48

INTERNATIONAL STANDARD

ISO 3585

Second edition
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Borosilicate glass 3.3 — Properties

Verre borosilicaté 3.3 — Propriétés

Reference number
ISO 3585:1991(E)

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*.

This second edition cancels and replaces the first edition (ISO 3585:1976), of which it constitutes a technical revision.

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, the relevant clauses of International Standards should be consulted.

Where nominal properties are given, they relate, unless otherwise specified, to the range of temperatures between 20 °C and 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 (see annex A).

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 7884-5:1987, *Glass — Viscosity and viscometric fixed points — Part 5: Determination of working point by sinking bar viscometer.*

ISO 7884-6:1987, *Glass — Viscosity and viscometric fixed points — Part 6: Determination of softening point.*

ISO 7884-7:1987, *Glass — Viscosity and viscometric fixed points — Part 7: Determination of annealing point and strain point 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 grain class ISO 719-HGB 1.

Test method: ISO 719.

4.2 Hydrolytic resistance at 121 °C

Hydrolytic resistance grain class ISO 720-HGA 1.

Test method: ISO 720.

4.3 Acid resistance

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).

Test method: ISO 1776.

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

Alkali resistance class ISO 695-A2 or better.

Test method: ISO 695.

5 Physical properties

NOTE 1 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

$\alpha(20\ °C; 300\ °C) = (3,3 \pm 0,1) \times 10^{-6}\ K^{-1}$

Test method: ISO 7991 (reference method).

5.2 Density at 20 °C

$\rho = 2,23\ g\ cm^{-3} \pm 0,02\ g\ cm^{-3}$

5.3 Mean thermal conductivity (20 °C to 100 °C)

$\lambda = 1,2\ W\ m^{-1}\ K^{-1}$

5.4 Mean specific heat capacity at constant pressure (20 °C to 100 °C)

$\bar{c}_p = 0,98 \times 10^3\ J\ kg^{-1}\ K^{-1}$

5.5 Working point

$\vartheta_{f1} = 1\,260\ °C \pm 20\ °C$

Test method: ISO 7884-2 and ISO 7884-5 (reference methods).

The working point corresponds to an equilibrium viscosity η_{f1} of 10^4 dPa·s.

5.6 Softening point

$\vartheta_{f2} = 820\ °C \pm 10\ °C$

Test method: ISO 7884-2 and ISO 7884-6 (reference methods).

In the case of borosilicate glass 3.3, the softening point corresponds to an equilibrium viscosity η_{f2} of $10^{7,5}$ dPa·s.

5.7 Annealing point

$\vartheta_{f3} = 560\ °C \pm 10\ °C$

Test method: ISO 7884-7 (reference method).

NOTE 2 From the beam bending method in accordance with ISO 7884-7, a non-equilibrium viscosity η_{f3} of $10^{13,2}$ dPa·s is assigned to the annealing point.

5.8 Strain point

$\vartheta_{f4} = 510\ °C \pm 10\ °C$

Test method: ISO 7884-7 (reference method).

NOTE 3 From the beam bending method in accordance with ISO 7884-7, a non-equilibrium viscosity η_{f4} of $10^{14,7}$ dPa·s is assigned to the strain point.

5.9 Transformation temperature

$t_g = 525\ °C \pm 15\ °C$

Test method: ISO 7884-8 (reference method).

5.10 Modulus of elasticity

$E = 64\ kN\ mm^{-2} = 64 \times 10^3\ MPa$

5.11 Poisson's ratio

$\mu = 0,20$

5.12 Ultimate tensile strength

$R_m = 35\ N\ mm^{-2}$ 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.*

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

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

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