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# ISO

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# ISO RECOMMENDATION

# R 1771

## ENCLOSED-SCALE GENERAL PURPOSE THERMOMETERS

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## BRIEF HISTORY

The ISO Recommendation R 1771, *Enclosed-scale general purpose 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 led to the adoption of Draft ISO Recommendation No. 1771, which was circulated to all the ISO Member Bodies for enquiry in December 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

| | | |
|---|---|---|
| Australia | India | Spain |
| Austria | Iran | Thailand |
| Belgium | Israel | Turkey |
| Canada | Italy | U.A.R. |
| Colombia | Netherlands | United Kingdom |
| Czechoslovakia | New Zealand | U.S.S.R. |
| France | Peru | Yugoslavia |
| Germany | Poland | |
| Greece | South Africa, Rep. of | |

The following Member Body opposed the approval of the Draft :

U.S.A.

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

ISO Recommendation R 1771 October 1970

# ENCLOSED-SCALE GENERAL PURPOSE THERMOMETERS

## INTRODUCTION

This ISO Recommendation is based in general on the provisions of ISO Recommendation R 386, *Principles of construction and adjustment of liquid-in-glass laboratory thermometers*, in so far as they are applicable to thermometers not intended for accurate measurements.

For ease of reference, each thermometer of the series has been allocated a designation consisting of a single letter representing the range of the thermometer and the abbreviation "e" (enclosed-scale type) separated by a stroke (for example A/e).

### 1. SCOPE

This ISO Recommendation specifies requirements for a series of inexpensive "commercial quality" thermometers of the enclosed-scale type suitable for general purpose use in industry, schools and laboratories when great accuracy of measurement is not required. The temperature range covered by the series is from – 100 to + 500 °C (see also Note to section 10).

### 2. TYPE OF THERMOMETER

The thermometer should be of the liquid-in-glass enclosed-scale type.

### 3. TEMPERATURE SCALE

The temperature scale to which the thermometers refer is the International Practical Temperature Scale in accordance with the latest definition of the Conférence Générale des Poids et Mesures.

### 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).

## 5. GLASS

The glass for the bulb, the capillary tube and the protective sheath 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 given in the Table, page 6, can be met.

5.3 The meniscus should be clearly visible without undue distortion by defects or impurities in the glass.

## 6. LIQUID FILLING

6.1 Mercury should be used as liquid filling except for thermometers with a scale extending below – 38 °C, for which a filling of toluene or technical pentane should be used which will remain liquid throughout the temperature range under the conditions prevailing in the thermometer.

6.2 Toluene or technical pentane used as the liquid filling should where possible be coloured by means of a light-fast dye which does not stain the glass.

## 7. GAS FILLING

The thermometers should be filled with a dry inert gas above the filling liquid. The pressure of the gas should be high enough to raise the boiling point of the liquid sufficiently to ensure that reliable readings are obtained over the complete thermometer scale. The air within the sheath should be dry.

## 8. CONSTRUCTION

### 8.1 Shape

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

### 8.2 Top finish

The top of the thermometer may be finished with a glass ring, the diameter of which should not exceed that of the stem. If a finish other than a ring is provided, its diameter should also not exceed that of the stem.

### 8.3 Strip bearing the scale

The strip bearing the scale should be of a translucent material suitable for the temperatures 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 fixed inside the sheath in a suitable manner.

### 8.4 Capillary tube

The inside of the capillary tube should be smooth in order to avoid possible sticking of the liquid.

8.5 **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 capillary tube. This volume may take the form of an extension of the bore, or of an expansion chamber; in the latter case the chamber should be pear-shaped with the hemisphere at the top, but an exception is permissible in the case of high pressure filling.

NOTE. – Overheating is liable to change the zero or other fiducial point of the thermometer, and a redetermination of this point is therefore necessary if it takes place.

8.6 **Enlargement of bore**

No enlargement of the bore should be located less than 5 mm from any part of the scale.

8.7 **Dimensions**

The dimensions of the thermometers should be as given in the Table, page 6.

## 9. GRADUATION AND FIGURING

9.1 The scales (nominal limits) and graduation intervals of the thermometers should be as given in the Table, page 6.

9.2 The graduation lines should be clearly marked and of uniform thickness. The lines should be at right angles to the axis of the thermometer. Typical schemes of graduation and figuring are shown in the Figure, page 7, but these are not intended to be obligatory.

