INTERNATIONAL

RECOMMENDATION

OIML R 43

Edition 1981 (E)

Standard graduated glass flasks for verification officers

Fioles étalons graduées en verre pour agents de vérification.

OIML R 43 Edition 1981 (E)

ORGANISATION INTERNATIONALE
DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION
OF LEGAL METROLOGY

Foreword

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STANDARD GRADUATED GLASS FLASKS

for VERIFICATION OFFICERS

1. General.

1.1. This Recommendation deals with standard graduated flasks made of glass, used by verification officers to check volumetric or capacity measures, for which the maximum permissible error is at least three times that for the standard graduated flask.

1.2. This Recommendation applies to new standard graduated flasks, intended for the replacement of flasks actually in use, or when new flasks are to be acquired as supplementary standards.

2. Definitions.

2.1. Capacity

2.1.1. The capacity « contained » in a standard graduated flask, corresponding to a scale mark (designated capacity « In »), is equal to the volume of water which the flask contains at the reference temperature, when filled to this scale mark.

2.1.2. The capacity « delivered » by a standard graduated flask, corresponding to a scale mark (designated capacity « Ex »), is equal to the volume of water delivered by the flask at the reference temperature, when filled to this scale mark and then emptied (see method described in appendix A, point A.3.2.).

Note : The expression « filled to this scale mark », means that the meniscus formed by the water in the neck of the flask, is so adjusted that the horizontal plane passing through the upper edge of the scale mark, is tangential to the lowest point of the meniscus, when viewed in this plane.

2.2. Nominal capacity.

The nominal capacity of a standard graduated flask is the volume used to designate the flask (see point 3.2.).

3. Nominal capacities.

3.1. Unit

The unit of volume is the cubic centimetre (cm^3), or cubic decimetre (dm^3).

Note : The term millilitre (ml) may be used as a special name for the cubic centimetre, and, the litre (l) as a special name for the cubic decimetre.

3.2. Values

The standard graduated flasks must have one of the following nominal capacities :

1×10^n dm^3, 2×10^n dm^3 or 5×10^n dm^3

where n is a positive or negative whole number, or zero.

A series of standard graduated flasks comprises a number of flasks, the nominal capacities of which may range from 10 cm^3 to 10 dm^3, the choice of nominal capacities included in the series being made in accordance with national regulations.

3.2.1. For special uses, standard graduated flasks may be used having nominal capacities of 250 cm^3 and 2.5 dm^3.

3.3. Reference temperature

The reference temperature, i.e. the temperature at which the flask is intended to contain or deliver a volume equivalent to its nominal capacity, must be 20 °C.

Note : When, in certain tropical countries, it is necessary to use standard flasks at temperatures exceeding 20 °C, and if these countries do not wish to adopt the reference temperature of 20 °C, it is recommended that a temperature of 27 °C, be adopted.

4. Material.

4.1. The standard graduated flasks must be constructed of clear glass, transparent, well annealed and having suitable thermal and chemical properties.

The glass must be free from visible defects, which might influence the appearance or use of the flask, in particular in the vicinity of the graduated scale.

5. Construction, shape and dimensions.

5.1. Standard graduated flasks must be of sufficiently robust construction to withstand normal use.

The wall thickness, at any point, must not be less than that indicated in Table 1.

5.2. The neck of the flask must be cylindrical.

The internal diameter of the graduated part of the neck, must not exceed the limits given in Table 1.

5.3. A standard graduated flask must maintain a stable vertical position, when placed with its base on a flat horizontal surface.

5.3.1. A standard graduated flask with a nominal capacity of 10 cm^3 or 20 cm^3 must not tip over, when placed empty (and without stopper) on a surface at an angle of 10° to the horizontal. A standard graduated flask with a nominal capacity exceeding 20 cm^3, must not tip over when placed empty (and without stopper) on a surface at an angle of 15° to the horizontal.

5.4. The top edge have a smooth finish, be square to the axis of the flask, and have a small flange.

5.5. The general shape of standard graduated flasks between 10 cm^3 and 10 dm^3, must be as shown in figure 1 (type A).

However, flasks of 1 dm^3 to 10 dm^3 can also have the shape as shown in figure 2 (type B).

