International Standard 835/1

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

Laboratory glassware — Graduated pipettes — Part 1 : General requirements

Verrerie de laboratoire — Pipettes graduées — Partie 1 : Spécifications générales

First edition — 1981-07-01

UDC 542.3 : 531.732 **Ref. No. ISO 835/1-1981 (E)**

Descriptors : glassware, laboratory glassware, pipettes, categories, specifications, capacity, graduations.

Price based on 7 pages

Foreword

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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 835/1 was developed by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, and was circulated to the member bodies in August 1979.

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

Australia	Germany, F.R.	Netherlands
Brazil	Hungary	Poland
Canada	India	Romania
Chile	Italy	Spain
Czechoslovakia	Korea, Rep. of	United Kingdom
Egypt, Arab Rep. of	Libyan Arab Jamahiriya	USSR
France	Mexico	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

South Africa, Rep. of
USA

This International Standard cancels and replaces ISO Recommendation R 835-1968, of which it constitutes a technical revision.

Printed in Switzerland

Laboratory glassware — Graduated pipettes — Part 1 : General requirements

1 Scope and field of application

This part of ISO 835 specifies general requirements for graduated pipettes, adequate for general laboratory purposes.

The requirements specified are in conformity with ISO 384.

NOTE — Particular requirements for the different types of graduated pipette are specified in the following parts of this International Standard :

Part 2 : Graduated pipettes, for which no waiting time is specified (class A and class B)

Part 3 : Graduated pipettes, for which a waiting time of 15 s is specified (class A only)

Part 4 : Graduated pipettes adjusted for blow-out (class B only)

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

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 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 to liquid volumes.

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 recommended 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.

In neither class shall the limit of volumetric error exceed the smallest scale division.

5 Types of pipette

The following types of pipette are specified :

— Graduated pipettes adjusted for delivery of a liquid from zero line at the top to any graduation line; nominal capacity represented by the lowest graduation line.

Class A and class B; no waiting time specified (pipettes type 1, see ISO 835/2).

— Graduated pipettes adjusted for delivery of a liquid from any graduation line down to the jet; nominal capacity represented by the highest graduation line.

Class A and class B; no waiting time specified (pipettes type 2, see ISO 835/2).

— Graduated pipettes adjusted for delivery of a liquid from zero line at the top to any graduation line; nominal capacity obtained by delivery down to the jet.

Class B only; no waiting time specified (pipettes type 3, see ISO 835/2).

— Graduated pipettes adjusted for delivery of a liquid from zero line at the top to any graduation line; nominal capacity obtained by delivery down to the jet.

Class A only; 15 s waiting time specified (see ISO 835/3).

— Graduated pipettes adjusted for delivery of a liquid from any graduation line down to the jet; nominal capacity represented by the highest graduation line.

Class B only; last drop (in the jet) to be blown out (blow-out pipettes, see ISO 835/4).

6 Limits of volumetric error

Errors in the delivered volume shall not exceed the limits shown in table 1. These limits represent the maximum permitted error at any point and also the maximum permissible difference between the errors at any two points.

Table 1 — Capacities, sub-divisions and limits of error

Nominal capacity	Smallest scale division	Limit of error	
		Class A	Class B
ml	ml	± ml	± ml
0,5	0,01	0,005	
1	0,01	0,006	0,01
2	0,02	0,01	0,02
5	0,05	0,03	0,05
10	0,1	0,05	0,1
25	0,1	0,1	—
25	0,2	0,1	0,2

NOTE — If pipettes are required of capacities and/or sub-divisions other than those listed in this table, it is recommended that they conform to the essential requirements of this part of ISO 835.

7 Construction

7.1 Material

Graduated 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.

7.2 Dimensions

Graduated pipettes shall comply with the dimensional requirements shown in table 2.

7.3 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.

7.4 Delivery jet

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

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

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

— smoothly ground square with the axis, and slightly bevelled on the outside;

— cut square with the axis and fire-polished.

