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2. Specifications and Tolerances for Field Standard Measuring Flask

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Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures

2. Specifications and Tolerances for Field Standard Measuring Flasks

Blayne C. Keysar

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Institute for Applied Technology
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Specifications and Tolerances for Reference Standard and Field Standard Weights and Measures

2. Specifications and Tolerances for Field Standard Measuring Flasks

Blayne C. Keysar

These specifications and tolerances are recommended as minimum requirements for standards used in the field by State and local weights and measures officials in quantity determinations of liquid commodities.

Key Words: Accurate measurements of volume of liquids; field standard measuring flasks; specifications; tolerances; weights and measures inspection.

Introduction

Field standard measuring flasks are intended to be used by weights and measures officials,[1] manufacturers and distributors of liquid products, research and testing laboratories personnel, and others concerned with accurate measurements of volumes of liquids.

The materials, design, fabrication, and error limitation of the field standards herein specified are intended to permit their use in normal testing operations as standards having nominal values. Field standards are relatable to the U. S. Prototype standards for length, mass, and capacity, through standards which have been supplied to the State Weights and Measures laboratories by the National Bureau of Standards. Field standards should be calibrated periodically. The frequency of calibration required will depend upon usage of the standards. Comparisons against other standards should be performed occasionally to detect those standards in need of recalibration.

Use of these volumetric standards at all appropriate levels of manufacture, distribution, and weights and measures inspection will help promote accuracy and uniformity in commerce.

Specifications: U.S. Customary

1. Sizes

1.1. A set of U.S. customary field standard flasks consists of a 2-fluid ounce cylindrical graduate and one each 1 gill, ½ pint, 1 pint, 1 quart, ½ gallon, and 1 gallon graduated neck flasks.

2. Material

2.1. A field standard flask shall be made of borosilicate glass.

3. Workmanship

3.1. The flask shall be transparent and free from chips, cracks, stones, and other defects that detract from its appearance or that may distort the appearance of the liquid surface under the graduated portion, or impair its serviceability.

4. Design

4.1. The design shall conform to the general configuration in the illustrations. The inscriptions and graduation lines shall be placed in the same relationship to each other and to the position on the flask as shown.

4.2. Any cross section taken in a plane perpendicular to the vertical axis shall be circular.

4.3. The shape shall permit complete emptying and thorough cleaning.

4.4. Each shall be equipped with a hexagonal base that is perpendicular to the vertical axis. (The hexagonal base, used for maximum stability, may be omitted from the 1 gallon size since its size and shape eliminates the necessity for a base.)

[1] Procedures for weights and measures inspection of commercial devices are contained in NBS Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Commercial Weighing and Measuring Devices."

4.5. The height of the graduated portion of the cylindrical graduate shall be at least 5 times the inside diameter.

5. Graduation Lines

5.1. Graduation markings shall be sharply defined lines of uniform width not to exceed 0.3 millimeter.

5.2. The lines shall be perpendicular to the vertical axis of the flask.

5.3. The graduation lines, if etched and filled, shall extend completely around the neck. Due to the difficulty in extending stained or enameled lines completely around the neck, a gap of 4 mm at the closure, or meeting point, is permitted. This gap must be approximately 90° from line of vision when the flask is viewed from the front so as to not interfere with setting a meniscus.

5.4. Subdivision lines shall extend at least halfway around the neck.

5.5. Graduation lines shall be applied by one of the following methods: Etched and filled with a permanent pigment; application of a stain which is fired into the glass without etching; application of an enamel fired onto the glass without etching.

5.6. If a pigment or enamel is used, the nominal volume line (and the 1 fluid ounce line on the cylindrical graduate) shall be of a contrasting color.

5.7. Main graduation lines shall be numbered with the number being placed immediately above the line. (See illustrations.)

6. Scales

6.1. The scale on the graduate shall be divided into fluid drams, and labeling shall so indicate (see illustrations) with the appropriate abbreviation: fl dr. At each 2 fluid drams there shall be a main graduation line. Each subdivision shall be ½ fluid dram.

6.2. Subdivision lines on the graduate shall be omitted between the base and the first numbered line. (Striation occurs in the glass in this area, being caused during manufacture when the base is joined to the cylindrical portion.)

6.3. Each nominal capacity line and the 1 fluid ounce line on the graduate shall be labeled with the appropriate capacity.

6.4. The scale on the flasks shall be graduated on each side of (above and below) the nominal line on each size as shown in table 1.

7. Inscriptions

7.1. Each standard shall be permanently and legibly marked with (1) the manufacturer's name or trademark; (2) serial or identification number; (3) the word "delivers"; (4) capacity; (5) temperature of calibration; and, (6) drainage time (10 seconds). On U.S. Customary standard glassware all letters except unit abbreviations are to be upper case. (figs. 1 and 2).

