
International Standard



1770

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Solid-stem general purpose thermometers

Thermomètres sur tige d'usage général

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Descriptors : glassware, laboratory glassware, temperature measuring instruments, thermometers, specifications, dimensions, precision.

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.

International Standard ISO 1770 was developed by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, and was circulated to the member bodies in September 1979.

It has been approved by the member bodies of the following countries :

Australia	Hungary	Romania
Brazil	India	South Africa, Rep. of
Canada	Italy	Spain
Czechoslovakia	Korea, Rep. of	United Kingdom
France	Libyan Arab Jamahiriya	USA
Germany, F.R.	Poland	USSR

No member body expressed disapproval of the document.

This International Standard cancels and replaces ISO Recommendation R 1770-1970, of which it constitutes a technical revision.

Solid-stem general purpose thermometers

0 Introduction

Although the thermometers covered by this International Standard are not intended for use in any specific test method, the overall lengths of the series of higher accuracy are specified with a tolerance so as to provide a degree of interchangeability for any special apparatus into which the thermometers are incorporated.

For ease of reference, each thermometer has been allocated a designation consisting of a single letter representing the range of the thermometer and the indication "TOTAL" or, for example, "75" relating to the intended immersion.

Some of the thermometers described in the scope and field of application of this International Standard, and which are in current use, are of a lower quality than those strictly covered in ISO 386. Accordingly, whilst this International Standard is based on the provisions of ISO 386, it does not align with those which recommend the distance between consecutive scale lines to be greater than 0,8 mm and the maximum error to be one scale division. In order to avoid increasing the cost of the thermometers, some of the dimensions recommended to be specified in ISO 386 have also been omitted.

1 Scope and field of application

This International Standard specifies requirements for two series of inexpensive "commercial quality" liquid-in-glass thermometers of the solid-stem type suitable for general purpose use in industry, schools and laboratories when great accuracy of measurement is not required :

- a) a series designated A to H, in which nominal ranges and maximum overall lengths are specified but which may not be acceptable for testing by a national verification laboratory;
- b) a series designated J to W of greater accuracy than in a) and with specified ranges and a tolerance on overall length, which may be acceptable for testing by a national verification laboratory.

The temperature range covered by each series is from $- 100\text{ }^{\circ}\text{C}$ to $+ 500\text{ }^{\circ}\text{C}$.

2 Reference

ISO 386, *Liquid-in-glass laboratory thermometers — Principles of design, construction and use*.

3 Temperature scale

The thermometers shall be graduated in accordance with the Celsius scale as defined in the current definition of the International Practical Temperature Scale (IPTS) adopted by the Conférence générale des poids et mesures, and in accordance with the International System of Units (SI).

4 Immersion

4.1 The thermometers shall be adjusted for use either at total immersion (i.e. the reading shall be correct when the thermometer is immersed so that the top of the liquid column is in the same plane as, or no more than two scale divisions above, the surface of the medium the temperature of which is required to be measured), or for partial immersion, as required.

4.2 In the latter case, the preferred immersion is 75 ± 1 mm, and the adjustment of such a thermometer shall be carried out at the average emergent liquid column temperature detailed in tables 1 and 2.

NOTES

- 1 Adjustment at partial immersion is not permitted for the thermometers with a scale extending below $- 38\text{ }^{\circ}\text{C}$, 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.
- 2 For guidance on the determination of the emergent liquid column corrections to be applied when the thermometer is used in situations where the average emergent liquid column temperature differs from that given in tables 1 and 2, see annex B.6 and B.7 of ISO 386.

5 Glass

The thermometer bulb shall be made of suitable thermometric glass.¹⁾ The glass or glasses comprising the thermometer shall

1) An International Standard (ISO 4795) dealing with glasses for thermometer bulbs is in preparation.

be selected and processed so that the finished thermometer shows the following characteristics.

