International Standard 655

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Long enclosed-scale thermometers for precision use

Thermomètres de précision, à échelle protégée, type long

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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 655 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	India	Portugal
Brazil	Italy	Romania
Canada	Korea, Rep. of	South Africa, Rep. of
Czechoslovakia	Libyan Arab Jamahiriya	Spain
France	Mexico	USSR
Germany, F.R.	Netherlands	
Hungary	Poland	

No member body expressed disapproval of the document.

This International Standard cancels and replaces ISO Recommendation R 655-1968, of which it constitutes a technical revision.

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Long enclosed-scale thermometers for precision use

0 Introduction

This International Standard is based on ISO 386, *Liquid-in-glass laboratory thermometers — Principles of design, construction and use.* It is one of four International Standards specifying requirements for basic series of long and short solid-stem and enclosed-scale thermometers, intended for general use in precision work.

For ease of reference, each thermometer of the series has been allocated a combination of letters and figures indicating the type of thermometer, the value of the smallest scale interval and the upper and lower limits of the nominal scale range. The letter abbreviations given below have been selected, after taking into account the descriptions in various languages usually given to these types of thermometers :

STL ..... Long solid-stem thermometers;

STC ..... Short solid-stem thermometers;

EL ..... Long enclosed-scale thermometers;

EC ..... Short enclosed-scale thermometers.

The method for determining the change in the zero indication is given in the annex.

1 Scope and field of application

This International Standard specifies requirements for a basic series of liquid-in-glass enclosed-scale thermometers, not exceeding 375 mm in length, for general use in precision work.

NOTE — There are in existence many different specifications for thermometers of the general types covered by this series. It is intended that this series should replace all such specifications, except those for which there is a well-established justification.

2 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).

3 Immersion

3.1 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 required to be measured).

3.2 Thermometers having a smallest scale division of 0,1 °C or 0,2 °C may alternatively be adjusted for complete immersion (i.e. the reading shall be correct when the entire thermometer is immersed in the medium) and if so shall be identified by marking [see 10 b)].

4 Glass

The thermometer shall be made of suitable thermometric glass[1)] selected and processed so that the finished thermometer shows the following characteristics.

4.1 Stress in the glass of the bulb capillary tube and sheath shall be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock.

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

4.2 The bulb glass shall be stabilized by suitable heat treatment to ensure that the accuracy requirements of 9.1 and 9.3 can be met.

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

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

5 Liquid filling

Mercury shall be used as liquid filling, except for thermometers with a scale extending below − 38 °C for which the eutectic alloy of mercury and thallium (8,5 % thallium by mass) shall be used. The liquid filling shall be free from any contamination likely to interfere with the proper functioning of the thermometer.

6 Gas filling

Thermometers having an upper nominal limit above 100 °C shall be filled with a dry, inert gas. The pressure of the gas shall be high enough to raise the boiling point of the liquid filling sufficiently to minimize vaporization.

7 Construction

7.1 Shape

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

7.2 Top finish

The top of the thermometer shall either be finished with a glass ring, or with a spherical end separated by a constricted neck.

7.3 Strip bearing the scale

The strip bearing the scale shall be of a non-transparent, dimensionally stable material suitable for the temperature to be measured and compatible with the method of fixing the strip. 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. The fixing shall not obscure the scale. 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 also allows for differential expansion (see figure 2 of ISO 386 for recommended designs).

7.4 Capillary tube

The thermometer shall be made from capillary tube which has been so tested as to ensure that the requirements of 7.4.1 and 7.4.2 are satisfied.

7.4.1 The inside of the capillary tube shall be smooth.

7.4.2 The cross-sectional area of the bore shall not show variations from the average greater than 10 %, and the bore shall be wide enough to ensure that jumping of the meniscus does not exceed one-fifth of the graduation interval.

7.4.3 The capillary tube should preferably incorporate an enamel back.

7.5 Expansion volume

7.5.1 An expansion volume shall be provided at the top of the capillary tube.

NOTE — Overheating is liable to change the zero point of a thermometer and a redetermination will be necessary if it occurs.

7.5.2 The volume above the scale shall be at least equivalent to that occupied by an interval of 50 °C of the scale.

7.5.3 This volume should preferably consist of an expansion chamber, and with the exception of thermometers EL/1/180/420 and EL/2/0/600, this chamber, if present, shall be pear-shaped with the hemisphere at the top.

7.5.4 For thermometers EL/0,1/− 25/+ 5 and EL/0,2/− 55/+ 5 the lower end of the expansion chamber shall be so elongated as to avoid the risk of a break in the mercury column during storage at ambient temperature.