7.5 Delivery time

The delivery time is defined as the time occupied by the free descent of the water meniscus from the highest graduation line :

— to the lowest graduation line, in the case of type 1 pipettes;

— to the point at which the meniscus appears to come to rest in the jet, in the case of each other pipette.

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.

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

The delivery time thus determined shall be within the limits specified for the particular pipette.

7.6 Waiting time

The waiting time, if specified, is defined as the period of time to be observed after the meniscus appeared to come to rest in the jet, and before the tip of the jet shall be removed from the receiving vessel.

8 Graduation and figuring

8.1 Graduation lines

8.1.1 Graduation lines shall be clean, permanent and uniform lines of thickness not exceeding 0,3 mm.

8.1.2 All graduation lines shall lie in planes at right angles to the longitudinal axis of the pipette.

Table 2 — Dimensions

Dimensions in millimetres

Dimensions			Nominal capacity, ml						
			0,5	1	2	5	10	25	25*
Essential dimensions	Distance from zero line to lowest graduation line for type 1 pipettes	max.		220	220	220	220	220	—
		min.		160	160	180	180	180	—
	Distance from highest to lowest figured graduation lines for each other pipette	max.	220	220	220	220	220	220	290
		min.	140	140	140	160	160	160	250
	Distance from highest graduation line to top of pipette	min.	100	100	100	100	100	100	100
	External diameter of suction tube	max.	—	—	—	8,3	8,3	8,3	8,3
		min.				6,8	6,8	6,8	6,8
	Length of tube of uniform bore below lowest graduation line	min.	10	10	10	10	10	10	10
Recommended dimensions	Overall length		360	360	360	360	360	360	450
	Length of tapered portion forming jet		20	20	20	25	25	30	30
	External diameter of jet at top of bevel		2,5	2,5	2,5	3	3	3	3
	Wall thickness		2	2	1,5	1	1	1	1

* Valid only for the 25/0,1 ml pipette (see ISO 835/3).

8.2 Spacing of graduation lines

8.2.1 There shall be no evident irregularity in the spacing of the graduation lines.

8.2.2 The limits on the spacing of graduation lines shall be such that the scale lengths are within the limits allowed in table 2.

8.3 Length of graduation lines

8.3.1 Graduation pattern 1

a) The length of the short lines shall be approximately, but not less than, 50 % of the circumference of the article.

b) The length of the medium lines shall be approximately 65 % of the circumference of the article and shall extend symmetrically at each end beyond the end of the short lines.

c) The long lines shall extend completely round the circumference of the article, but a gap, not exceeding 10 % of the circumference, may be permitted.

8.3.2 Graduation pattern 2

a) The length of the short lines shall be not less than 10 % and not more than 20 % of the circumference of the article.

b) The length of the medium lines shall be approximately 1,5 times the length of the short lines and shall extend symmetrically at each end beyond the end of the short lines.

c) The long lines shall extend completely round the circumference of the article, but a gap, not exceeding 10 % of the circumference, may be permitted.

8.3.3 Graduation pattern 3

a) The length of the short lines shall be not less than 10 % and not more than 20 % of the circumference of the article.

b) The length of the medium lines shall be approximately 1,5 times the length of the short lines and shall extend symmetrically at each end beyond the ends of the short lines.

c) The length of the long lines shall be not less than twice the length of the short lines and shall extend symmetrically at each end beyond the ends of the short and medium lines.

8.4 Sequence of graduation lines (see figure 1)

8.4.1 On pipettes in which the volume equivalent of the smallest scale division is 0,01 ml or 0,1 ml :

a) every tenth graduation line shall be a long line;

b) there shall be a medium line midway between two consecutive long lines;

c) there shall be four short lines between consecutive medium and long lines.

8.4.2 On pipettes in which the volume equivalent of the smallest scale division is 0,02 ml or 0,2 ml :

a) every fifth graduation line shall be a long line;

b) there shall be four short lines between two consecutive long lines.

