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Specification for

Glass alcohol hydrometers not incorporating a thermometer

UDC 531.756.3:542.3:661.722

Cooperating organizations

The Laboratory Apparatus Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific, industrial and consumer organizations:

Agricultural Research Council
Association for Science Education
Association of Technical, Scientific and Managerial Staffs
British Laboratory Ware Association*
British Lampblown Scientific Glassware Manufacturers' Association Ltd*
British Pharmacopoeia Commission*
Chemical Industries Association*
Chemical Society, Analytical Division
Department of Health and Social Security
Department of Industry, Laboratory of the Government Chemist*
Department of Industry, National Physical Laboratory
Glass Manufacturers' Federation
Institute of Petroleum*
Ministry of Defence
Pharmaceutical Society of Great Britain
Scientific Instrument Manufacturers' Association
Society of Chemical Industry
Society of Glass Technology*
Standardization of Tar Products Tests Committee

The Government department and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Agricultural Education Association
Royal Institute of Chemistry
Scotch Whisky Association
Wine and Spirit Association of Great Britain

This British Standard, having been prepared under the direction of the Laboratory Apparatus Standards Committee, was published under the authority of the Executive Board on 31 March 1977

The following BSI references relate to the work on this standard:
Committee reference LBC/5
Draft for comment 76/54389

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Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

Foreword

This British Standard was published under the authority of the Laboratory Apparatus Standards Committee following consultations between Government departments, manufacturers and users of alcohol hydrometers. It was prepared at the request of HM Customs and Excise in support of an intended statutory instrument to implement a Council Directive of the EEC[1)], and covers only those instruments which are expected to be used in the United Kingdom; it thus excludes alcoholometers (indicating strength as % *m*/*m* or % *V*/*V*, instruments incorporating a thermometer, and instruments of class I or class III accuracy as defined in the EEC Directive.

The requirements of this British Standard align with those of two draft International Standards for hydrometers, ISO/DIS 387[2)] and ISO/DIS 4801[2)], insofar as they were known at the time of preparation. These International Standards were in course of preparation by Sub-committee 4, Hydrometers, of ISO Technical Committee 48, Laboratory glassware and related apparatus.

The expression "graduation line" which appears in clauses **6**, **7** and **9**, and "datum mark" which appears in **4.5** are internationally accepted terminology, and are equivalent to the expressions "scale mark" and "reference mark" respectively, used in the Directive.

Information on the testing of the hydrometers is given in Appendix A.

Certification. Attention is drawn to the certification facilities described on the inside back cover of this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1)] Council Directive of 27 July 1976, 76/765/EEC on the approximation of the laws of the Member States relating to alcoholometers and alcohol hydrometers.
[2)] in course of preparation.

1 Scope and field of application

This British Standard specifies the requirements of instruments suitable for the accurate determination of the ethanol content of simple mixtures of ethanol and water. They are graduated in density (kg/m^3). One class of accuracy is specified.

2 References

The titles of the publications referred to in this standard are listed on page 6.

3 Basis of scales

3.1 The standard reference temperature for the instruments shall be 20 °C.

3.2 The instruments shall be graduated for reading at the level of the free horizontal surface of the liquid.

4 Description

4.1 Each instrument shall consist of a cylindrical body whose lower end is of such a form, cone-shaped or hemispherical, as will effectively prevent the entrapment of air bubbles.

4.2 At its upper end the body shall be fused on to a hollow cylindrical stem. The top end of the stem shall be sealed.

4.3 The shape of the instrument shall be symmetrical about its longitudinal (vertical) axis. Its cross section shall not exhibit any abrupt variations.

4.4 The loading material for adjusting the mass of the instrument shall be contained in the lower part of the body.

4.5 The stem shall contain a graduated scale, marked on a cylindrical strip of suitable material (see **6.2**, **6.3** and **6.4**) which shall be securely fastened to the interior of the stem. Datum marks shall be provided on the strip and on the stem in order that any displacement of the former relative to the latter would be readily apparent.

5 Materials and workmanship

5.1 The instrument shall be constructed from soda lime glass which shall be transparent, free from stress (i.e. properly annealed) and free from flaws such as would obscure or alter the reading of the scale.

5.2 The coefficient of cubical thermal expansion of the glass shall be $(25 \pm 2) \times 10^{-6}$ °C^{-1}.

5.3 The loading material shall be so fixed that after the finished instrument has been kept in a horizontal position for 1 h at 80 °C and subsequently cooled to room temperature in that position, the instrument shall meet the requirements of **5.4**. Mercury shall not be used as the loading material.

5.4 The instrument shall float with its axis vertical to within 1.5 degrees of arc.

5.5 There shall be no loose material in any part of the instrument.

6 Scale

6.1 The instrument shall not have more than one scale.

6.2 The scale and the inscriptions shall be marked on a strip having a smooth matt surface of white or off-white colour. The graduations within the nominal scale limits and the inscriptions shall be marked in black. Graduations outside the nominal scale limits (see **6.9**) may be marked in a colour other than black.

6.3 The strip bearing the scale shall be of cylindrical form, straight and free from twist.

6.4 The strip bearing the scale shall show no evidence of charring. The strip shall not become discoloured or distorted when the stem is maintained for 24 h at a temperature of 70 °C.