7.6 Contraction chamber

Thermometers having a lower limit of the main scale above 0 °C shall be provided with a contraction chamber to allow for the inclusion of an auxiliary scale (see figure 1, type B). The contraction chamber shall be so elongated and as narrow as possible to avoid risk of a break in the mercury column at ambient temperature.

7.7 Position of chambers

No enlargement of the bore shall be so located as to produce any variation (greater than that permitted in 7.3) in the cross-section of the capillary tube in the scale portion, and in all cases there shall be at least 5 mm of unchanged capillary between any enlargement and the nearest scale line. The distance from the top of the contraction chamber to the first scale line of the scale immediately above it shall be not less than 13 mm, except that for thermometers EL/0,5/190/310 and EL/1/180/420, this distance shall be not less than 30 mm.

7.8 Dimensions

The dimensions of the thermometers shall be as given in table 1 and figure 1.

8 Marking

8.1 The scale ranges and scale intervals of the thermometers shall be as given in table 2.

8.2 The scale lines shall be clearly and durably marked and of uniform thickness, which shall not exceed 0,12 mm. The lines shall be at right angles to the axis of the thermometer.

8.3 The longest lines shall extend across not less than 0,8 of the width of the strip bearing the scale, and the lengths of the medium and long lines should be respectively at least 2 mm and 4 mm longer than the short scale lines. All lines shall extend equally on both sides of the capillary when the thermometer is held in a vertical position and viewed from the front.

8.4 The length of the short scale lines shall be at least 1 mm longer than the width of the capillary.

8.5 The arrangement of the scale lines shall be as follows :

8.5.1 On thermometers where the smallest scale division is 1 °C or 0,1 °C :

a) every tenth scale line shall be a long line;

b) there shall be a medium line midway between two consecutive long lines;

c) there shall be four short lines between consecutive medium and long lines (see drawings A and D of figure 2).

Table 1 — Dimensions (see also figure 1)

Dimensions in millimetres

Dimension		Type A	Type B
Total length	max.	375	375
Distance from top of bulb (shoulder) to lower nominal limit of scale	min.	35	—
Distance from top of bulb (shoulder) to 0 °C scale line	min.	—	35
Length of main scale (nominal limits)	min.	220	170
Distance from upper nominal limit of scale to top of thermometer	min.	50	50
Diameter of sheath		9,0 ± 1,0	9,0 ± 1,0
External diameter of bulb :		6,0 ± 0,5	6,0 ± 0,5
Length of bulb to shoulder	min.	15	15
Distance from shoulder of bulb to lower end of parallel-sided capillary tube	max.	5	5
Distance from top of contraction chamber to lowest scale line on scale above it	min.	—	13*
Distance from lower nominal limit of scale to 0 °C scale line	min.	—	50

* Except for thermometers EL/0,5/190/310 and EL/1/180/420, for which this dimension should be at least 30 mm.

Table 2 — Graduation

Designation	Inscription	Scale interval	Main scale	Auxiliary scale	Type (see figure 1)
		°C	°C	°C	
EL/0,1/ − 25/ + 5	EL 1	0,1	− 25 to + 5	—	A
EL/0,1/ − 5/ + 25	EL 2	0,1	− 5 to + 25	—	A
EL/0,1/20/45	EL 3	0,1	20 to 45	− 0,5 to + 0,5	B
EL/0,1/40/65	EL 4	0,1	40 to 65	− 0,5 to + 0,5	B
EL/0,1/60/85	EL 5	0,1	60 to 85	− 0,5 to + 0,5	B
EL/0,1/80/105	EL 6	0,1	80 to 105	− 0,5 to + 0,5	B
EL/0,2/ − 55/ + 5	EL 7	0,2	− 55 to + 5	—	A
EL/0,2/ − 35/ + 25	EL 8	0,2	− 35 to + 25	—	A
EL/0,2/ − 15/ + 45	EL 9	0,2	− 15 to + 45	—	A
EL/0,2/35/85	EL 10	0,2	35 to 85	− 1 to + 1	B
EL/0,2/75/125	EL 11	0,2	75 to 125	− 1 to + 1	B
EL/0,2/115/165	EL 12	0,2	115 to 165	− 1 to + 1	B
EL/0,2/155/205	EL 13	0,2	155 to 205	− 1 to + 1	B
EL/0,5/ − 35/ + 115	EL 14	0,5	− 35 to + 115	—	A
EL/0,5/90/210	EL 15	0,5	90 to 210	− 3 to + 3	B
EL/0,5/190/310	EL 16	0,5	190 to 310	− 3 to + 3	B
EL/1/ − 30/ + 270	EL 17	1	− 30 to + 270	—	A
EL/1/180/420	EL 18	1	180 to 420	− 5 to + 5	B
EL/2/0/600	EL 19	2	0 to 600	—	A