8.4.3 On pipettes in which the volume equivalent of the smallest scale division is 0,05 ml :

a) every tenth graduation line shall be a long line;

b) there shall be four medium lines equally spaced between two consecutive long lines;

c) there shall be one short line between two consecutive medium lines or between consecutive medium and long lines.

8.5 Position of graduation lines (see figure 2)

8.5.1. On pipettes graduated according to pattern 1, the ends of the short graduation lines shall lie on an imaginary vertical line down the centre of the front of the pipette, the lines themselves extending preferably to the left when the pipette is viewed from the front in the position of normal use.

8.5.2 On pipettes graduated according to pattern 2 or 3, the mid-points of the short and medium graduation lines shall lie on an imaginary vertical line down the centre of the front of the pipette, when the pipette is viewed from the front in the position of normal use.

8.6 Figuring of graduation lines

Table 3 — Figuring of graduation lines

Nominal capacity	Smallest scale division	Figured at every
ml	ml	ml
0,5	0,01	0,1
1	0,01	0,1
2	0,02	0,2
5	0,05	0,5
10	0,1	1,0
25	0,1	1,0
25	0,2	2,0

9 Setting of the meniscus

Setting of the meniscus shall be performed by one of the two methods detailed below. In order to minimize possible errors, the same method of setting shall be used for both zero and end readings.

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.

NOTE — It should be borne in mind that an additional error will result, when the method of setting the meniscus is not consistent in adjustment and use of pipettes for delivery down to the jet.

10 Inscriptions

10.1 The following inscriptions shall be marked on each pipette :

a) the symbol cm^3 or the symbol ml to indicate the unit in terms of which the pipette is graduated;

b) the inscription 20 °C to indicate the 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 inscription 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;

g) a small white ring (etched, sand-blasted or enamelled) close to the top of the pipette, in the case of blow-out pipettes. Additionally, these pipettes may have an inscription that the instrument is a blow-out pipette (for example "blow-out", "à souffler" or similar).

10.2 The following additional inscriptions should 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 lines, 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 All graduation lines, figures and inscriptions shall be clearly visible and permanent.

12 Colour coding

If colour coding is used on these pipettes, it shall comply with the requirements of ISO 1769.

