INTERNATIONAL STANDARD

ISO 4795

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Glass for thermometer bulbs

Verre pour réservoirs de thermomètres

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

This International Standard ISO 4795 has been prepared by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, Subcommittee SC 3, *Thermometers*.

Annex A forms an integral part of this International Standard. Annexes B, C and D are for information only.

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Glass for thermometer bulbs

1 Scope

This International Standard specifies the physical and chemical characteristics and the marking of thermometric glass and the test methods to be used for the selection of glass for the manufacture of the bulbs of liquid-in-glass thermometers.

It is not applicable to the glass used in parts of the thermometer other than the bulb (e.g. the stem). However, the glass used for the other parts can be identical to that used for the bulb.

The coefficient of linear thermal expansion of the bulb glass should not differ from that of the glass intended for the stem by more than $0{,}2 \times 10^{-6}\ K^{-1}$.

2 Normative references

The following standards contain provisions which, through references in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 719:1985, *Glass — Hydrolytic resistance of glass grains at 98 °C — Method of test and classification.*

ISO 7884-7:1987, *Glass — Viscosity and viscometric fixed points — Part 7: Determination of annealing point and strain point by beam bending.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 strain point, θ_{f4}: The temperature determined in accordance with ISO 7884-7.

NOTE — By the beam-bending method, the viscosity of glass at the strain point may be evaluated as $10^{14,7}$ dPa·s.

3.2 zero-point correction, K: Correction of the thermometer at 0 °C:

$$K = 0\ °C - t_{ind}$$

where t_{ind} is the temperature indicated.

3.3 zero-point depression: Change of the zero-point correction after heating and fast cooling of the thermometer.

4 Maximum temperature of use

The maximum temperature recommended for use shall not exceed (θ_{f4} –130) °C, where θ_{f4} is the strain point determined in accordance with the method given in ISO 7884-7.

5 Requirements

5.1 Stability

The indication at 0 °C of a suitable test thermometer having a bulb made of the glass under consideration shall not change by more than 2 °C after exposure to the maximum temperature recommended for use (see clause 4) for 500 h.

This stability requirement can be determined in accordance with annex B.

5.2 Zero-point depression

When tested in accordance with the procedure given in annex A, a thermometer having a bulb made of the glass under consideration shall have an average zero-point depression not exceeding 0,05 °C for "normal glass" or 0,03 °C for borosilicate glass.

NOTE —The zero-point depression of some types of thermometric glass is given in annex C.

5.3 Chemical resistance

When tested according to the procedure and classification given in ISO 719, the glass shall comply with the requirements of class HGB 3 or better.

6 Marking

6.1 Thermometric glass complying with this International Standard shall be identified according to either of the schemes given in 6.2 and 6.3.

6.2 The manufacturer of the thermometric glass shall incorporate an identification stripe or stripes in accordance with the approved list shown in table D.1 (see annex D).

6.3 The manufacturer of the thermometer shall mark it with an identification alphanumeric code in accordance with the approved list shown in table D.1 (see annex D) and shall, on request, supply a certificate of conformity provided by the manufacturer of the thermometric glass.

NOTE 1 The list of approved identification stripes and identification codes will be maintained under the responsibility of the secretariat for this International Standard, on the basis of data provided by the national test authorities or notified bodies responsible for testing and certification of thermometric glass.

NOTE 2 Manufacturers wishing to claim, for a thermometric glass not listed in table D.1, compliance with the requirements of this International Standard, should apply to their national standards body, who will register the glass with the secretariat for this International Standard. A certificate from a national test authority or notified body that the thermometric glass to be registered corresponds to the requirements of this International Standard is recommended.

Annex A
(normative)

Determination of the average zero-point depression

NOTE — This annex is based on annex B of International Recommendation OIML R7:1978, *Clinical thermometers — Mercury-in-glass with maximum device.*

A.1 Fabrication of test thermometers

Using the glass under consideration for the bulb, make test thermometers with the following specifications.

Scale range at least:	- 3,0 °C to + 3,0 °C.
Graduation:	0,02 °C, 0,05 °C, or 0,1 °C.
Distance between consecutive graduation lines:	at least 0,7 mm for enclosed-scale thermometers or at least 1,0 mm for solid-stem thermometers.
Expansion chamber:	of sufficient volume that the thermometer can be heated 50 °C above the maximum recommended temperature without damage.
Stabilization:	thermometers stabilized (see A.2).

