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Specification for

Secondary reference thermometers

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- Association for Science Education
- British Laboratory Ware Association*
- British Lamphown Scientific Glassware Manufacturers' Association*
- British Pharmacopoeia Commission
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- Department of Trade and Industry (Laboratory of the Government Chemist)*
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- British Medical Association
- British Standards Institution (Test Centre)
- Meteorological Office
- Ministry of Defence (Army Department)
- Royal College of Nursing and National Council of Nurses of the UK

This British Standard, having been prepared under the direction of Laboratory Apparatus Industry Standards Committee was published under the authority of the Executive Board on 31 December 1976

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Contents

	Page
Co-operating organizations	Inside front cover
Foreword	ii
1 Scope	1
2 Type	1
3 Temperature scale	1
4 Material	1
5 Construction	1
6 Annealing	1
7 Stabilization	1
8 Accuracy	1
9 Graduations and figuring	2
10 Inscriptions	2
Appendix A Thermometric glasses approved by the National Physical Laboratory (1974)	4
Appendix B Annealing and stabilization	4
Appendix C Procedure for testing secondary reference thermometers	5
Appendix D Testing of British Standard thermometers	5
Figure 1 — Typical construction of a thermometer	7
Figure 2 — Examples of graduation and figuring for secondary reference thermometers	8
Table 1 — Details of British Standard secondary reference thermometers	3
Table 2 — Uncertainty of test for British Standard secondary reference thermometers verified at NPL	6

Foreword

This British Standard was first published in 1952 to meet the increasing use of liquid-in-glass thermometers as secondary reference (SR) thermometers for the absolute measurement of temperature in terms of the International Practical Temperature Scale. These thermometers were adopted as means of calibrating other thermometers¹⁾, both by the standardizing laboratories of various testing institutions and by manufacturers and users of thermometers. A comprehensive series of thermometers was listed, based upon those developed initially at the National Physical Laboratory (NPL).

Between 1952 and 1963 five amendments were issued, and the present revision was undertaken to incorporate further changes. These are an up-to-date list of approved thermometric glasses, a modification to the requirement for the means of identifying the bulb glass, and a new table in Appendix D giving the uncertainty of verification tests carried out at the NPL.

For convenience of reference to individual thermometers a designation mark has been allotted to each, consisting of the letters SR (for Secondary Reference) followed by a serial number and an indication of the maximum working temperature (e.g. SR6/51C).

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 9 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⁾ When comparing other thermometers with the secondary reference thermometers, at least two SR thermometers should be used in the testing apparatus. The agreement between these two thermometers then gives a guide to the efficiency of the stirring of the medium.

1 Scope

This British Standard specifies a comprehensive series of secondary reference (SR) thermometers for calibrating other thermometers in laboratory and industrial use.

2 Type

Two types of thermometer are specified as follows.

- a) All thermometers, except SR1/30C, shall be of the mercury-in-glass, solid-stem type, filled with inert gas at a pressure sufficient to raise the boiling point of the mercury so that reproducible readings can be obtained at the maximum temperature shown on the scale.
- b) Thermometer SR1/30C shall be of the spirit-in-glass, solid-stem type, the spirit being pure toluene or pure ethanol (ethyl alcohol) coloured with a permanent dye which does not stain the glass.

3 Temperature scale

The temperature scale to which this specification refers is the Celsius scale as defined in the current definition of the International Practical Temperature Scale adopted by the General Conference of Weights and Measures (CGPM).

4 Material

Both bulb and stem of the thermometer shall be made of the same approved thermometric glass suitable for the range of temperature covered (see Appendix A). The stem shall have an enamel back.

NOTE It is permissible to join a normal glass bulb from one manufacturer to a normal glass stem from a different manufacturer.

5 Construction

The construction of a typical secondary reference thermometer is illustrated in Figure 1.

5.1 General. Each thermometer shall comply in all respects with the relevant details given in Table 1. The shapes of the bulb and the expansion and contraction chambers shall be such as not to entrap mercury or gas.

5.2 Stem and bulb. Both bulb and stem shall be cylindrical. The stem diameter shall be not less than 5.5 mm and not greater than 7.5 mm. The bulb diameter shall not exceed the stem diameter. The bulb shall be concentric with the stem.

5.3 Expansion volume. To minimize the effect of being accidentally overheated, and in the exceptional case of a thermometer whose temperature range is below ambient being stored at ambient temperature, an expansion volume shall be provided at the top of the capillary tube. This volume should preferably consist of an expansion chamber, and there shall be at least 10 mm of unchanged capillary tube between the highest scale line and the commencement of the widening of the capillary tube. Such a chamber shall be pear-shaped with the hemisphere at the top. In the case of gas filling, the expansion volume may take the form of at least 30 mm of unchanged capillary tube above the highest scale line.

NOTE A thermometer should not be heated above its maximum working temperature because it may be subject to damage which may not be visible and 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 °C).

5.5 Bore. The shape of the bore shall be such as to reduce sticking of the mercury to a minimum. No enlargement of the bore shall be within 10 mm of any part of the scale.

5.6 Top finish. Each thermometer shall be plain finished or with a glass ring or button, as required by the purchaser. The outside diameter of the ring or button, when provided, shall not exceed that of the stem. Thermometer SR12A/505C shall have a plain finish.

6 Annealing

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

7 Stabilization

Each thermometer shall be stabilized by suitable heat treatment before it is graduated, and this process shall be such that the finished thermometer meets the requirements of clause 8.

8 Accuracy

8.1 Instrument error. When tested in accordance with the procedure given in Appendix C, the maximum error at any point shall be within the limits given in Table 1.

8.2 Interval error. When tested in accordance with the procedure given in Appendix C, the maximum error in an interval shall be within the limits given in Table 1.