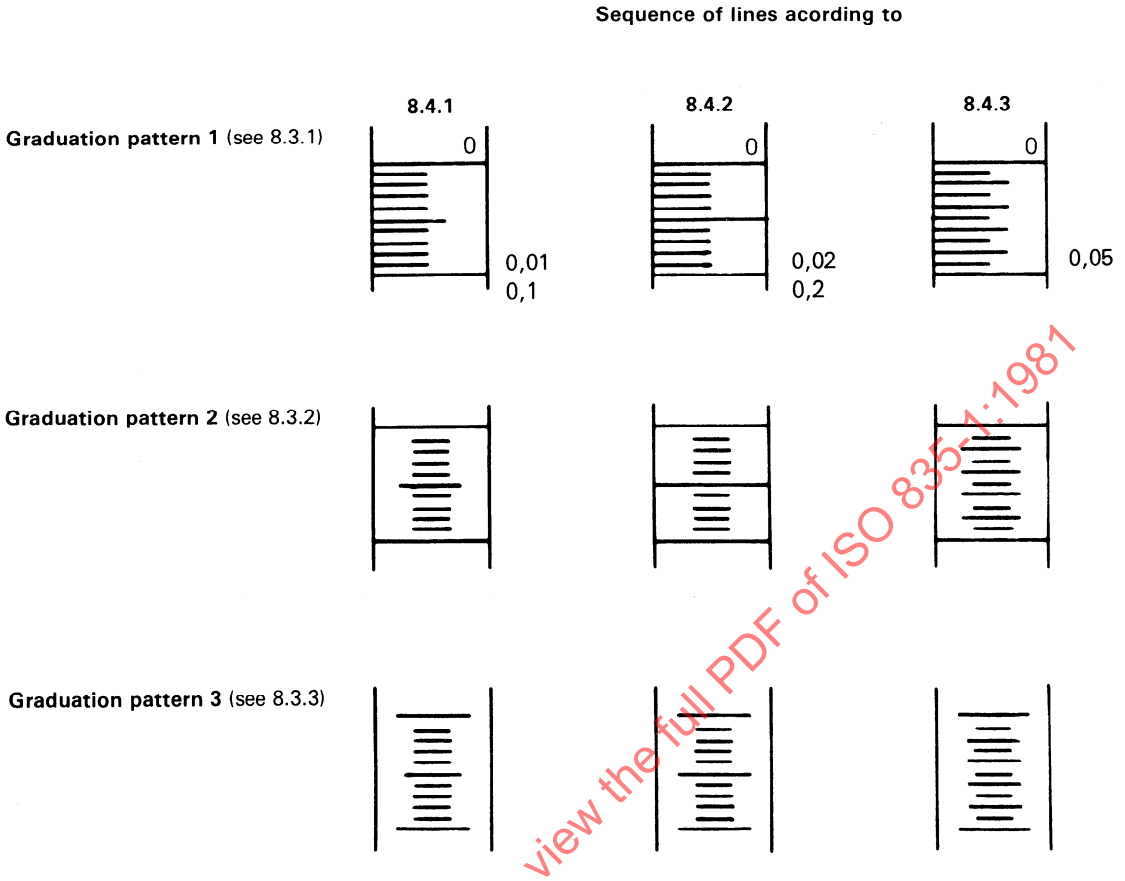
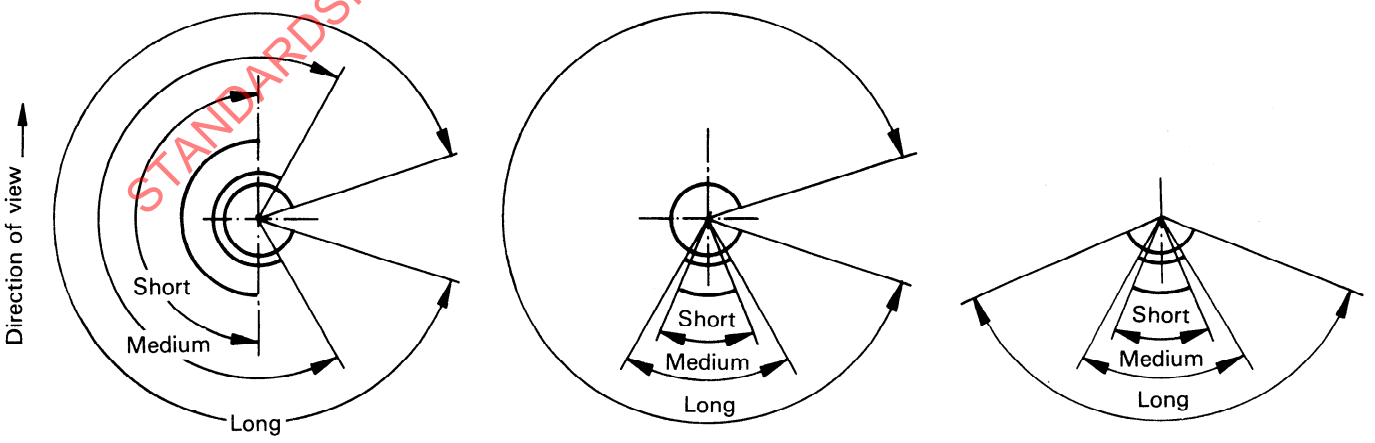


