INTERNATIONAL STANDARD

ISO 3585

Third edition
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Borosilicate glass 3.3 — Properties

Verre borosilicaté 3.3 — Propriétés

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.

International Standard ISO 3585 was prepared by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, Subcommittee 5, *Quality of glassware*.

This third edition cancels and replaces the second edition (ISO 3585:1991), which has been technically revised.

Annex A of this International Standard is for information only.

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Introduction

It is the purpose of this International Standard to define and facilitate the identification of a type of glass appropriate for laboratory glassware, glass plant, pipeline and fittings.

The design of glass components is dependent on the coefficient of mean linear thermal expansion and the ultimate tensile strength. Utilization requires not only a product design which is satisfactory within temperature and pressure limitations, but one which will also satisfy certain criteria for chemical resistance.

Therefore, the glass, as distinct from the components made from it, shall satisfy certain specified requirements. However, it is accepted that methods of working the glass to achieve the various forms required in practice can affect the properties of the glass.

The glass used for this application, referred to as “borosilicate glass 3.3”, is resistant to both heat and chemicals. Its heat resistance characteristics are defined by the nominal values given for physical properties. Its chemical resistance characteristics are specified within stated limits, using standard test methods to which reference is made in this International Standard.

The glass is deemed to be satisfactory for the construction of laboratory glassware, glass plant, pipeline and fittings, while for the glass components themselves, other relevant International Standards should be consulted.

Where nominal properties are given, they relate, unless otherwise specified, to the range of temperatures of 20 °C to 300 °C. However, this does not imply that products manufactured from this glass can necessarily be used freely within this range, nor that they cannot be used outside this range.

Borosilicate glass 3.3 — Properties

1 Scope

This International Standard specifies the characteristics of a type of glass designated “borosilicate glass 3.3” used for the construction of laboratory glassware, glass plant, pipeline and fittings.

NOTE — Annex A lists related International Standards.

2 Normative references

The following standards contain provisions which, through reference 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 695:1991, *Glass — Resistance to attack by a boiling aqueous solution of mixed alkali — Method of test and classification*.

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

ISO 720:1985, *Glass — Hydrolytic resistance of glass grains at 121 °C — Method of test and classification*.

ISO 1776:1985, *Glass — Resistance to attack by hydrochloric acid at 100 °C — Flame emission or flame atomic absorption spectrometric method*.

ISO 7884-2:1987, *Glass — Viscosity and viscometric fixed points — Part 2: Determination of viscosity by rotation viscometers.*

ISO 7884-3:1987, *Glass — Viscosity and viscometric fixed points — Part 3: Determination of viscosity by fibre elongation viscometer.*

ISO 7884-4:1987, *Glass — Viscosity and viscometric fixed points — Part 4: Determination of viscosity by beam bending*.

ISO 7884-8:1987, *Glass —Viscosity and viscometric fixed points — Part 8: Determination of (dilatometric) transformation temperature*.

ISO 7991:1987, *Glass — Determination of coefficient of mean linear thermal expansion*.

3 General requirements

The glass shall be annealed to commercially acceptable quality and shall be homogeneous enough to be free from larger inclusions which can affect the mechanical strength (i.e. refractory inclusions).

4 Chemical resistance

4.1 Hydrolytic resistance at 98 °C

Hydrolytic resistance shall conform to grain class ISO 719-HGB 1.

For test method see ISO 719.

4.2 Hydrolytic resistance at 121 °C

Hydrolytic resistance shall conform to grain class ISO 720-HGA 1.

For test method see ISO 720.

4.3 Acid resistance

Acid resistance shall be equivalent to a mass of sodium oxide (Na_2O) $\leqslant$ 100 µg per 1 dm^2 of glass when the glass "as a material" is tested (including preliminary acid treatment).

For test method see ISO 1776.

4.4 Resistance to attack by a boiling aqueous solution of mixed alkali

Alkali resistance shall conform to class ISO 695-A2 or better.

