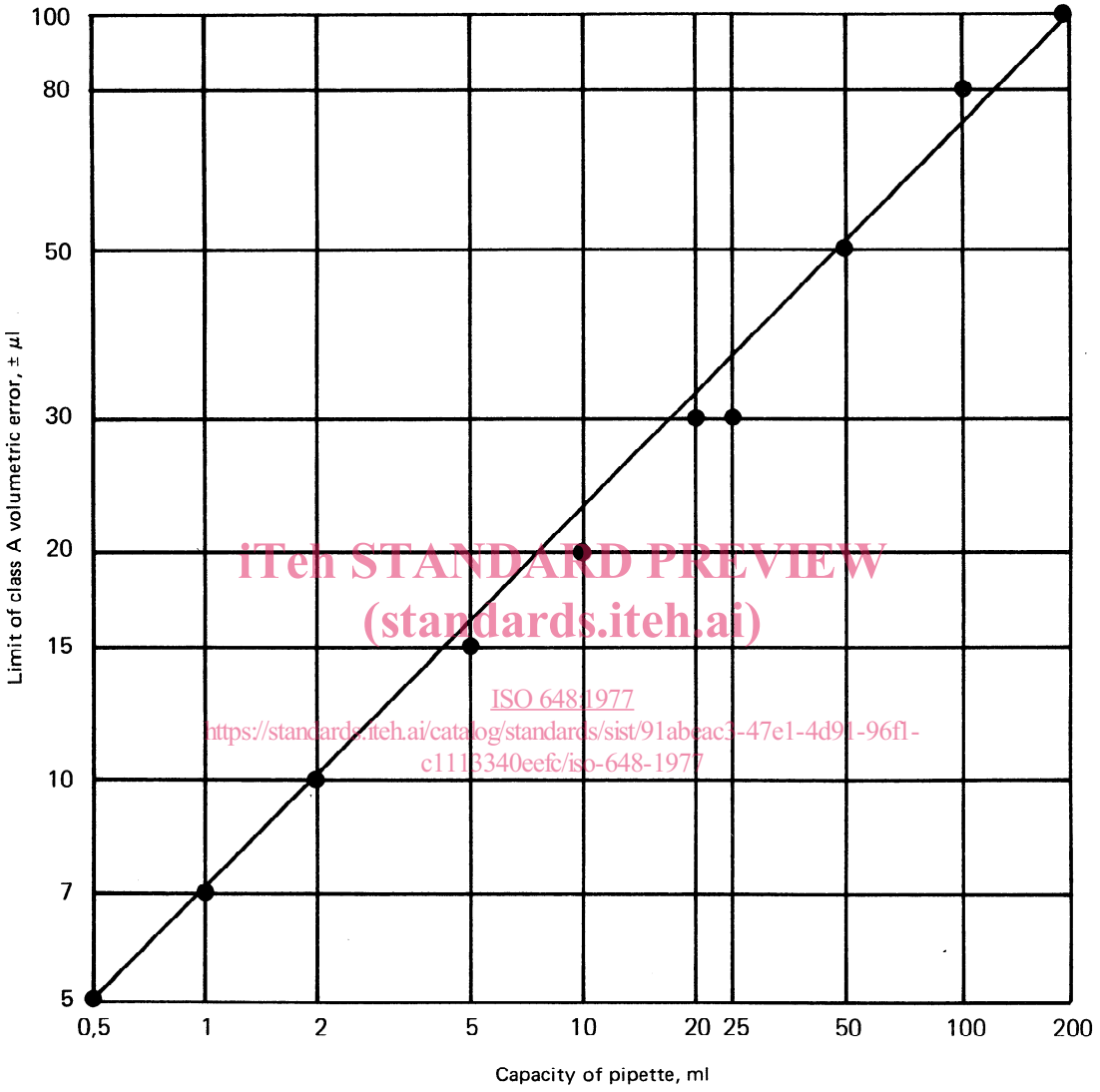
11.2 The graduation line, the figures and inscriptions shall be clearly visible and permanent.

12 COLOUR CODING

Colour coding, if used on these pipettes, shall comply with the requirements of ISO 1769.

ANNEX A

RELATIONSHIP BETWEEN CAPACITY AND LIMIT OF ERROR FOR CLASS A PIPETTES AS REQUIRED BY 4.4 OF ISO 384



ANNEX B

NOMOGRAPH INDICATING THE RELATIONSHIP BETWEEN LIMIT OF ERROR AND MENISCUS DIAMETER FOR CLASS A PIPETTES AS REQUIRED BY 4.7 OF ISO 384