5.6. The main dimensions of standard graduated flasks must satisfy the requirements given in Table 1.

6. Scale.

6.1. The scale must be regular.

The lines must be distinct, permanent and of uniform thickness, not exceeding 0.3 mm.

6.2. The lines must be at right angles to the longitudinal axis of the graduated part of the flask.

6.3. The lines must appear on the neck of the flask.

The distance between the highest line and the top edge of the neck, must not be less than 10 mm.

The distance between the lowest line and the bottom point of the neck, at which point the neck starts to widen, must not be less than the values indicated in Table 1.

6.4. The line for the nominal « contained » capacity (nominal capacity « In »), must take up at least 9/10 of the circumference of the neck (the interruption, if any, in this line must be centered on the lateral generatrix of the neck).

6.5. The standard graduated flasks may be marked :

either with lines indicating the « contained » capacity (capacity « In »), or with lines indicating the « delivered » capacity (capacity « Ex »).

6.5.1. If a flask is marked with lines indicating the « contained » capacity (capacity « In »), a line corresponding to the nominal « delivered » capacity (nominal capacity « Ex ») must also be marked on the neck.

6.5.2. If a flask is marked with lines indicating the « delivered » capacity (capacity « Ex »), a line corresponding to the nominal « contained » capacity (nominal capacity « In ») must also be marked on the neck.

6.6. The volumetric scale range above and below the line corresponding to the nominal capacity («contained » or « delivered »), must be in accordance with the provisions of Table 2.

6.6.1. A standard graduated flask to indicate « contained » capacity, must be marked « In », and a standard graduated flask to indicate « delivered » capacity, must be marked « Ex ».

6.7. The numbered lines (see Table 2) must be appreciably longer than un-numbered lines, to ensure that they are visually distinguishable.

6.8. Un-numbered lines (see Table 2) must have a minimum length of half the circumference of the neck.

6.9. Lines and numbers must be clearly legible, and indelible.

7. Maximum permissible errors on initial and subsequent verification.

7.1. The maximum permissible errors on the « contained » capacity (capacity « In »), corresponding to any scale mark, must satisfy the requirements indicated in column E_1 of the table below.

7.2. The maximum permissible errors on the « contained » capacity, between any two scale marks, must satisfy the requirements given in column E_2 of the table below.

7.3. The maximum permissible errors on the « delivered » capacity (capacity « Ex »), corresponding to any scale mark, or between any two marks, are 50 % greater than on the « contained » capacity, as stated in points 7.1 and 7.2.

7.4. A method for verification is given in the appendix, for guidance.

Maximum permissible errors for the « contained » capacity (« In »)

Nominal capacity	Maximum permissible error	
	E_1	E_2
	± cm^3	± cm^3
10 cm^3	0.05	0.02
20	0.08	0.03
50	0.12	0.05
100	0.20	0.06
200	0.30	0.09
500	0.50	0.15
1 dm^3	0.80	0.22
2	1.20	0.33
5	2.50	0.75
10	5.00	1.50

Standard graduated flasks for special uses

250 cm^3	0.30	0.10
2.5 dm^3	1.40	0.40

8. Inscriptions.

8.1. The following inscriptions must be included on the wall of the standard graduated flask, on the outside neck :

a — one or several suitable letters to indicate that the flask is a « standard graduated flask for verification officers »,

b — nominal capacity in Arabic numerals, followed by the symbol cm^3 (or ml) or dm^3 (or l),

c — the inscription 20 °C (or 27 °C), indicating the reference temperature,

d — name of the manufacturer of the flask,

e — serial number of the flask.

8.2. The following inscription must be marked on the neck of the standard graduated flask :

a — the inscription « In » opposite the appropriate zero scale mark, to indicate that the flask has been adjusted to contain a volume equal to its nominal capacity, when filled to this line,

or

b — the inscription « Ex », opposite the appropriate zero scale mark, to indicate that the flask has been adjusted to deliver a volume equal to its nominal capacity, when filled to this line.

8.3. The standard graduated flasks intended specifically for use with non-drinkable liquids, must be marked « for non-drinkable liquids ».