- a) Stress in the glass of the bulb and capillary stem shall be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock.
- b) The bulb glass shall be stabilized by suitable heat treatment to ensure that the accuracy requirements of clause 10 are met.
- c) The legibility of the reading shall not be impaired by devitrification or clouding.
- d) The meniscus or its image shall be distorted as little as possible by defects or impurities in the glass.

6 Liquid filling

6.1 Mercury shall be used as liquid filling except for thermometers with a scale extending below $-38\text{ }^{\circ}\text{C}$ for which a filling of an organic liquid shall be used which will remain liquid throughout the temperature range under the pressures prevailing inside the thermometer.

6.2 The organic liquid used as the liquid filling should preferably be coloured by means of a light-fast dye which does not stain the glass.

6.3 The organic liquid used as the liquid filling should preferably be toluene or an isomer or suitable mixture of isomers of pentane.

7 Gas filling

Thermometers containing mercury as the liquid filling shall be filled with a dry inert gas above the liquid filling. The pressure of the gas shall be high enough to raise the boiling point of the liquid sufficiently to minimize vaporization over the nominal range of the thermometer.

8 Construction

8.1 Shape

The thermometers shall 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 shall be finished with a plain top, button top or glass ring. In all cases, the diameter of the top finish of the thermometer shall not exceed that of the stem.

8.3 Capillary tube

The capillary tube should preferably incorporate an enamel back. The inside of the capillary tube shall be smooth in order to avoid possible sticking of the liquid filling.

For the thermometers listed in table 2, the cross-sectional area of the bore shall not show variations from the average greater than 10 %.

8.4 Expansion volume (safety chamber)

8.4.1 An expansion volume shall be provided at the top of the capillary tube. This volume may take the form either of an extension of the bore or of an expansion chamber.

NOTE — Overheating a thermometer beyond its upper nominal limit is liable to change the zero or other fiducial point of the thermometer, and a redetermination of this point will therefore become necessary if it takes place.

8.4.2 If an expansion chamber is incorporated, it shall, except when the stem is made from borosilicate glass, be pear-shaped with the hemisphere at the top.

8.5 Enlargement of bore

There shall be at least 10 mm of unchanged capillary between any enlargement and the nearest scale line or immersion line.

8.6 Dimensions

The dimensions of the thermometers shall be as detailed in tables 1 and 2.

The tolerance on the overall length of the thermometers of higher accuracy given in table 2 shall be $\pm 10\text{ mm}$.

The bulb diameter shall not exceed that of the stem.

9 Scale lines, immersion line and figuring

9.1 The nominal ranges, figuring and scale divisions of the thermometers shall be as detailed in tables 1 and 2.

9.2 The scale lines shall be clearly etched or otherwise durably marked and of uniform thickness not exceeding the values given in tables 1 and 2. The lines shall be at right angles to the axis of the thermometer. Typical schemes of graduation and figuring are shown in the figure.

9.3 In the case of the thermometers listed in table 1 with $0\text{ }^{\circ}\text{C}$ as the lower nominal limit or $100\text{ }^{\circ}\text{C}$ as the upper nominal limit, the scale shall be extended by at least three divisions beyond each of these limits. In all other cases, the scales may also be suitably extended beyond the nominal limits.

9.4 On thermometers adjusted for partial immersion the immersion depth shall be indicated by a line on the stem at the appropriate distance from the bottom of the bulb (see clause 4). This line shall be marked around the back of the thermometer and shall not cross the scale.

9.5 In the case of etched scales, the pigment filling shall remain in the scale lines, figures, inscriptions and immersion line under normal conditions of use.

10 Accuracy

The instrument error for the thermometers shall not be greater than the values given in tables 1 and 2.

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 at temperatures in the upper part of the scale range.