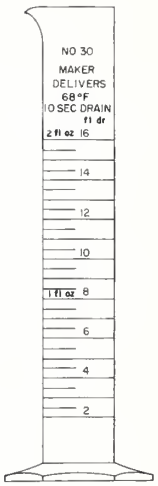

FIGURE 1. *One half pint measuring flask.*
FIGURE 2. *Two fluid ounce cylindrical graduate.*

7.2. The numbers and letters indicating the capacity at the various points shall be placed immediately above the line to which they refer.

8. Temperature

8.1. The calibration temperature shall be 68 °F.

9. Tolerances

9.1. The difference between the actual volumes and indicated volumes at the prescribed temperature (68 °F) shall be not greater than that shown in table 2.

Table 1. Scale Units for U.S. Customary Flasks

Size	Graduation on Each Side of Nominal	Minimum Graduation
Gill	½ fl dr	¼ fl dr
½ Pint	1	¼
Pint	2	½
Quart	4	1
½ Gallon	6	1
Gallon	8	1

Table 2. Tolerances for U.S. Customary Field Standard Flasks and Cylinders (with conversions to milliliters)

Nominal Capacity at 68° F			Tolerances at Nominal Capacity Graduations		Tolerances at Total or Partial Capacity (Graduated Portion)	
1 Gill	1,920 Minims	118.3 ml	± 3 Minims	0.18 ml	±1.0 Minims	0.06 ml
½ Pint	3,840 Minims	236.6 ml	± 4 Minims	0.25 ml	±1.5 Minims	0.09 ml
1 Pint	7,680 Minims	473.2 ml	± 7 Minims	0.43 ml	±3.0 Minims	0.18 ml
1 Quart	15,360 Minims	946.3 ml	±12 Minims	0.74 ml	±5.0 Minims	0.31 ml
½ Gallon	30,720 Minims	1892.7 ml	±16 Minims	0.99 ml	±5.0 Minims	0.31 ml
1 Gallon	61,440 Minims	3785.4 ml	±20 Minims	1.23 ml	±5.0 Minims	0.31 ml
2 Fluid Ounce Cylinder	960 Minims	59.1 ml	± 5 Minims	0.31 ml	±5.0 Minims	0.31 ml

Specifications: Metric

1. Sizes

1.1. A set of metric field standard flasks consists of a 50 milliliter cylindrical graduate and one each 100 milliliter, 250 milliliter, 500 milliliter, 1 liter, and 2 liter graduated neck flasks.

2. Material Workmanship, Design, Graduation Lines, Inscriptions

2.1. Specifications for material, workmanship, design, graduation lines, and inscriptions shall be the same as those for a U.S. Customary set. (Also, see figs. 3 and 4.)

3. Scales

3.1. The scale on a cylindrical graduate shall be divided into milliliters, and labeling shall so indicate (see illustrations) with the appropriate abbreviation: ml. At each 10 milliliters there shall be a main graduation line. Each subdivision shall be 1 milliliter.

3.2. The scale on the flasks shall be graduated on each side of (above and below) the nominal line on each size, as shown in table 3.

Table 3. Scale Units for Metric Flasks

Size	Graduation on Each Side of Nominal	Minimum Graduations
100 ml	2 ml	0.25 ml
250	4	.25
500	8	.5
1000	15	1.0
2000	25	1.0

4. Temperature

4.1. The calibration temperature shall be 20 °C.

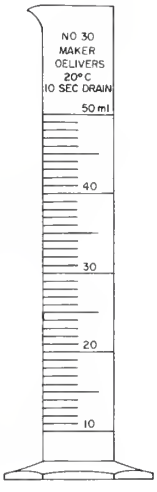

FIGURE 3. *100 milliliter measuring flask.*
FIGURE 4. *50 milliliter cylindrical graduate.*

5. Tolerances

5.1. The difference between the actual volume and the indicated volume at the prescribed temperature (20 °C) shall not be greater than that shown in table 4.

Table 4. Tolerances for Metric Field Standard Flasks and Cylinder

Capacity	Tolerance at Nominal Capacity Graduation	Tolerance at Total or Partial Capacity (Graduated Portion)
100 ml	0.2 ml	0.08 ml
250	.3	.1
500	.5	.2
1000	.8	.3
2000	1.0	.3
50 ml cylinder	.3	.3

Definitions

1. Main graduation lines: Lines which extend at least ¾ the circumference and are numbered.

2. Nominal graduation line: Line indicatilng the nominal capacity such as 1 pint, 1 quart, etc.

3. Subdivision lines: Lines which are between the main graduation lines and are not numbered.

4. Borosilicate Glass: Glass of a low coefficient of expansion used for most precision laboratory glassware and known by such trade names as Kimax (KG–33) or Pyrex.

Abbreviations

Fluid Dram . . . . fl dr
Fluid Ounce . . . . fl oz
Milliliter . . . . . ml
Pint . . . . . pt

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