8.4. All inscriptions must be clearly legible and indelible, under normal conditions of use.

9. Periodic verification.

9.1. The standard graduated flasks must be verified at intervals of time, as prescribed by national regulations.

Note : It is recommended that this interval be ten years.

10. Stamping of flasks.

10.1. Each standard graduated flask must :

— either be marked in a suitable manner after verification, in a place which does not obstruct observation of the meniscus,

— or be given a certificate of verification in which case the certificate must show the serial number of the flask.

11. Boxes.

11.1. If necessary, standard graduated flasks may be housed in dust-proof boxes, made of suitable non-

corrodible materials, and lined with velvet, chamois leather, soft plastics or any other suitable material.

Note : Standard graduated flasks obtained as replacements for those in current use, may be placed in existing boxes.

11.2. The standard graduated flasks must be placed in their boxes, in such a way as to avoid any movement, dislodgement or damage.

12. Inscriptions on the boxes.

12.1. A descriptive plate may be fixed on each box containing standard graduated flasks.

This plate must indicate the identification numbers of the flasks, where given, together with the following markings, where necessary :

a — national identification mark,

b — identification of the flasks, for example : « Verification officers standard graduated glass flasks »,

c — name of manufacturer,

d — series of flasks contained in the box.

12.2. Other markings may be provided, in accordance with national regulations.

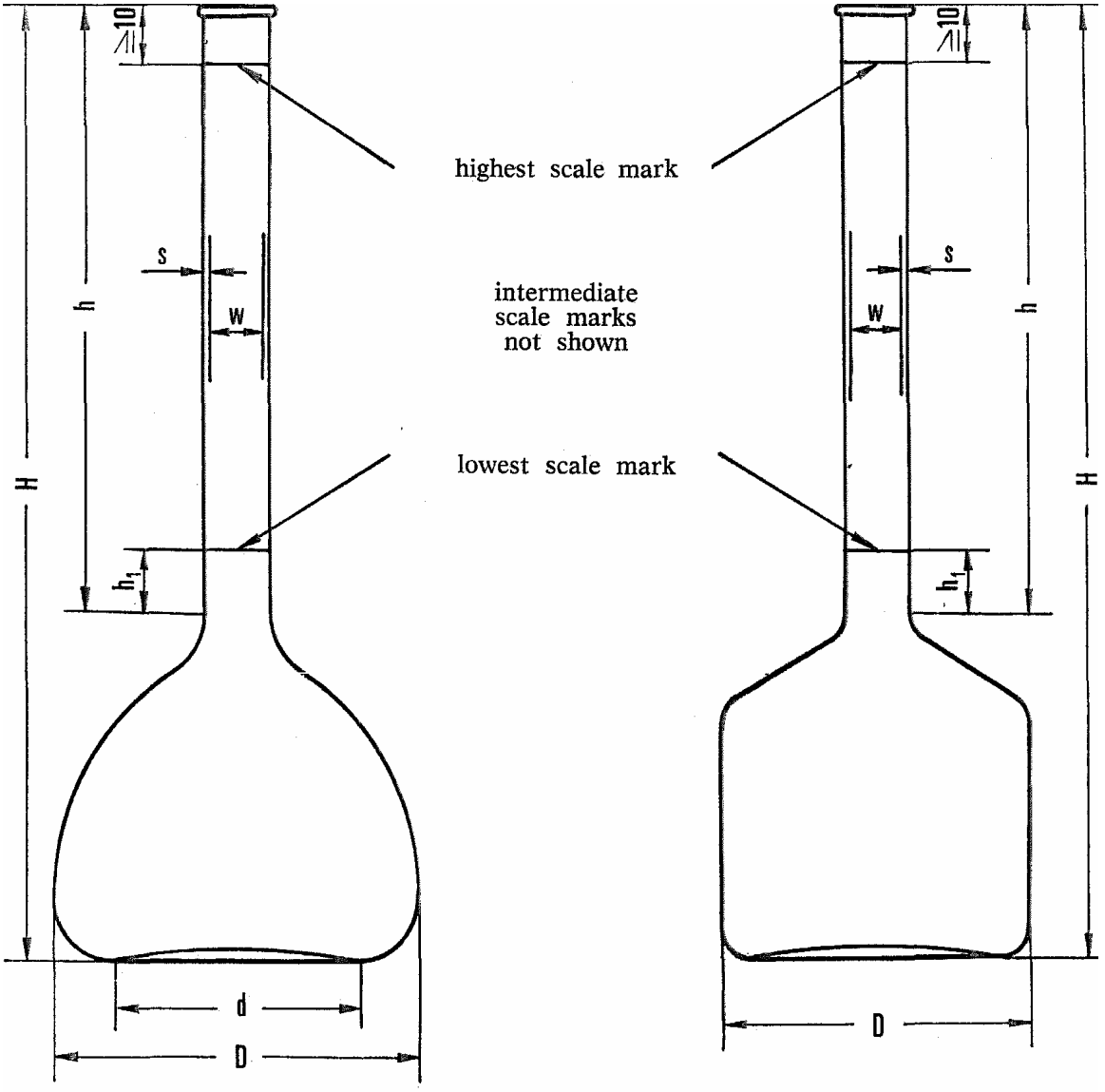

Figure 1
(flasks of 10 cm³ to 10 dm³)
TYPE « A »

Figure 2
(flasks of 1 dm³ to 10 dm³)
TYPE « B »

TABLE 1

DIMENSIONS OF STANDARD GRADUATED FLASKS

