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Specification for

Laboratory thermometers

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Laboratory Apparatus Standards Policy Committee LBC/4, upon which the following bodies were represented:

- British Laboratory Ware Association
- British Medical Association
- Department of Health
- Department of Trade and Industry (National Physical Laboratory)
- Institute of Petroleum
- Medical Sterile Products Association
- Scientific Glassware Association

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Foreword

This British Standard has been prepared under the direction of the Laboratory Apparatus Standards Policy Committee and supersedes BS 593:1974, which is withdrawn.

This British Standard was first published in 1935 under the title "*General purpose laboratory thermometers*" and revised editions appeared in 1940 and under the new title "*Laboratory thermometers*" in 1954 and 1974.

This revision introduces changes to bring the standard up to date and in particular to take into account ISO 386:1977 "*Liquid-in-glass laboratory thermometers — Principles of design, construction and use*", published by the International Organization for Standardization, and changes in the availability of glasses and arrangements for calibration and testing.

BS 1704 was published in 1951 to meet the demand for a series of good quality thermometers, covering the most commonly used ranges of temperature, which could be manufactured in large quantities with reasonable accuracy and at a reasonable price. Laboratory thermometers of greater precision are specified in this standard. BS 5074 covers total immersion Celsius scale only thermometers.

The thermometers covered by this standard are grouped into the following series.

- a) *Series A.* Thermometers about 400 mm long, with zeros, covering ranges of about 30 °C to 40 °C or about 55 °F to 75 °F, and graduated at each 0.1 °C or 0.2 °F.
- b) *Series B.* Thermometers similar to those of series A, but with ranges of about 60 °C or about 110 °F and graduated at each 0.2 °C or 0.5 °F.
- c) *Series F.* Thermometers intended for use in the distillation of certain solvents and based on those specified for this purpose by the Institute of Petroleum (IP) and the American Society for Testing of Materials (ASTM). No extension of the scale beyond the nominal range is specified for these thermometers; they are therefore identical with the corresponding IP and ASTM thermometers.

Series C, D and E thermometers included in previous editions have been omitted due to lack of demand.

Designations. For convenience of reference, each thermometer is given a designation (e.g. A20C/Total) indicating the following:

- 1) the series to which the thermometer belongs;
- 2) the nominal upper limit of the scale;
- 3) the immersion conditions under which the thermometer is intended to be used.

Graduation. The graduation of the thermometers is such that they can be read to as high an accuracy as can be certified by an approved calibration laboratory in the given temperature range (see Appendix A). The minimum spacing of the graduation lines is specified at about seven times the maximum width of the lines themselves, as it has been found from experience that a closer scale can not be read to the same accuracy.

Immersion. Series A and B thermometers include total and partial immersion thermometers for each temperature range in both Celsius and Fahrenheit scales. Series F thermometers are Celsius thermometers for use at partial immersion only.

Tolerances. The tolerances (maximum permissible errors) that apply to the Fahrenheit thermometers are close arithmetical equivalents of those that would apply to Celsius thermometers of identical ranges. No special significance should therefore be attached to the odd values (e.g. 1.1 °F) that occur among them.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS 5750.

Enquiries as to the availability of third party certification schemes may be forwarded by BSI to the Association of Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

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 to iv, pages 1 to 14, 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 Scope

This British Standard specifies requirements for series A, B and F laboratory thermometers (see foreword) calibrated either for total or for partial immersion, covering the overall temperature ranges $-30\text{ }^{\circ}\text{C}$ to $+400\text{ }^{\circ}\text{C}$ and $-23\text{ }^{\circ}\text{F}$ to $+320\text{ }^{\circ}\text{F}$.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Type

Thermometers shall be of the mercury-in-glass, solid-stem type filled with dry inert gas at a suitable pressure.

3 Temperature scale

Thermometers shall be graduated in accordance with the Celsius scale as defined in the current definition of the International Practical Temperature Scale adopted by the General Conference on Weights and Measures (CGPM). The Fahrenheit scale is calculated from the Celsius scale.

4 Materials

The bulb of the thermometer shall be made of a thermometric glass approved by the National Physical Laboratory as suitable for the range of temperature covered (see Appendix B).

For thermometers in which the upper level of the scale is above $300\text{ }^{\circ}\text{C}$, the same thermometric glass shall be used for both the bulb and the stem.

NOTE For thermometers in which the upper level of the scale is $300\text{ }^{\circ}\text{C}$ or less, it is recommended that the stem should be made of the same thermometric glass as the bulb but it is also permissible for the stem to be made of lead glass or other suitable glass with an enamel back.

5 Construction

5.1 General

Each thermometer shall have details as given in the appropriate table of Table 1 to Table 4. The shapes of the bulb and the expansion and contraction chambers shall be such that they do not entrap mercury or gas.

5.2 Stem and bulb

The stem diameter shall lie within the prescribed limits. The bulb shall be cylindrical, in line with the stem, and its diameter shall not exceed that of the stem.

5.3 Expansion chamber

To minimize the effect of being accidentally overheated, an expansion volume shall be provided at the top of the stem. If this takes the form of an expansion chamber, it shall be pearshaped with the hemisphere at the top and there shall be at least 10 mm of unchanged capillary tube above the highest scale line. If the expansion volume takes the form of an unchanged capillary tube, there shall be a length of at least 30 mm above the highest scale line.

NOTE A thermometer should not be heated above its maximum working temperature. Overheating is liable to change the indication of the thermometer, and if this takes place a recalibration may be necessary.

5.4 Contraction chamber

The design of the contraction chamber shall be such that the mercury does not recede into the main bulb at the ice point ($0\text{ }^{\circ}\text{C}$ or $32\text{ }^{\circ}\text{F}$). No contraction chamber shall be above the immersion line.

5.5 Enlargement of bore

No enlargement of the bore shall be within 10 mm of the immersion line or of any part of the scale.

5.6 Top finish

The thermometer shall be plain finished or with a glass ring or button as requested by the user. The outside diameter of the ring or button, when provided, shall not exceed that of the stem.

6 Annealing

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

7 Stabilization

The thermometer shall be stabilized before graduation using a process such that, when tested in accordance with Appendix C, the maximum error and maximum change in error over any interval of the finished thermometer are within the limits given in the appropriate table of Table 1 to Table 4, and the rise at the selected reference point is not greater than the maximum error given.

8 Graduation and figuring (including immersion line)

8.1 Scale lines

The scale lines shall be clearly etched or otherwise durably marked and of uniform thickness not exceeding the value given in the appropriate table of Table 1 to Table 4. The lines shall lie in planes at right angles to the axis of the thermometer.