For test method see ISO 695.

5 Physical properties

NOTE — Property values without limiting deviations (see 5.3, 5.4 and 5.10 to 5.12) are given for guidance only. They do not specify borosilicate glass 3.3. Therefore, no test method is stated.

5.1 Coefficient of mean linear thermal expansion, α

α (20 °C; 300 °C) shall be equal to $(3{,}3 \pm 0{,}1) \times 10^{-6}\ K^{-1}$.

For test method see ISO 7991 (reference method).

5.2 Density at 20 °C, ρ

ρ shall be equal to 2,23 $g \cdot cm^{-3} \pm 0{,}02\ g \cdot cm^{-3}$.

5.3 Mean thermal conductivity (20 °C to 200 °C), λ

λ shall be equal to 1,2 $W(m^{-1} \cdot K^{-1})$.

5.4 Mean specific heat capacity at constant pressure (20 °C to 100 °C), $\bar{c}_p$

$\bar{c}_p$ shall be equal to $0{,}8 \times 10^3\ J(kg^{-1} \cdot K^{-1})$.

5.5 Viscosity/temperature behaviour

The viscosity, η, and its relationship to temperature, T, is characterized by the following (equilibrium) viscosity/temperature points:

$\eta_1 = 10^4$ dPa·s at a temperature of $T_1 = (1\,260 \pm 20)$ °C;

$\eta_2 = 10^{7,6}$ dPa·s at a temperature of $T_2 = (825 \pm 10)$ °C;

$\eta_3 = 10^{13}$ dPa·s at a temperature of $T_3 = (560 \pm 10)$ °C.

Measuring methods shall be as follows:

rotation viscometer, see ISO 7884-2;

fibre elongation viscometer, see ISO 7884-3;

beam bending viscometer, see ISO 7884-4.

NOTE — The measurement data of three equilibrium viscosities allow calculation of the viscosity/temperature relationship by the VFT equation [see equation (2) of ISO 7884-1:1987] for interpolations. The temperature T_1, T_2 and T_3 more or less correspond to the working point, softening point and annealing point, respectively (see ISO 7884-1), although at least the latter two do not characterize well-defined equilibrium viscosities and do not fit into a VFT curve.

5.6 Transformation temperature, t_g

t_g shall be equal to 525 °C ± 15 °C.

For test method see ISO 7884-8 (reference method).

5.7 Modulus of elasticity, E

E shall be equal to 64 kN·mm^{-2} (= 64 × 10^3 MPa).

5.8 Poisson's ratio, μ

μ shall be equal to 0,20.

5.9 Ultimate tensile strength, R_m

R_m shall be equal to 35 N·mm^{-2} to 100 N·mm^{-2} (= 35 MPa to 100 MPa).

The wide range of ultimate tensile strength given indicates the wide scatter of test results obtainable with normal commercial glass to which this specification relates, when smooth, pressed, drawn or fire-polished test specimens are used. Surface damage will reduce the failure stresses. The figures given are not intended as a guide to design stresses.

Annex A
(informative)

Bibliography

[1] ISO 3586:1976, *Glass plant, pipeline and fittings — General rules for testing, handling and use*.

[2] ISO 3587:1976, *Glass plant, pipeline and fittings — Pipeline and fittings of nominal bore 15 to 150 mm — Compatibility and interchangeability*.

[3] ISO 3819:1985, *Laboratory glassware — Beakers*.

[4] ISO 4704:1977, *Glass plant, pipeline and fittings — Glass plant components*.

[5] ISO 4797:1981, *Laboratory glassware — Flasks with conical ground joints.*

[6] ISO 4803:1978, *Laboratory glassware — Borosilicate glass tubing*.

[7] ISO 7884-1:1987, *Glass — Viscosity and viscometric fixed points — Part 1: Principles for determining viscosity and viscometric fixed points.*