
INTERNATIONAL STANDARD



652

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Enclosed-scale calorimeter thermometers

Thermomètres pour calorimètres à échelle protégée

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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 652 and found it technically suitable for transformation. International Standard ISO 652 therefore replaces ISO Recommendation R 652-1968 to which it is technically identical.

ISO Recommendation R 652 was approved by the Member Bodies of the following countries :

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

The Member Body of the following country expressed disapproval of the Recommendation on technical grounds :

Germany

No Member Body disapproved the transformation of ISO/R 652 into an International Standard.

Enclosed-scale calorimeter thermometers

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies requirements for a series of short-range enclosed-scale 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 enclosed-scale type.

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 sheath of the thermometer, at the level to which it is intended to be immersed, which should preferably be the junction of the "saddle" and the sheath (marked E in figure 1).

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

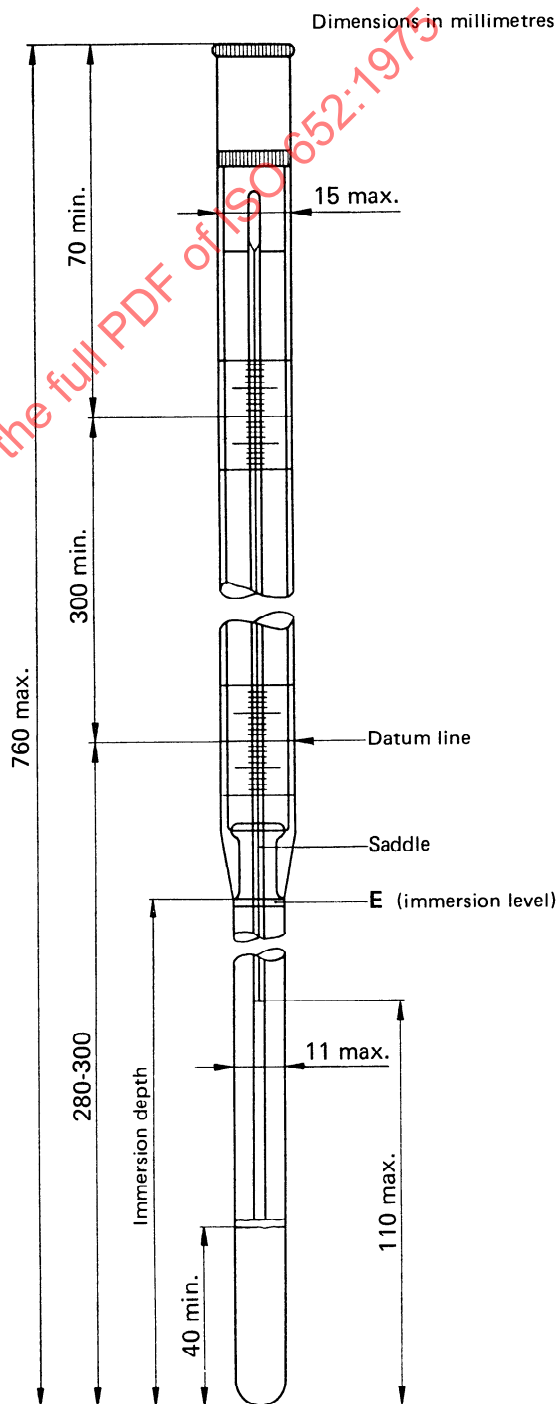


FIGURE 1 — Enclosed-scale calorimeter thermometer

by more than $0,02^{\circ}\text{C}$ 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 $0,01^{\circ}\text{C}$, 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 $0,5\text{ bar}^1$, 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 sheath shall be sealed by fusing and shall be covered by a metal cap.

7.3 Strip bearing the scale

The strip bearing the scale shall be of a material suitable to the temperature to be measured and compatible with the method of fixing the strip. It shall be placed tightly against the capillary tube inside the sheath and shall be firmly and securely fastened at the top of the thermometer. A suitable method of fixing is by fusing a glass tube or rod to the sheath and to the upper end of the strip bearing the scale; the lower end of the strip shall be freely held in a suitable glass saddle. Alternatively, it shall be fixed inside the sheath in any other suitable manner that allows for differential expansion.

7.4 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 $0,05^{\circ}\text{C}$ per minute. In the case of thermometers calibrated for use at partial immersion, the volume of mercury contained in the capillary tube between the immersion line and the lowest figured graduation line shall not exceed the equivalent of 2°C .

7.5 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 (70°C in the case of thermometers ECal/0,01/42 and ECal/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 .

7.6 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.

7.7 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 7.4.

7.8 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 sheath	15 max.
External diameter of bulb and adjoining portion of stem	11 max.
Length of bulb to shoulder	40 min.

1) $1\text{ bar} = 10^5\text{ Pa}$

8 GRADUATION AND FIGURING

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

TABLE 2 — Graduation

Designation	Graduation interval	Nominal scale range
	°C	°C
ECal/0,01/15	0,01	9 to 15
ECal/0,01/18	0,01	12 to 18
ECal/0,01/21	0,01	15 to 21
ECal/0,01/24	0,01	18 to 24
ECal/0,01/27	0,01	21 to 27
ECal/0,01/30	0,01	24 to 30
ECal/0,01/33	0,01	27 to 33
ECal/0,01/36	0,01	30 to 36
ECal/0,01/39	0,01	33 to 39
ECal/0,01/42	0,01	36 to 42
ECal/0,01/45	0,01	39 to 45

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 lie in planes at right angles to the axis of the thermometer.

8.3 The arrangement and figuring of the scale lines shall be according to one of the types shown in figure 2. Each 0,1 °C scale line shall be a long line, each 0,05 °C line shall have a length of two-thirds of the long lines, and each 0,01 °C line shall have a length of one-third of the long lines. The figures shall be placed immediately above the line to which they refer.

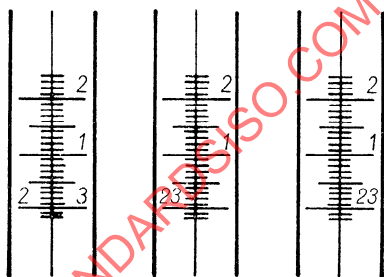


FIGURE 2 Alternative types of graduation and figuring

8.4 The scale of the thermometer shall be extended by ten divisions (i.e. 0,1 °C) beyond the nominal limits given in table 2.

8.5 The scale shall be figured at each 0,1 °C division. Full figuring shall be provided at least at each division of 1 °C and more frequently, if required.

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

8.7 Datum line

At the right-hand side of the sheath, an indelible datum line shall be placed on a level with the lowest nominal scale line so that any displacement of the scale can easily be noticed.

9 ACCURACY

9.1 Scale error

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

- Unit of temperature. Abbreviation of the name Celsius such as "C", or symbol "°C".
- 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.
- Gas filling, if any; for example "nitrogen filled", "vacuous" or a suitable abbreviation.
- The bulb glass shall be identified, preferably by means of a coloured stripe or stripes, or by an inscription on the thermometer.
- Identification number (manufacturer's).
- Maker's and/or vendor's name or readily identifiable mark.
- The number of this International Standard, i.e. ISO 652.
- The designation allocated to the thermometer, for example ECal/0,01/15.

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