Nominal capacity	Inside diameter of flask neck (W)		Length of neck (h)	Distance h_1 (*)	Diameter of flask body			Flask height (H)	Wall thickness (s)
					Type A flasks figure 1		Type B flasks figure 2		
	Min	Max		min.	(D) approx.	(d) approx.	(D) approx.		min
	mm	mm	mm	mm	mm	mm	mm	mm	mm
10 cm^3	6.0	8.0	55 to 70	5	27	18	—	90	0.8
20	8.0	10.0	75 to 95	5	35	25	—	110	0.8
50	10.0	12.0	90 to 110	10	50	35	—	140	1
100	12.0	14.0	110 to 125	10	60	40	—	170	1
200	14.0	17.0	115 to 130	10	75	50	—	210	1
500	17.0	21.0	130 to 150	15	100	70	—	260	1.3
1 dm^3	21.0	25.0	175 to 200	15	125	85	105	300	1.5
2	25.0	30.0	195 to 220	15	160	110	135	370	1.5
5	35.0	41.0	215 to 240	20	220	160	180	450	2.5
10	44.0	52.0	245 to 280	20	275	210	230	550	3
standard graduated flasks for special uses									
250 cm^3	14.0	17.0	115 to 130	10	80	55	—	220	1.3
2.5 dm^3	28.0	32.0	200 to 220	15	175	130	145	390	1.5

(*) h_1 is the distance between the lowest scale mark, and the point at the base of the neck at which the flask diameter changes (see fig. 1).

TABLE 2

SCALES FOR STANDARD GRADUATED FLASKS

Nominal capacity	Volumetric scale range	Scale interval		Numbering
		Type A	Type B	
	cm^3	cm^3	cm^3	cm^3
10 cm^3	± 1	0.1		1
20	± 1.6	0.1		1
50	± 3	0.2		1
100	± 4	0.5		2
200	± 6	0.5		5
500	± 10	1		5
1 dm^3	± 20	1	2	Type A : 5 Type B : 10
2	± 30	2	5	10
5	± 50	5	10	50
10	± 150	10	20	Type A : 50 Type B : 100

standard graduated flasks for special uses

250 cm^3 2.5 dm^3	± 6 ± 30	0.5 2	1 5	5 10

APPENDIX A

VERIFICATION OF STANDARD GRADUATED GLASS FLASKS

FOR VERIFICATION OFFICERS

A.1. Test liquid.

A. 1.1. Water : distilled or deionized of high purity, in accordance with the following requirements when tested immediately before use :

it must be free from dissolved gases, and heavy metals, in particular copper, as shown by the dithizone test,

the specific conductivity must not exceed 1×10^{4} $S \cdot m^{-1}$ at 20 °C, and it must be neutral to methyl red.

