BRITISH STANDARD

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Specification for

Thermometer for use with alcohol hydrometers

UDC 536.512:531.756.3:542.3:661.722

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 departments 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:

British Medical Association
Meteorological Office

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/4
Draft for comment 76/54426

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Amendments issued since publication

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2788	March 1979	Indicated by a sideline in the margin

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 the thermometer which is expected to be used in the United Kingdom. It thus excludes enclosed-scale glass thermometers and thermometers with a graduation interval of 0.1 °C or 0.2 °C.

The requirements of this British Standard align with those of two draft International Standards for thermometers, ISO/DIS 386[2)] and ISO/DP 6152[3)] insofar as they were known at the time of preparation. The International Standards were in course of preparation by Sub-committee 3, Thermometers, of ISO Technical Committee 48, Laboratory glassware and related apparatus.

Appendix A lists thermometric glasses approved by the National Physical Laboratory.

Information on the testing of thermometers for use with alcohol hydrometers is given in Appendix B.

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.

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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)] ISO 386 was subsequently published in 1978 without significant technical changes to the text of DIS 386.

[3)] In course of preparation.

1 Scope

This British Standard specifies requirements for a solid-stem mercury-in-glass thermometer for use with alcohol hydrometers complying with the requirements of BS 5470.

2 References

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

3 Type, range and scale interval

3.1 The thermometer shall be of the solid-stem type.

3.2 The nominal range of the thermometer shall be from – 5 °C to + 40 °C.

3.3 The smallest scale division shall be 0.5 °C.

4 Temperature scale

The thermometer shall be graduated in accordance with the Celsius scale as defined in the 1968 definition of the International Practical Temperature Scale (IPTS-68) adopted by the Conférence Générale des Poids et Mesures, and in accordance with the International System of units (SI).

5 Immersion

The thermometer shall be graduated for complete immersion, i.e. the entire thermometer being immersed in the sample.

6 Glass

The thermometer shall be made of a suitable thermometric glass selected and processed so as to show the following characteristics.

6.1 The bulb shall be made of an approved thermometric glass (see Appendix A) and shall be stabilized by suitable heat treatment to ensure that the accuracy requirements of **11.1** and **11.2** can be met.

6.2 The stem shall be made of a lead glass or other suitable glass with a white enamel back.

6.3 Stress in the glass of the bulb and stem shall be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock.

6.4 The legibility of the reading shall not be impaired by devitrification or clouding.

6.5 The image of the meniscus shall be distorted as little as possible by defects or impurities in the glass.

7 Liquid filling

The liquid filling shall be mercury free from any contamination likely to interfere with the proper functioning of the thermometer.

8 Gas filling

The space above the mercury shall be filled with a dry inert gas.

9 Construction

9.1 The thermometer shall be straight and its external cross section shall be approximately circular.

9.2 The top of the thermometer shall preferably be plain rounded, or finished with a glass ring or button as requested by the user.

9.3 The inside of the capillary tube shall be smooth, and the cross-sectional area of the bore shall not show variations from the average greater than 10 %.

9.4 The bore of the capillary tube shall be of sufficient diameter to ensure that the thermometer complies with **10.1**.

9.5 There shall be an expansion chamber at the top of the capillary tube consisting of a pear-shaped chamber with the hemisphere at the top. The volume above the scale shall be such that the thermometer will withstand exposure to a temperature of 80 °C without damage.

9.6 Dimensions of the thermometer shall be as given in Table 1.

Table 1 — Dimensions for thermometer for use with alcohol hydrometers

Dimension		
		mm
Total length	max.	250
	min.	245
Distance from top of bulb (shoulder) to lower nominal limit of scale	min.	20
Length of scale (between nominal limits)	min.	130
Diameter of stem		5.5 to 8.0
External diameter of bulb	min.	5
	max.	not greater than that of stem
Length of bulb to shoulder	min.	15
Distance from top of bulb funnel to lowest scale line	min.	13
Distance from highest scale line to bottom of expansion chamber	min.	10

10 Marking

10.1 General. The thermometer shall be such that its indication can easily be read through the wall of a glass jar containing the sample.

NOTE The bore, scale lines, and figuring often have to be viewed under the poor lighting conditions commonly encountered in the field use of alcohol hydrometers.

10.2 Scale lines and figuring

10.2.1 The pattern of graduation shall be as follows.

a) Every tenth scale 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.

10.2.2 Every tenth scale line shall be fully figured.

10.2.3 The scale lines shall be clearly etched or otherwise durably marked and of a uniform thickness, which shall not be less than 0.12 mm nor exceed 0.20 mm. The lines shall be at right angles to the axis of the thermometer.

