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ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 652

ENCLOSED-SCALE CALORIMETER
THERMOMETERS

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 652, *Enclosed-scale calorimeter thermometers*, 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 1957 and led, in 1961, to the adoption of a Draft ISO Recommendation.

In December 1963, this Draft ISO Recommendation (No. 716) was circulated to all the ISO Member Bodies for enquiry. It was approved by the following Member Bodies:

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

One Member Body opposed the approval of the Draft:

Germany

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.

ENCLOSED-SCALE CALORIMETER THERMOMETERS

1. SCOPE

This ISO Recommendation 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 should be of the mercury-in-glass enclosed-scale type.

3. TEMPERATURE SCALE

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

4. IMMERSION

The thermometers should in general 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) in a vertical position, but adjustment for use at partial immersion should be optional at the request of the user. On partial immersion thermometers, a line should be etched at least half way 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 Fig. 1, page 4).

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 correction of the thermometer reading at the lowest temperature of the nominal range should not change by more than 0.02 degree Celsius immediately after the thermometer has been heated for 15 minutes at a temperature 30 degrees Celsius higher than the lowest temperature and allowed to cool naturally in air.
- 5.3 The accuracy of the reading should not be impaired by devitrifying or clouding during manufacture.
- 5.4 The meniscus should be distorted as little as possible by defects or impurities in the glass.

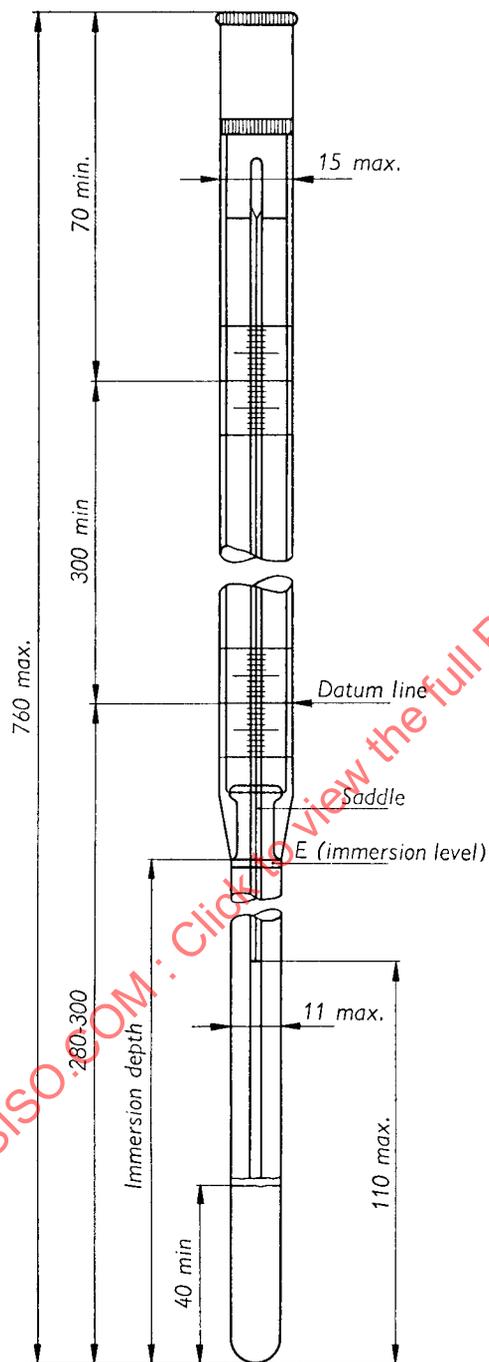


FIG. 1. — Enclosed-scale calorimeter thermometer

Dimensions in millimetres

6. GAS FILLING

Above the thermometric liquid, thermometers may be either vacuous or gas-filled; in the latter case, only a dry, inert gas should be used. The indication of a gas-filled thermometer, when the meniscus is at the top of the scale, should not change by more than 0.01 degree Celsius, when the temperature of the gas above the mercury is changed by 30 degrees Celsius.

NOTE. — If the bulb is sufficiently rigid for the thermometer to comply with clause 7.4, this requirement should be satisfied, if the internal gas pressure does not exceed $\frac{1}{2}$ atm (normal atmosphere), when the thermometer is registering its highest temperature.

7. CONSTRUCTION

7.1 Shape

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

7.2 Top finish

The top of the sheath should be sealed by fusing and should be covered by a metal cap.

7.3 Strip bearing the scale

The strip bearing the scale should be of translucent material suitable to the temperature to be measured. It should be placed tightly against the capillary tube inside the sheath and should be firmly and securely fastened at the top of the thermometer, in such a way that it can freely expand in length. A suitable method of fixing is by fusing a glass tube to the sheath and to the upper end of the strip bearing the scale. The lower end of the strip should be held in a glass saddle which is firmly fused to the sheath.

7.4 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 5%, and the bore should 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 degree Celsius per minute. In the case of thermometers adjusted for use at partial immersion, the volume of mercury contained in the capillary tube between the immersion line and the lowest figured graduation line should not exceed the equivalent of 2 degrees Celsius.

7.5 Expansion chamber (safety chamber)

The capillary tube should 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 E Cal/0.01/42 and E Cal/0.01/45). This expansion chamber should be pear-shaped with the hemisphere at the top. It should be so shaped that the meniscus remains in the narrow portion at temperatures up to 40 °C.

7.6 Contraction chamber

A contraction chamber should be provided so that the mercury does not recede into the bulb at 0 °C. It should be elongated and as narrow as possible.

7.7 Enlargement of the bore

No enlargement of the bore should be so located as to produce any variation in the cross-section of the capillary tube in the scale portion.

7.8 Dimensions

The dimensions of the thermometers should be as given in Table 1 below and Figure 1, page 4.

TABLE 1. — Dimensions (see also Figure 1)

Dimensions in millimetres

Total length	max.	760
Distance from bottom of bulb to top of contraction chamber	max.	110
Distance from bottom of bulb to lower nominal limit of scale		280 to 300
Length of main scale (nominal limits)	min.	300
Distance from upper nominal limit of scale to top of thermometer	min.	70
Diameter of sheath	max.	15
External diameter of bulb and adjoining portion of stem	max.	11
Length of bulb to shoulder	min.	40

8. GRADUATION AND FIGURING

8.1 The scales and graduation interval of the thermometers should be as given in Table 2 below:

TABLE 2. — Graduation

Designation	Graduation interval	Nominal scale range
	degrees Celsius	°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