INTERNATIONAL STANDARD 4786

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Enclosed-scale adjustable-range thermometers

Thermomètres à échelle protégée ajustable

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FOREWORD

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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 4786 was developed by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus,* and was circulated to the member bodies in May 1976.

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

Australia	Hungary	Romania
Austria	Ireland	South Africa, Rep. of
Belgium	Israel	Spain
Canada	Italy	Turkey
Chile	Korea, Rep. of	United Kingdom
Czechoslovakia	Mexico	U.S.A.
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No member body expressed disapproval of the document.

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Enclosed-scale adjustable-range thermometers

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies requirements for enclosed-scale adjustable-range thermometers for measuring small temperature differences not exceeding 5 °C (or, exceptionally, 6 °C) within the range − 20 °C to + 140 °C.

The thermometers are unsuitable for measuring absolute temperatures unless they have been compared with standard instruments immediately before use.

2 TYPE OF THERMOMETER

The thermometer shall be of the mercury-in-glass enclosed-scale type.

3 TEMPERATURE SCALE

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

4 IMMERSION

The immersion level shall be the position where the supporting saddle for the scale is fused into the outer tube (point E on figure 1).

5 GRADUATION

The thermometer shall be graduated for use in a vertical position when immersed to the immersion level (see clause 4) and when adjusted at a setting temperature (see 8.5) and emergent mercury column temperature of 20 °C.

6 GLASS

The glass for the bulb and capillary tube shall be made of a suitable thermometric glass selected and processed so that the finished thermometer shows the following characteristics :

6.1 Stress in the glass shall be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock.

6.2 The bulb glass shall be stabilized by suitable heat treatment to ensure that the accuracy requirements of clause 10 can be met.

6.3 The legibility of the reading shall not be impaired by devitrification or clouding.

6.4 The image of the meniscus shall be distorted as little as possible by defects or impurities in the glass.

7 VACUUM

The thermometer shall be vacuous, and the vacuum above the mercury shall be such that no difficulty is experienced in re-joining the column after setting.

8 CONSTRUCTION

8.1 Shape

The thermometer shall be straight and with an approximately circular external cross-section.

8.2 Top finish

The top of the sheath shall be sealed by suitable means and should be covered by a cap.

8.3 Strip bearing the scale

The strip bearing the scale shall be of a material suitable for the temperature to be measured and compatible with the method of fixing the strip.

The strip shall be placed tightly against the capillary tube inside the sheath and shall be firmly and securely fastened at the top of the thermometer. A suitable method of fixing is by fusing a glass tube or rod to the sheath and to the upper end of the strip bearing the scale, while the lower end of the strip shall be freely held in a suitable saddle. Alternatively, it shall be fixed inside the sheath in any other suitable manner that allows for differential expansion.

8.4 Capillary tube

The capillary tube shall be transparent and its inside shall be smooth. The cross-sectional area of the bore below and above the immersion level shall be similar, and in the scale

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portion this area shall not show variations from the average greater than 5 %. The volume of mercury contained in the capillary tube from the immersion level to the nearest graduation line shall not exceed the equivalent of 2 °C. The bore shall be wide enough to ensure that, without tapping, jumping of the meniscus, as observed with unaided vision, does not exceed one-half of the smallest scale division when the temperature is rising at a uniform rate not exceeding 0,01 °C per minute.

8.5 Adjusting device

For adjusting the amount of mercury in the bulb and main capillary tube to the intended range, an enlargement shall be provided above the main scale to serve as a reservoir for the separated mercury. Two suitable designs are illustrated in figures 1 and 2. Adjustment shall be possible without difficulty. To facilitate adjustment of the range, an auxiliary scale may be provided. In the case of the alternative design shown in figure 2, the temperature increase necessary to raise the mercury column of the thermometer from the zero of the scale to the end of the capillary extension (point P in figure 2) may be marked on the thermometer.

Setting temperature is that temperature of the thermometer bulb at which the thermometer indicates zero value on the main scale.

8.6 Dimensions

The dimensions of the thermometer shall be as detailed in the table and figure 1.

9 SCALE LINES AND FIGURING

9.1 The range and graduation interval of the thermometer shall be as detailed in the table.

9.2 The scale lines shall be clearly and durably marked and of uniform thickness which shall not exceed 0,05 mm. The lines shall lie in planes at right angles to the axis of the thermometer.

9.3 The arrangement of the scale lines shall be as shown in figure 3. Each 0,1 degree line shall be a long line not less than 0,8 of the width of the strip bearing the scale. Each 0,05 degree line shall have a length of 0,6 of the long lines, and each 0,01 degree line shall have a length of 0,3 of the long lines.

9.4 The scale of the thermometer shall be extended at each end by at least two scale divisions beyond the nominal limits of the scale.

9.5 The lowest long scale line shall be figured "0". Each full degree shall be figured with large numbers. Each tenth of a degree shall be figured, if required, by small numbers on the right-hand side of the scale. The figures shall be placed immediately above the lines to which they refer.