11 Inscriptions

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

- a) unit of temperature : abbreviation of the name Celsius, for example "C", or the symbol "°C";
- b) the designation of the thermometer;
- c) for partial immersion thermometers, an indication of the immersion depth for which the thermometer is adjusted, for example "75 mm". No inscription is required for total immersion thermometers;
- d) vendor's and/or maker's name or readily identifiable mark;
- e) the number of this International Standard, i.e. ISO 1770, or the number of the corresponding national standard;
- f) identification of the bulb glass, preferably by means of a coloured stripe or stripes, or by an inscription on the thermometer;
- g) manufacturer's identification or serial number, the last two digits of which may, if required, indicate the year of manufacture.

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Table 1 — Requirements for solid-stem general purpose thermometers for measurements of lower accuracy

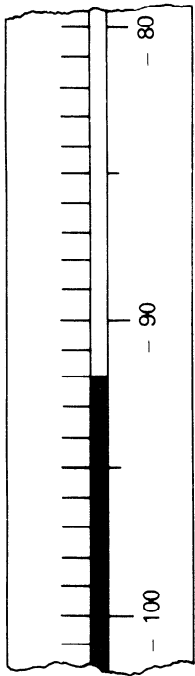
Nominal range °C	Scale division °C	Longer lines at each °C	Line thickness max. mm	Fractional figuring at each °C	Full figuring at each °C	Overall length max. mm	Scale length (nominal range) min. mm	Total immersion		Partial immersion		Designation (The immersion is added as appropriate, for example, "/75".)
								Maximum error °C		Average emergent liquid column temperature °C		
								Maximum error °C		Maximum error °C		
- 100 to + 30	1	5	0,25	—	10	305	180	2	*	*	A	
- 35 to + 30	0,5	1	0,25	5	10	305	180	1	1,5	20	B	
0 to + 60	0,5	1	0,25	5	10	305	180	0,5	0,5	20	C	
0 to + 100	1	5	0,25	—	10	305	180	1	1,5	35	D	
0 to + 160	1	5	0,25	10	100	305	180	2	3	35	E	
0 to + 250	1	5	0,20	10	100	305	180	2	3	35	F	
0 to + 360	2	10	0,20	20	100	305	180	4	6	50	G	
0 to + 500	5	10	0,25	50	100	350	180	10	15	75	H	

* Graduation for partial immersion is not permitted for these thermometers (see note 1 in clause 4).

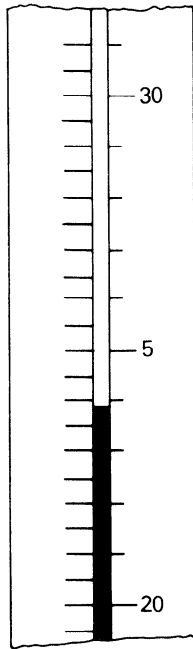
Table 2 — Requirements for solid-stem general purpose thermometers for measurements of higher accuracy

Range °C	Scale division °C	Longer lines at each °C	Line thickness max. mm	ISO 1770:1981		Overall length mm ± 10	Scale length min. mm	Total immersion		Partial immersion		Designation (The immersion is added as appropriate, for example, “/75”)	
				Full figuring at each °C	Fractional figuring at each °C			Maximum error °C		Maximum error °C			Average emergent liquid column tempera- ture °C
								°C		°C			
- 100 to + 50	1	5	0,25	10	100	305	200	2	*	*	*	J	
- 50 to + 50	1	5	0,25	—	10	305	150	2	*	*	*	K	
- 1 to + 51	0,1	0,5	0,10	1	10	460	300	0,3	1	1	20	L	
- 1 to + 101	0,1	0,5	0,10	1	10	610	500	0,3	1	1	35	M	
- 1 to + 201	0,2	1	0,25	2	10	610	500	0,4 °C to 100 °C 0,5 °C above 100 °C	1 °C to 100 °C 1,5 °C above 100 °C	1 °C to 100 °C 1,5 °C above 100 °C	35	N	
- 35 to + 50	1	5	0,25	—	10	305	200	0,5	1	1	20	P	
- 20 to + 110	1	5	0,25	—	10	305	200	0,5	1	1	35	R	
- 20 to + 150	1	5	0,20	10	100	305	200	0,5	1	1	35	S	
- 10 to + 260	1	5	0,20	10	100	405	250	0,5 °C to 100 °C 1 °C above 100 °C	1 °C to 100 °C 1,5 °C above 100 °C	1 °C to 100 °C 1,5 °C above 100 °C	35	T	
- 10 to + 400	2	10	0,25	20	100	405	250	2 °C to 300 °C 4 °C above 300 °C	2 °C to 300 °C 5 °C above 300 °C	2,5 °C to 300 °C 5 °C above 300 °C	50	V	
- 10 to + 500	2	10	0,20	20	100	405	250	2 °C to 300 °C 4 °C above 300 °C	2 °C to 300 °C 5 °C above 300 °C	2,5 °C to 300 °C 5 °C above 300 °C	75	W	

