

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 653

LONG SOLID-STEM THERMOMETERS
FOR PRECISION USE

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BRIEF HISTORY

The ISO Recommendation R653, *long solid-stem thermometers for precision use*, was drawn up by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1954 and led, in 1959, to the adoption of a Draft ISO Recommendation.

In October 1963, this Draft ISO Recommendation (No. 671) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Argentina	Greece	New Zealand
Australia	Hungary	Poland
Austria	India	Spain
Belgium	Israel	Switzerland
Chile	Italy	U.A.R.
Czechoslovakia	Japan	United Kingdom
France	Korea, Rep. of	U.S.S.R.
Germany	Netherlands	Yugoslavia

One Member Body opposed the approval of the Draft:

U.S.A.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in February 1968, to accept it as an ISO RECOMMENDATION.

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INTRODUCTION

This ISO Recommendation is based on ISO Recommendation R 386, *Principles of construction and adjustment of liquid-in-glass laboratory thermometers*. It is one of four ISO Recommendations specifying requirements for basic series of long and short solid-stem and enclosed-scale thermometers, intended for general use for precision work.

For ease of reference, each thermometer of the series has been allocated a combination of letters and figures indicating the type of thermometer, the value of the smallest graduation interval and the upper and lower limits of the nominal scale range. The letter abbreviations given below have been selected, after taking into account the descriptions in various languages usually given to these types of thermometer:

- STL Long solid-stem thermometers,
- STC Short solid-stem thermometers,
- EL Long enclosed-scale thermometers,
- EC Short enclosed-scale thermometers.

1. SCOPE

This ISO Recommendation specifies requirements for a basic series of long solid-stem thermometers, not exceeding 375 mm in length, for general use in precision work.

NOTE. — There are in existence many different specifications for thermometers of the general types covered by this series. It is intended that this series should replace all such specifications, except those for which there is a well-established justification.

2. TYPE OF THERMOMETER

The thermometers should be of the liquid-in-glass solid-stem type, preferably with enamel back.

3. TEMPERATURE SCALE

The temperature scale to which the thermometers refer is the International Practical Scale of Temperature, adopted by the Conférence Générale des Poids et Mesures in 1960 as the revised edition of the International Temperature Scale of 1948.

4. IMMERSION

The thermometers should be adjusted for use at total immersion (i.e. the reading should be correct when the thermometer is immersed at least to the end of the liquid column in the medium whose temperature is required to be measured).

NOTE. — If thermometers divided to 0.1 or 0.2 degree Celsius are required to read correctly when the complete thermometer is immersed in the medium, this should be stated in the purchasing contract and the thermometer should be specially marked.

5. GLASS

The glass should be selected so that the finished thermometer shows the following characteristics:

- 5.1 Strain in the glass should be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock.
 - 5.2 The bulb glass should be stabilized by suitable heat treatment to ensure that the accuracy requirements of section 10 can be met.
 - 5.3 The errors in the finished thermometer resulting from the thermometric properties of the glass used for the bulb should be within the limits specified in section 10.
- NOTE. — The maximum temperature up to which a glass may be used depends on the degree of stability required and is related to the viscosity of the glass at the temperature concerned.
- 5.4 The accuracy of the reading should not be impaired by devitrifying or clouding during manufacture.
 - 5.5 The meniscus should be distorted as little as possible by defects or impurities in the glass.

6. LIQUID FILLING

Mercury should be used as liquid filling, except for thermometers with a scale extending below $-38\text{ }^{\circ}\text{C}$. For temperatures down to $-55\text{ }^{\circ}\text{C}$, the eutectic alloy of mercury and thallium (8.5% thallium by mass) should be used.

7. GAS FILLING

Only a dry, inert gas may be used as gas filling. It is essential that thermometers intended for use above $100\text{ }^{\circ}\text{C}$ should be gas-filled. The pressure of the gas should be high enough to raise the boiling point of the mercury sufficiently to ensure that reliable readings are obtained over the complete thermometer scale.

8. CONSTRUCTION

8.1 Shape

The thermometers should be straight and their external cross-section approximately circular.

8.2 Top finish

The top of the thermometer should preferably be finished with a glass ring, the diameter of which should not exceed that of the stem. Alternatively, a plain finish may be provided, and this is preferred for thermometers STL/1/180/420 and STL/2/0/600.

8.3 Capillary tube

The inside of the capillary tube should be smooth. The cross-sectional area of the bore should not show variations from the average greater than 10%, and the bore should be wide enough to ensure that jumping of the meniscus does not exceed one-fifth of the graduation interval.

8.4 Expansion chamber (safety chamber)

A thermometer should not be heated above its top normal working temperature. To avoid serious results from momentary accidental overheating, a safety volume should be provided at the top of the stem.* The volume above the scale should be at least equivalent to that occupied by an interval of 80 degrees Celsius of the scale. If this volume takes the form of an expansion chamber, this should be pear-shaped with the hemisphere at the top, except for thermometers STL/1/180/420 and STL/2/0/600. For thermometers in which the upper limit of the scale is below room temperature, the lower end of the "pear" should be considerably elongated, to avoid risk of a break in the liquid column at room temperature.

* Overheating is liable to change the zero point of the thermometer, and a readjustment is therefore necessary, if it takes place.