9.6 At the right-hand side of the sheath, an indelible datum line of thickness comparable with that of the scale lines shall be placed on a level with the scale line "0" so that any displacement of the scale can easily be noticed.

10 INTERVAL ERROR

The interval error of any interval of 1 °C or less shall not exceed ± 0,01 °C. The interval error of any interval greater than 1 °C shall not exceed ± 0,02 °C. These values refer only to an adjustment of the thermometer to a setting temperature of 20 °C and at a temperature of the emergent mercury column of 20 °C.

11 STABILITY

The stability of the thermometer shall be such that when adjusted to a setting temperature of 100 °C, heated to 130 °C for at least 15 min, cooled to 100 °C, and maintained at this temperature, the reading does not change by more than 0,01 °C during a subsequent period of 24 h.

12 INSCRIPTIONS

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

a) temperature scale indication : the official symbol "°C"; an abbreviation of the name Celsius (for example "C") is also permitted;

b) immersion : the depth of immersion, for example "195 mm";

c) bulb glass : the glass shall be identified preferably by means of a coloured stripe or stripes, or by an inscription on the thermometer;

d) manufacturer's identification serial number;

e) maker's and/or vendor's name or readily identifiable mark;

f) the number of this International Standard, i.e. ISO 4786, or the number of the corresponding national standard.

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TABLE — **Graduation and dimensions**

Scale range (nominal)		5 °C[1)]
Graduation interval		0,01 °C
Adjustable range		−20 °C to + 140 °C
Total length	max.	625 mm
Depth of immersion (distance from bottom of bulb to immersion level)		200 ± 10 mm
Distance from immersion level to lowest numbered graduation line		20 to 30 mm
Length of main scale (nominal range)	min.	200 mm[1)]
Diameter of sheath (top portion)	max.	16 mm
Length of auxiliary scale, if provided	min.	30 mm
External diameter of bulb		11 ± 0,5 mm (but not exceeding the external diameter of the adjoining portion of sheath)
Length of bulb to shoulder	max.	40 mm
Distance from shoulder of bulb to lower end of parallel-sided capillary tube	max.	11 mm

1) Alternatively, a range of 6 °C is permitted, if required, for which the length (minimum) of the main scale shall be 240 mm.

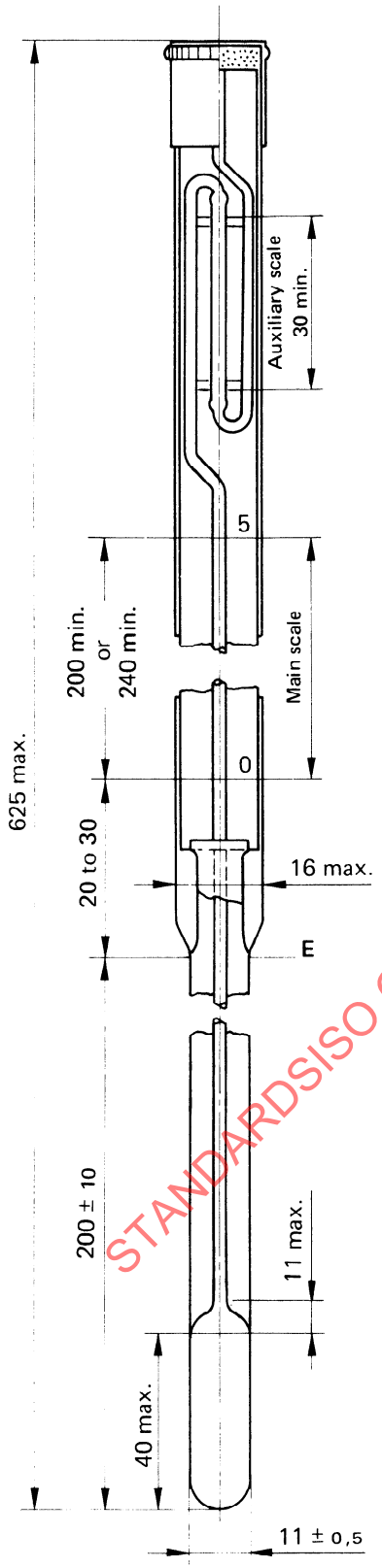

FIGURE 1 — **Enclosed-scale adjustable-range thermometers**

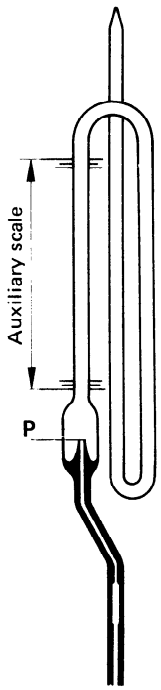

FIGURE 2 — **Alternative adjusting device**

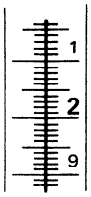

FIGURE 3 — **Graduation and figuring**

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