
INTERNATIONAL STANDARD



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Solid-stem calorimeter thermometers

Thermomètres sur tige pour calorimètres

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Descriptors : laboratory glassware, temperature measuring, calorimeters, specifications, dimensions, marking.

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 48 has reviewed ISO Recommendation R 651 and found it technically suitable for transformation. International Standard ISO 651 therefore replaces ISO Recommendation R 651-1968 to which it is technically identical.

ISO Recommendation R 651 was approved by the Member Bodies of the following countries :

Australia	France	New Zealand
Austria	Greece	Poland
Belgium	Hungary	South Africa, Rep. of
Brazil	India	Spain
Bulgaria	Ireland	Switzerland
Canada	Israel	Turkey
Chile	Italy	United Kingdom
Colombia	Japan	U.S.A.
Czechoslovakia	Korea, Rep. of	U.S.S.R.
Egypt, Arab Rep. of	Netherlands	Yugoslavia

No Member Body expressed disapproval of the Recommendation.

No Member Body disapproved the transformation of ISO/R 651 into an International Standard.

Solid-stem calorimeter thermometers

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies requirements for a series of short-range solid-stem thermometers for use in bomb calorimetry and for other purposes where an accurate measurement of a change of temperature is required. The thermometers are not provided with auxiliary scales at 0 °C and are therefore not suited to the absolute measurement of temperature (which is not normally required in calorimetry), unless they are checked against a standard thermometer immediately before use.

2 TYPE OF THERMOMETER

The thermometers shall be of the mercury-in-glass solid-stem type with enamel back.

3 TEMPERATURE SCALE

The thermometers shall be graduated in accordance with the Celsius scale as defined in the current definition of the International Practical Scale of Temperature, adopted by the Conférence Générale des Poids et Mesures.

4 IMMERSION

The thermometers should preferably be calibrated for use at total immersion (i.e. the reading is taken when the thermometer is vertical and immersed at least to the end of the liquid column in the medium whose temperature is required to be measured), but calibration for use at partial immersion is permitted at the request of the user. On partial immersion thermometers, a line shall be etched at least halfway round the stem of the thermometer at the level to which it is intended to be immersed.

5 GLASS

The glass shall be selected and processed so that the finished thermometer shows the following characteristics:

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

5.2 The correction of the thermometer reading at the lowest temperature of the nominal range shall not change by more than 0,02 °C immediately after the thermometer has been heated for 15 min at a temperature 30 °C higher than the lowest temperature and allowed to cool naturally in air.

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

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

6 GAS FILLING

Above the mercury, thermometers may be either vacuum or gas-filled; in the latter case, only a dry, inert gas shall be used. The indication of a gas-filled thermometer, when the meniscus is at the top of the scale, shall not change by more than 0,01 °C when the temperature of the gas above the mercury is changed by 30 °C.

NOTE — It is generally possible for this requirement to be satisfied if the internal gas pressure does not exceed 0,5 bar¹⁾, when the thermometer is registering its maximum temperature.

7 CONSTRUCTION

7.1 Shape

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

7.2 Top finish

The top of the thermometer shall have a rounded finish, unless otherwise specially required.

7.3 Capillary tube

The inside of the capillary tube shall be smooth. The cross-sectional area of the bore shall not show variations from the average greater than 5 %, and the bore shall be wide enough to ensure that, without tapping, jumping of the meniscus does not exceed one half of the graduation interval, when the temperature is rising at a uniform rate not exceeding 0,05 °C per minute. In the case of thermometers calibrated for use at partial immersion, the

1) 1 bar = 10⁵ Pa

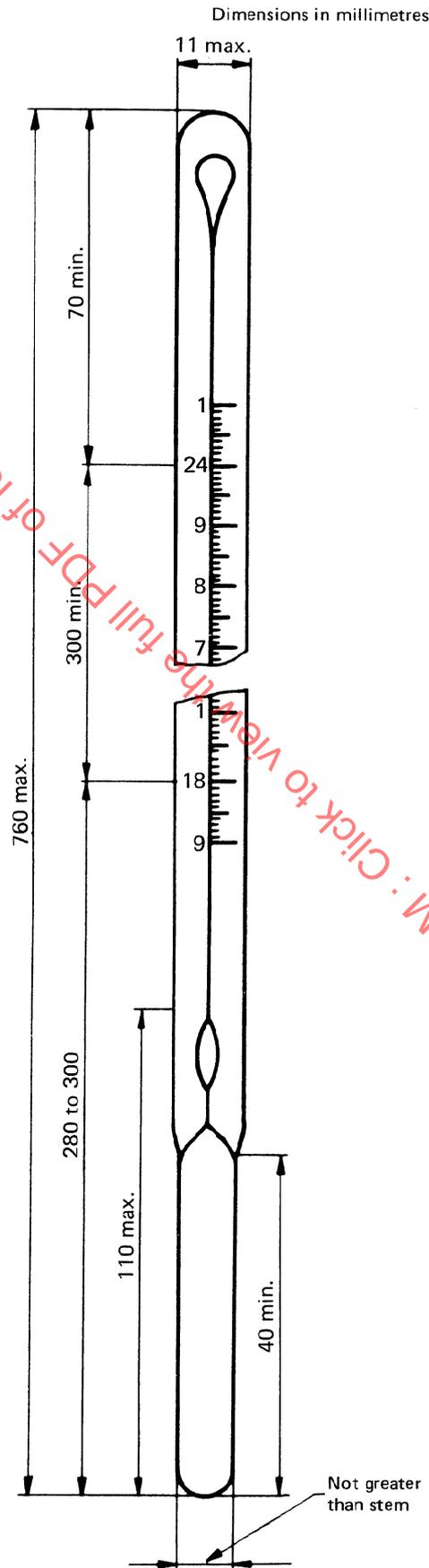


FIGURE 1 — Solid-stem calorimeter thermometer

volume of mercury contained in the capillary tube between the immersion line and the lowest figured scale line shall not exceed the equivalent of 2°C .