A.2 Confirmation of stabilization

A.2.1 Heat the thermometer in a liquid bath or metal block oven from room temperature to the maximum recommended temperature of use ± 5 °C and keep it at this temperature for at least 5 min.

A.2.2 Cool the thermometer to 50 °C at a rate between 10 °C/h and 15 °C/h.

A.2.3 Remove the thermometer from the bath or oven, determine the correction at 0 °C and record its value (K_1).

A.2.4 Heat the thermometer again to the maximum recommended temperature of use ± 5 °C, using the same immersion depth as that employed in A.2.1 and keep it at this temperature for 24 h.

A.2.5 Cool the thermometer as specified in A.2.2.

A.2.6 Redetermine the correction as specified in A.2.3 and record its value (K_2).

A.2.7 If the difference between K_1 and K_2 exceeds 0,15 °C, reject the samples. Carry out the stabilization of fresh samples and repeat the procedures described in A.2.1 to A.2.6. If the difference between K_1 and K_2 is 0,15 °C or less, carry out the depression of zero test (A.3).

A.3 Depression of zero test

A.3.1 Select m stabilized test thermometers (where $m \geq 3$), tested according to A.2, which have not subsequently been heated above room temperature.

A.3.2 Keep each thermometer at a temperature of between 20 °C and 25 °C for 7 days. Determine the correction at 0 °C and record its value (K_3).

A.3.3 Heat each thermometer to (100 ± 1) °C. Keep it at this temperature for 30 min, then remove it from the test bath and allow it to cool to room temperature without the bulb touching any object. Determine the correction at 0 °C within 15 min of its removal from the test bath and record its value (K_4).

A.3.4 Repeat step A.3.2 and determine K_5; repeat step A.3.3 and determine K_6; repeat step A.3.2 and determine K_7; repeat step A.3.3 and determine K_8.

A.3.5 Further repetitions of steps A.3.2 and A.3.3 may be carried out to obtain corrections up to K_{2n+1} and K_{2n+2}, where n (the number of zero depressions obtained) is greater than 3.

A.4 Expression of results

A.4.1 Calculate the average depression of zero from

$$\frac{1}{m \times n} \sum_{i=1}^{i=m} (K_{i4} - K_{i3}) + (K_{i6} - K_{i5}) + \ldots\ldots + (K_{i(2n+2)} - K_{i(2n+1)})$$

where

i is the serial number of the test thermometer;
m is the total number of test thermometers;
n is the number of zero depressions obtained.

A.4.2 If the standard deviation of the $m \times n$ values of zero depression obtained is not greater than 0,01 °C, report the average depression of zero as calculated in A.4.1.

Annex B
(informative)

Stabilization test

Heat a suitable test thermometer to a temperature equal to the maximum recommended temperature of use (see clause 4) of the glass under consideration and keep it at this temperature for 5 min. Allow the thermometer to cool in the test bath or furnace to 50 °C at a rate between 10 °C/h and 15 °C/h and then determine the correction at 0 °C.

Heat the thermometer again to the maximum recommended temperature and keep it at this temperature for 500 h.

Allow the thermometer to cool to 50 °C at the same rate as before, and redetermine the correction under the same conditions as before.

Report the difference between the two corrections in degrees Celsius.

Annex C
(informative)

Zero-point depression of some types of thermometric glass

Type of glass	Manufacturer	Zero-point depression °C
DURAN	SCHOTT GLASWERKE	0,011
NG 360	Russia	0,011
N16B	SCHOTT ROHRGLAS	0,013
2954 III	SCHOTT GLASWERKE	0,02
B49T	Choisy-le-Roi	0,02
GGI 860	Saale-Glas	0,024
TNIII	Terumo	0,037

Annex D
(informative)

Type of glass and identification

The types of thermometric glass listed in table D.1 are certified by the following national testing authorities as complying with the particular requirements of this International Standard:

National testing authorities:

CNAM: LNE	Paris, France
NML:	National Measurement Laboratory, Sydney, Australia
PTB:	Physikalisch-Technische Bundesanstalt, Braunschweig und Berlin, Germany
NPL:	National Physical Laboratory, Teddington, United Kingdom
NPLI:	National Physical Laboratory, New Delhi, India
CsMo:	Slovak Laboratory for Metrology, Bratislava, Slovakia
SU:	Glass Institute, Hradec Králové, Czech Republic