10.2.4 When the thermometer is held in a vertical position and viewed from the front, the left hand ends of all the scale lines shall lie on an imaginary vertical line. When the thermometer is viewed in such a position that the right-hand end of the shortest scale lines align with the left-hand side of the bore, the medium and long lines shall extend across the bore towards the right.

The figures shall be placed slightly to the right of the line in such a way that an extension of the line to which they refer would bisect them. The figures shall be upright when the thermometer is held vertically and shall be so chosen to ensure that the thermometer complies with **10.1**. When the mercury column is viewed in this position at least the right-hand ends of the shortest scale lines and the figures shall be in full view. The minimum length of the shortest scale lines shall be 1.5 mm; the length of the medium scale lines shall be nominally 1.5 times the length of the short lines, and the length of the long scale lines shall be nominally 2.5 times the length of the short scale lines. The scale lines and figures shall be so positioned that the enamel backing in the stem provides a background to the mercury column when it is seen just beyond the right-hand end of the short scale lines.

10.2.5 Each end of the scale shall be extended by 2 or 4 divisions beyond the nominal scale limits.

10.3 Pigment filling. The pigment filling in the etched scale lines, figuring and inscriptions shall be black and shall withstand immersion in all mixtures of ethanol and water for at least 24 h.

11 Accuracy

11.1 Instrument error. The maximum permissible instrument error shall be ± 0.2 °C when the thermometer is vertical and completely immersed in the sample.

11.2 Interval error. The maximum permissible difference between the errors at any two points which are 50 divisions apart shall not be more than 0.4 °C.

12 Inscriptions

The following inscriptions shall be durably and legibly marked on the thermometer.

a) Temperature scale indication. The official symbol: "°C". An abbreviation of the name Celsius, e.g. "C" is also permitted.

b) Immersion. "Complete" or suitable abbreviation.

c) Gas filling, e.g. "Nitrogen filled", or suitable abbreviation.

d) Bulb glass. The glass from which the bulb is made should preferably be identified by means of a coloured stripe or stripes, or by an inscription on the thermometer (see Appendix A).

e) Manufacturer's identification number. The last two digits of the number shall indicate the year of manufacture.

f) Maker's name or readily identifiable mark.

g) The number of this British Standard, i.e. BS 5471.

h) The designation, i.e. AH/0.5/– 5/+ 40.

Appendix A List of approved NPL glasses

Table 2 — Thermometric glasses approved by the National Physical Laboratory (1977)

Glass	Identification stripe(s) or approved abbreviation	Normal maximum working temperature
		°C
Normal glass, made by Whitefriars Glass Limited	Single blue stripe	350
Normal glass, Dial, made by Plowden and Thompson Limited	Double blue stripe	350
Normal glass, Schott-N 16, made by Jenaer Glaswerk Schott and Genossen, Mainz	Single red stripe	350
Normal glass, 7560, made by Corning Glass Company	CN	350
Corning borosilicate glass, made by Corning Glass Company	CB	450
Thermometric glass, Schott-2954, made by Jenaer Glaswerk Schott and Genossen, Mainz	Single black stripe	460
Borosilicate glass, made by Whitefriars Glass Limited	Single white stripe	460
Corning glass, 1720, made by Corning Glass Company	C 1720	600
Schott-Supermax R 8409, made by Jenaer Glaswerk Schott and Genossen, Mainz	SPX 8409	600

NOTE The maximum temperatures given in the last column of the table are a guide to normal practice. The performance of a thermometer depends greatly on the stabilizing heat treatment which it has been given during manufacture, and a well-made thermometer of "normal glass" may be quite satisfactory for many purposes at temperatures as high as 400 °C. On the other hand, for the best accuracy it may be preferred to use one of the borosilicate glasses for temperatures lower than 350 °C. In general, the lower the maximum temperature of use in relation to the approved temperature of the glass, the better will be the "stability of zero" of the thermometer.

Appendix B Testing of British Standard thermometers

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

It is desirable that thermometers be retested at intervals not exceeding five years, or more frequently if determinations at a reference point indicate that retest is required. A change of one or two divisions does not necessarily indicate the need for a complete retest as this may be due to a normal change in the volume of the bulb and may be allowed for by applying a correction, equal to the zero change, throughout the scale.

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Publications referred to

BS 5470, *Glass alcohol hydrometers not incorporating a thermometer.*
ISO 386, *Liquid-in-glass laboratory thermometers — Principles of design, construction and use.*
ISO/DP 6152, *Thermometers for use with glass alcoholometers and alcohol hydrometers*[4)].

[4)] In course of preparation.

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