9.3 The scale of the thermometers may be extended beyond the nominal limits given in the Table, page 6. In the case of thermometers with 0 °C as the lower nominal limit of the range, the scale should be extended by at least three divisions below 0 °C. In the case of the thermometer with nominal range 0 to 100 °C, the scale should be extended by at least three divisions above 100 °C.

9.4 If the strip bearing the scale is not fused to the top of the thermometer, an indelible datum line of thickness comparable with that of the graduation lines, should be placed on the right hand side of the sheath on a level with the lowest, or lowest figured, graduation line, so that any displacement of the scale can easily be noticed.

## 10. ACCURACY

The scale error for the thermometer should not be greater than the value given in the Table, page 6.

NOTE. – In the case of thermometers of ranges 0 to 360 °C and 0 to 500 °C, an appreciable error may develop after long exposure to temperatures in the upper part of the scale range.

## 11. INSCRIPTIONS

The following inscriptions should be permanently and legibly marked on the thermometer.

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

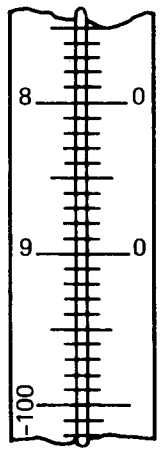
(*b*) *Bulb glass.* The bulb glass should preferably be identified, either by means of a coloured stripe or stripes, or by an inscription on the thermometer.

(*c*) *Identification number (manufacturer's),* if required.

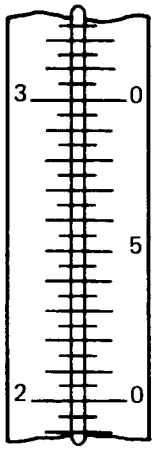
(*d*) *Vendor's and/or maker's name or mark.*

TABLE – Requirements for enclosed-scale general purpose thermometers

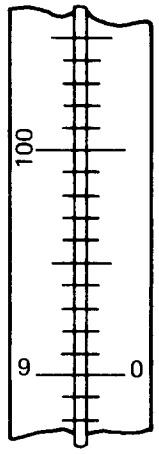
| Nominal range | Graduation interval | Longer lines at each | Fractional figuring at each | Full figuring at each | Overall length max. | Scale length (nominal range) min. | Bulb diameter | Maximum error | Designation |
|---|---|---|---|---|---|---|---|---|---|
| °C | degrees Celsius | degrees Celsius | degrees Celsius | degrees Celsius | mm | mm | | degrees Celsius | |
| − 100 to + 30 | 1 | 5 | – | 10 | 305 | 200 | | 2 | A/e |
| − 35 to + 30 | 0.5 | 1 | 5 | 10 | 305 | 200 | Not | 1 | B/e |
| 0 to 60 | 0.5 | 1 | 5 | 10 | 305 | 200 | greater | 0.5 | C/e |
| 0 to 100 | 1 | 5 | – | 10 | 305 | 200 | than | 1 | D/e |
| 0 to 160 | 1 | 5 | 10 | 100 | 305 | 200 | diameter | 2 | E/e |
| 0 to 250 | 1 | 5 | 10 | 100 | 305 | 200 | of | 2 | F/e |
| 0 to 360 | 2 | 10 | 20 | 100 | 305 | 200 | sheath | 4 | G/e |
| 0 to 500 | 5 | 10 | 50 | 100 | 350 | 200 | | 10 | H/e |



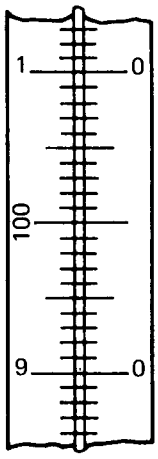

A/e



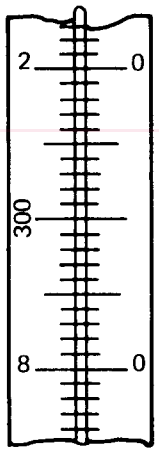

B/e
C/e



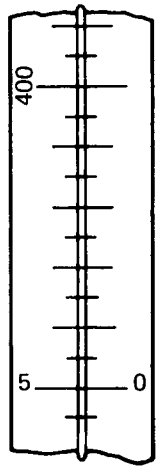

D/e




E/e
F/e




G/e




H/e

FIGURE – **Examples of graduation and figuring**