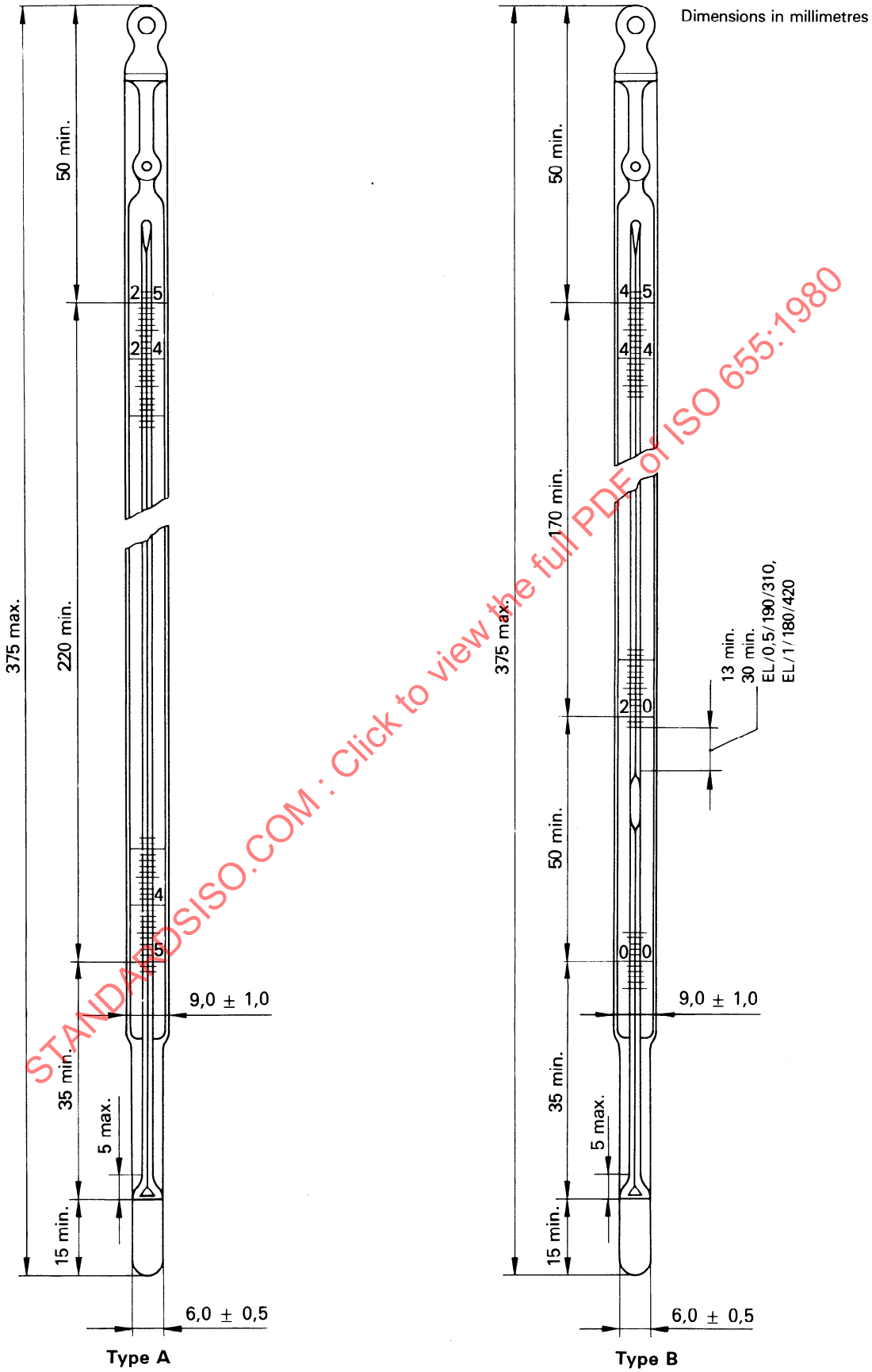

Figure 1 — Long enclosed-scale thermometers for precision use

NOTE — The position of the top ring may be either as shown or at right angles to this.