

# ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

## ISO RECOMMENDATION R 1770

SOLID-STEM GENERAL PURPOSE THERMOMETERS

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## BRIEF HISTORY

The ISO Recommendation R 1770, *Solid-stem 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. 1770, 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.

## SOLID-STEM 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 indication "TOTAL" or "75" relating to the intended immersion.

#### 1. SCOPE

This ISO Recommendation specifies requirements for a series of inexpensive "commercial quality" thermometers of the solid-stem 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 clause 10.1).

#### 2. TYPE OF THERMOMETER

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

#### 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), or for partial immersion as required.

In the latter case the preferred immersion is 75 mm, and the adjustment of such a thermometer should have been carried out at the average emergent stem temperature shown in the Table, page 6.

NOTE. - Adjustment at partial immersion is not permitted for the thermometer of range  $-100$  to  $+30$  °C, because of the large errors likely to be caused in a spirit-in-glass thermometer by variations in temperature around the emergent portion of the stem.

## 5. GLASS

The glass for the bulb and stem 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  $-38^{\circ}\text{C}$ , 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.

## 8. CONSTRUCTION

### 8.1 Shape

The thermometers should be straight. Their external cross-section should be approximately circular, but if required an external lens-shaped deviation from the circular cross-section is permitted to facilitate reading.

### 8.2 Top finish

The top of the thermometer should be finished with a plain top, button top or ring, except that only a plain top should be used for the thermometer of range 0 to  $500^{\circ}\text{C}$ . In all cases the diameter of the top finish of the stem should not exceed that of the rest of the stem.

### 8.3 Capillary tube

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

### 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 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.

### 8.5 Enlargement of bore

No enlargement of the bore should be located less than 10 mm from the immersion line or any part of the scale.

### 8.6 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 and do not necessarily apply to lens-front thermometers.

9.3 The scale of the thermometer may be extended beyond the nominal limits given in the Table, page 6. In the case of the 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 Immersion line

On thermometers adjusted for partial immersion the immersion depth should be indicated by a line on the stem at the appropriate distance from the bottom of the bulb.

## 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) *Immersion.* For partial immersion thermometers, an indication of the immersion depth for which the thermometer is adjusted, e.g. "75 mm". No inscription is required for total immersion thermometers.
- (c) *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.
- (d) *Identification number (manufacturer's),* if required.
- (e) *Vendor's and/or maker's name or mark.*

TABLE - Requirements for solid-stem 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	Total immersion		Partial immersion		Designation ("Total" or "75" to be added as appropriate for immersion)
								Maximum error	degrees Celsius	Maximum error	Average emergent stem temperature	
°C	degrees Celsius	degrees Celsius	degrees Celsius	degrees Celsius	mm	mm		degrees Celsius	degrees Celsius	degrees Celsius	°C	
- 100 to + 30	1	5	-	10	305	200		2	*	*	*	A/
- 35 to + 30	0.5	1	5	10	305	200		1	1.5	20	20	B/
0 to + 60	0.5	1	5	10	305	200		0.5	0.5	20	20	C/
0 to + 100	1	5	-	10	305	200		1	1.5	35	35	D/
0 to + 160	1	5	10	100	305	200	Not greater than stem diameter	2	3	35	35	E/
0 to + 250	1	5	10	100	305	200		2	3	35	35	F/
0 to + 360	2	10	20	100	305	200		4	6	50	50	G/
0 to + 500	5	10	50	100	350	200		10	15	75	75	H/

\* Partial immersion is not permitted for this thermometer (see note to section 4).