6.5 The graduation lines shall lie in planes perpendicular to the axis of the stem. They shall be distinct and of uniform thickness not exceeding one-fifth of the distance between the centres of adjacent graduation lines or 0.2 mm, whichever is less.

6.6 The short and long graduation lines shall extend, respectively, to at least one-fifth and one-half of the circumference of the stem. The long lines shall extend beyond the ends of the short lines (see Figure 1).

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

6.8 The mean value of the scale spacing (i.e. distance between centres of adjacent graduation lines) shall be not less than 1.05 mm.

6.9 The nominal range of each instrument shall be 20 kg/m^3. Each instrument shall carry 5 to 10 additional graduation lines beyond the nominal limits at both ends of its scale, except that there shall be no lines beyond 1 000 kg/m^3.

7 Graduation and numbering

7.1 Each graduation line corresponding to a whole unit of kg/m^3 shall be a long line. There shall be four short lines corresponding to 0.2 kg/m^3 between two consecutive long lines.

7.2 All the long lines shall be numbered; with the exception of the nominal scale limits they may be partially numbered if required. The short lines shall not be numbered.

7.3 The numbers shall appear immediately above the long lines to which they refer and to the left of the short lines.

8 Surface tension

In marking the graduation lines, the conventional values given in Table 1 shall be assumed for the surface tension at 20 °C of ethanol solutions of various concentrations.

NOTE The values given in Table 1 are based on values adopted by the International Organization of Legal Metrology (OIML) and the International Organization for Standardization (ISO).

9 Dimensions

9.1 The total length of the instrument shall not exceed 300 mm.

9.2 The body diameter shall be 38 ± 2 mm.

9.3 The volume below the lower nominal scale limit shall be 110 ± 15 ml.

9.4 The stem diameter shall be not less than 4 mm.

9.5 The cross section of the stem shall remain unchanged for at least 5 mm below the lowest graduation line of the scale.

9.6 The stem shall extend by at least 15 mm above the uppermost graduation line of the scale.

10 Inscriptions

The following shall be legibly and indelibly marked inside each instrument.

a) The basis of the scale and the standard temperature, i.e. kg/m^3, 20 °C.

b) The word “ethanol”.

c) The accuracy class of the instrument, i.e. class II.

d) The maker’s name or readily identifiable mark.

e) The serial number of the instrument, the last two digits of which indicate the year of manufacture.

f) The number of this British Standard, i.e. BS 5470.

With the consent of the appropriate pattern approval agency, the EEC pattern approval sign “ε” may also be marked.

11 Accuracy and testing

The maximum permissible error shall be ± 1 scale division.

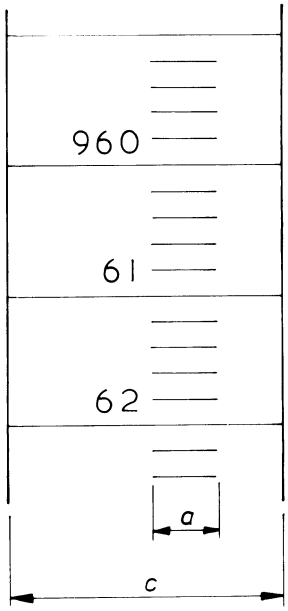
When an instrument is tested for compliance with this requirement, at least three points evenly distributed over the nominal scale shall be tested. (See Appendix A).

12 Determination of temperature

A thermometer suitable for the determination of sample temperature, required during the use of the instruments, is one designated AH/0.5/– 5/+ 40 complying with the requirements of BS 5471.

Table 1 — Density and surface tension

Density at 20 °C	Surface tension at 20 °C	Density at 20 °C	Surface tension at 20 °C
kg/m^3	mN/m	kg/m^3	mN/m
780	21.1	900	27.5
786	22.3	906	27.8
790	22.4	910	28.0
794	22.7	914	28.2
800	22.9	920	28.6
806	23.2	926	29.0
810	23.4	930	29.4
814	23.5	934	29.8
820	23.8	940	30.4
826	24.1	946	31.3
830	24.3	950	32.1
834	24.4	954	32.9
840	24.7	960	34.7
846	25.0	966	37.1
850	25.2	970	39.1
854	25.3	974	41.7
860	25.6	980	46.2
866	25.9	986	51.9
870	26.1	990	56.5
874	26.3	994	62.0
880	26.5	1 000	80.5
886	26.8		
890	27.0		
894	27.1		



a 0.2 *U* min.
c = 0.5 *U* min.
U = circumference of stem

Figure 1 — Style of graduation for alcohol hydrometers

Appendix A Testing of British Standard hydrometers

The British Standards Institution at its Hemel Hempstead Centre is prepared to examine hydrometers for compliance with the requirements of this British Standard. Testing arrangements and particulars of fees can be obtained on application to the Director, British Standards Institution, Maylands Avenue, Hemel Hempstead, Herts HP2 4SQ.

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Publications referred to

BS 5471, *Thermometer for use with alcohol hydrometers.*
ISO/DIS 387, *Hydrometers — Principles of construction and adjustment*[3)].
ISO/DIS 4801, *Glass alcoholometers and alcohol hydrometers not incorporating a thermometer*[3)].

[3)] In course of preparation.

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