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# International Standard



# 1771

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

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## Enclosed-scale general purpose thermometers

*Thermomètres à échelle protégée d'usage général*

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**Descriptors :** laboratory equipment, laboratory glassware, temperature measuring instruments, thermometers, graduations, accuracy, dimensions, specifications.

## 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 1771 was developed by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, and was circulated to the member bodies in October 1979.

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

Australia	Germany, F. R.	Netherlands
Brazil	Hungary	Poland
Canada	India	Romania
Chile	Italy	South Africa, Rep. of
Czechoslovakia	Korea, Rep. of	Spain
France	Mexico	USSR

No member body expressed disapproval of the document.

This International Standard cancels and replaces ISO Recommendation R 1771-1970, of which it constitutes a technical revision.

# Enclosed-scale general purpose thermometers

## 0 Introduction

This International Standard is based in general on the provisions of ISO 386, *Liquid-in-glass laboratory thermometers — Principles of design, construction and use*. However, to avoid increasing the cost of the thermometers, some of the dimensions recommended to be specified in ISO 386 have been omitted.

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 and field of application

This International Standard specifies requirements for a series of inexpensive "commercial quality" liquid-in-glass thermometers of the enclosed-scale type suitable for general purpose use in industry, schools and laboratories when great accuracy is not required.

The temperature range covered 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

The thermometers shall be adjusted for use 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 to be measured).

## 5 Glass

The thermometer bulb shall be made of suitable thermometric glass.<sup>1)</sup> The glass or glasses comprising the thermometer shall be selected and processed so that the finished thermometer shows the following characteristics.

- a) Stress in the glass 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.

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

## 8 Construction

### 8.1 Shape

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

### 8.2 Top finish

The top of the thermometer should be finished with a fused-in glass tube (Richter top finish) and may be provided with a button the diameter of which shall not exceed that of the sheath.

### 8.3 Strip bearing the scale

The strip bearing the scale shall be of a non-transparent, dimensionally stable material suitable for the temperatures to be measured. 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, in such a way that it can freely expand in length. The fixing shall not obscure the scale. 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 shall be fixed inside the sheath in a suitable manner.

### 8.4 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.

### 8.5 Expansion volume (safety chamber)

**8.5.1** 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.

**8.5.2** 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.

### 8.6 Enlargement of bore

These shall be at least 10 mm of unchanged capillary between any enlargement of the bore and the nearest scale line.

### 8.7 Dimensions

The dimensions of the thermometers shall be as detailed in table 1.

The bulb diameter shall not exceed that of the sheath.

## 9 Scale lines and figuring

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

**9.2** The scale lines shall be clearly and durably marked and of uniform thickness. 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 with 0 °C as the lower nominal limit or 100 °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** 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, shall be placed on the right hand side of the sheath on a level with the lowest figured graduation line, so that any displacement of the scale can easily be noticed.

## 10 Accuracy

The instrument error for the thermometers shall not be greater than the values given in table 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 (see table 1);
- c) vendor's and/or maker's name or readily identifiable mark;
- d) the number of this International Standard, i.e. ISO 1771, or the number of the corresponding national standard;
- e) identification of the bulb glass preferably by means of a coloured stripe, or stripes, or by an inscription on the thermometer;
- f) manufacturer's identification or serial number the last two digits of which may, if required, indicate the year of manufacture.

Table 1 – 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	Scale length (nominal range)		Bulb diameter	Designation
						max.	min.		
°C	°C	°C	°C	°C	mm	mm	mm		
- 100 to + 30	1	5	—	10	305	200		Not greater than diameter of sheath	A/e
- 35 to + 30	0,5	1	5	10	305	200			B/e
0 to 60	0,5	1	5	10	305	200			C/e
0 to 100	1	5	—	10	305	200			D/e
0 to 160	1	5	10	100	305	200			E/e
0 to 250	1	5	10	100	305	200			F/e
0 to 360	2	10	20	100	305	200			G/e
0 to 500	5	10	50	100	350	200			H/e

Table 2 – Maximum error

Nominal range	Maximum error
°C	°C
- 100 to 30	± 2
- 35 to 30	± 0,5
0 to 60	± 0,5
0 to 100	± 1
0 to 160	± 1
0 to 250	up to 210 °C : ± 1 above 210 °C : ± 2
0 to 360	± 2
0 to 500	± 5

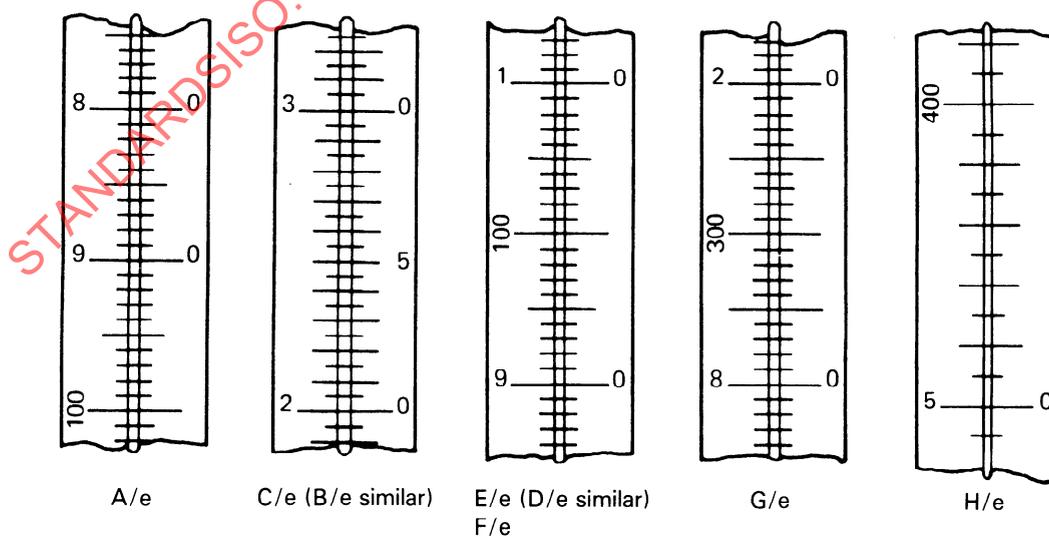


Figure – Examples of scale lines and figuring

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