7.4 Expansion chamber (safety chamber)

The capillary tube shall have an enlargement at the top of sufficient size to allow heating of the thermometer to 60°C (or 70°C in the case of thermometers STCal/0,01/42 and STCal/0,01/45). This expansion chamber shall be pear-shaped, with the hemisphere at the top. It shall be so shaped that the meniscus remains in the narrow portion at temperatures up to 40°C .

7.5 Contraction chamber

A contraction chamber shall be provided so that the mercury does not recede into the bulb at 0°C . It shall be elongated and as narrow as possible and shall be separated from the bulb by not less than 3 mm of capillary tube.

7.6 Enlargement of the bore

No enlargement of the bore shall be so located as to produce a variation in the cross-section of the capillary tube in the scale portion greater than that permitted in 7.3.

7.7 Dimensions

The dimensions of the thermometers shall be as given in table 1 and figure 1.

TABLE 1 — Dimensions (see also figure 1)

Dimensions in millimetres	
Total length	760 max.
Distance from bottom of bulb to top of contraction chamber	110 max.
Distance from bottom of bulb to lower nominal limit of scale	280 to 300
Length of main scale (nominal limits)	300 min.
Distance from upper nominal limit of scale to top of thermometer	70 min.
Diameter of stem	11 max.
External diameter of bulb	not greater than that of stem
Length of bulb to shoulder	40 min.

8 GRADUATION AND FIGURING

8.1 The scales and graduation interval of the thermometers shall be as given in table 2.

8.2 The scale lines shall be clearly etched and of uniform thickness, which in no case shall exceed 0,05 mm. The lines shall be at right angles to the axis of the thermometer.

TABLE 2 — Graduation

Designation	Graduation interval	Nominal scale range
	$^{\circ}\text{C}$	$^{\circ}\text{C}$
STCal/0,01/15	0,01	9 to 15
STCal/0,01/18	0,01	12 to 18
STCal/0,01/21	0,01	15 to 21
STCal/0,01/24	0,01	18 to 24
STCal/0,01/27	0,01	21 to 27
STCal/0,01/30	0,01	24 to 30
STCal/0,01/33	0,01	27 to 33
STCal/0,01/36	0,01	30 to 36
STCal/0,01/39	0,01	33 to 39
STCal/0,01/42	0,01	36 to 42
STCal/0,01/45	0,01	39 to 45

8.3 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 so that the right-hand ends of the shorter lines, denoting an interval of $0,01^{\circ}\text{C}$, align with the left-hand side of the bore, longer lines at each $0,05^{\circ}\text{C}$ shall extend across the bore towards the right. The shorter lines shall be about 1 mm long.

8.4 The figures shall be placed in such a way that an extension of the line to which they refer would bisect them. They may be placed either to the left or to the right of the scale lines, as preferred.

8.5 The scale lines shall be so positioned that the enamel backing in the stem provides a background for the figures, the scale and the mercury column, when the latter is seen just beyond the left- or right-hand ends of the short lines (see figure 2).

NOTE — Figure 2 illustrates two different types of graduation and figuring for the thermometers, but these are not intended to be obligatory.

8.6 The scale of the thermometer shall be extended by ten divisions (i.e. $0,1^{\circ}\text{C}$) beyond the nominal limits given in table 2.

8.7 The scale shall be figured at each division of $0,1^{\circ}\text{C}$. Full figuring shall be provided at least at each division of 1°C and more frequently, if required.

8.8 The pigment filling shall remain in the scale lines, figures and inscriptions, under conditions specified by agreement between purchaser and vendor.

9 ACCURACY

9.1 Scale error

The scale error, when the thermometer is under normal atmospheric pressure and when the emergent liquid column



FIGURE 2 — Alternative types of graduation and figuring

(in the case of a partial immersion thermometer) is at the prescribed temperature (see 10b)), shall not be greater than 0,1 °C.

9.2 Interval error

The absolute value of the algebraic difference between the errors at any two points which are not more than 50 divisions apart shall in no case be greater than 0,01 °C.

10 INSCRIPTIONS

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

a) Unit of temperature. Abbreviation of the name Celsius such as "C", or symbol "°C".

b) Immersion. On each thermometer graduated for use at partial immersion, the immersion depth shall be indicated, and the emergent stem temperature for which the thermometer was calibrated shall be marked.

c) Gas filling, if any; for example "nitrogen filled", "vacuous" or a suitable abbreviation.

d) The bulb glass shall be identified preferably by means of a coloured stripe or stripes, or by an inscription on the thermometer.

e) Identification number (manufacturer's).

f) Maker's and/or vendor's name or readily identifiable mark.

g) The number of this International Standard, i.e. ISO 651.

h) The designation allocated to the thermometer, for example STCal/0,01/15.