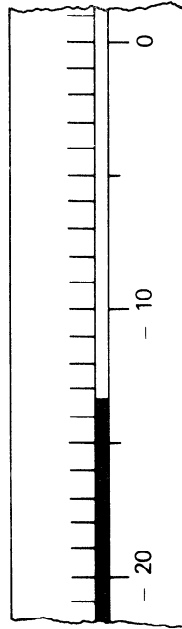
* Graduation for partial immersion is not permitted for these thermometers (see note 1 in clause 4).



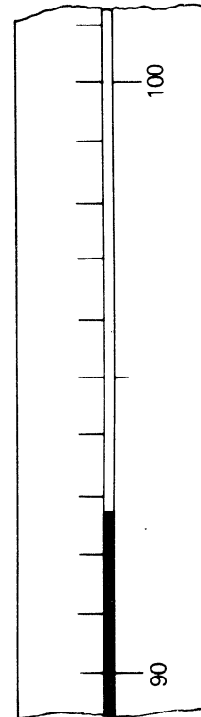
A (L and M similar)
J



B
C



P

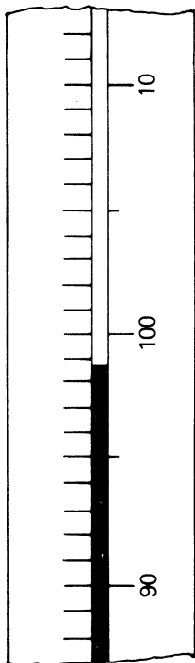


D
R

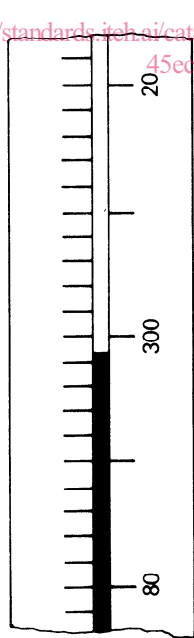
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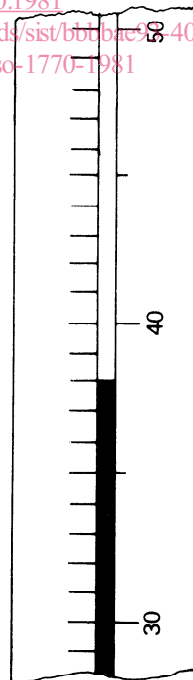
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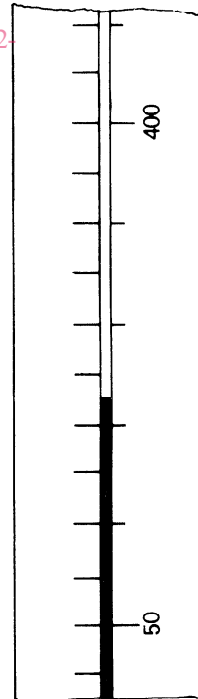
E
F
S
T



G (N similar)
V
W



K



H

Figure — Examples of scale lines and figuring