A.2. Instruments.

A.2.1. Scales : of suitable maximum capacity, having an accuracy at least equal to that of non-automatic weighing machines of the high accuracy class (or possibly special accuracy class).

3.2.2. Thermometer : with appropriate measurement range, suitable for the measurement of temperature with error not exceeding ± 0.1 °C.

A.3. Method.

A.3.1. Determination of the « contained » capacity (capacity « In »).

A.3.1.1.

- clean and dry the flask,
- weigh the flask empty,
- allow the temperature of flask and water used for testing to equalise,
- record the water temperature,
- place the flask on a flat horizontal surface, and fill it with water to a point a few millimetres below the mark indicating the nominal capacity « In »,
- add more water slowly, to bring the meniscus carefully to the scale mark concerned,
- check that the outside surface of the flask, and its internal surface above water level are dry, and that neither bubbles or foam are present in the water,
- weigh the flask and its contents.

A.3.1.2.

From the difference between the results of weighing the flask when full and the flask when empty, and allowing for correction of the displaced air, the mass of the quantity of water corresponding to nominal « contained » capacity is obtained.

Knowing the temperature of the water in the flask, and using tables for the density of water as a function of the temperature, the volume of the water contained in the flask may be determined.

From this volume and the coefficient of cubic expansion of the glass, the conventional true capacity of the flask is determined for the scale mark corresponding to nominal « contained » capacity, at the chosen reference temperature (20 °C or 27 °C).

A.3.1.3.

Repeat the procedure for filling and weighing the filled flask as in point A.3.1.1., and calculate as in point A.3.1.2., for four other scale marks, including both the highest and lowest scale marks.

A.3.1.4.

The error on the « In » capacity for any scale mark, is equal to the difference between the « In » capacity indicated by a mark, and the conventional true capacity corresponding to this mark, determined by the method described in points A.3.1.1. to A.3.1.3.

The error on the « In » capacity between any two scale marks, is equal to the difference between :

— the difference between the capacities indicated by the marks and,

— the difference between the conventional true capacities determined by the method given in points A.3.1.1. to A.3.1.3.

A.3.2. Determination of the « delivered » capacity (capacity « Ex »)

A.3.2.1.

— clean the flask,
— equalize the temperature of the flask and the water used for testing,
— record the water temperature,
— fill the flask with water to a few millimetres below the scale mark indicating the nominal capacity « Ex »,
— empty the flask, and allow to drain for 2 to 3 minutes,
— refill the flask as above, adding the water slowly so as to bring the meniscus carefully to the scale mark concerned,
— check that the outside surface of the flask, and its internal surface above water level are dry, and that neither bubbles or foam are present in the water,
— weigh the flask and its contents,
— empty the contents into a container,
— hold the flask in an inverted position to drain for 30 seconds,
— remove the last drop adhering to the lip of the neck, by bringing the lip into contact with the internal wall of the container,
— weigh the empty flask.

A.3.2.2. From the difference between the results of weighing the flask when full and when empty, and allowing for correction of the displaced air, the mass of the quantity of water corresponding to the « delivered » capacity is obtained.

Knowing the temperature of the water in the flask, and using tables for the density of water as a function of the temperature, the volume of the water delivered can be determined.

From this volume and the coefficient of cubic expansion of the glass, the conventional true capacity of the flask for the scale mark corresponding to « Ex » nominal capacity, at the chosen reference temperature (20 °C or 27 °C) may be determined.

A.3.2.3. Repeat the procedure for filling, draining and weighing as in point A.3.2.1., and calculate as in point A.3.2.2., for four other scale marks, including both the highest and lowest scale marks.

4.3.2.4. The error on the « Ex » capacity for any scale mark, is the difference between the « Ex » capacity indicated by a mark, and the conventional true capacity corresponding to this mark, determined by the method given in points A.3.2.1. to A.3.2.3.

The error on the « Ex » capacity between any two scale marks, is equal to the difference between :

— the difference between the capacities indicated by these marks, and

— the difference between the conventional true capacities determined by the method given in points A.3.2.1. to A.3.2.3.

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