Figure 1 — Length and sequence of graduation lines



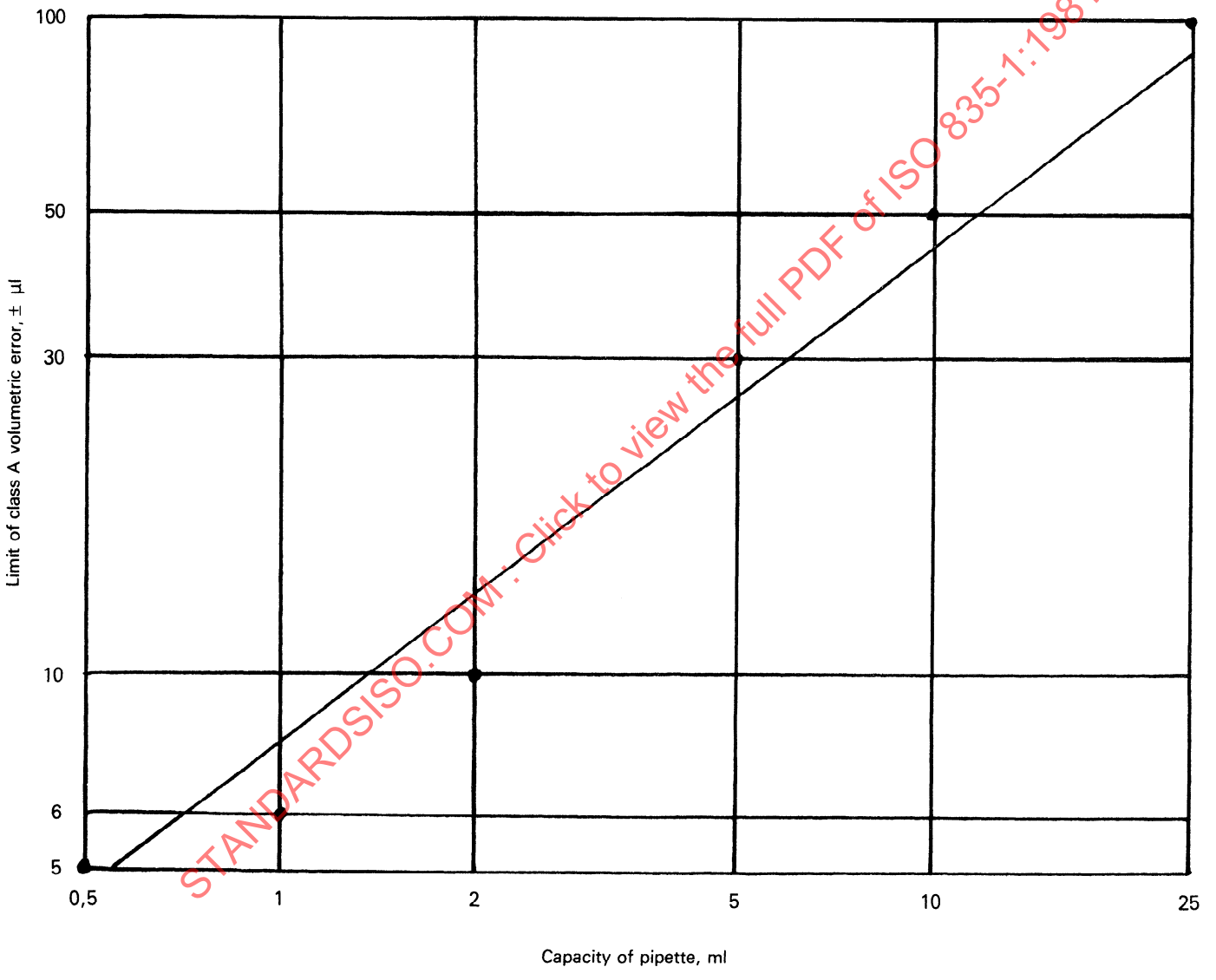
Graduation pattern 1 Graduation pattern 2 Graduation pattern 3

Figure 2 — Position of graduation lines

Annex A

Relationship between volumetric capacity and limits of error for class A pipettes as required by 4.4 of ISO 384

(This annex forms part of the standard.)



Annex B

Relationship between limits of volumetric error and meniscus diameter for class A pipettes as required by 4.7 of ISO 384

(This annex forms part of the standard.)