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Guidelines on types of glass of normal bulk-production composition and their test methods

Lignes directrices sur les types de verre de composition normale de production en vrac et leurs méthodes d'essai

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Contents

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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.

International Standard ISO 12775 was prepared by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus,* Subcommittee SC 5, *Quality of glassware.*

Annex A of this International Standard is for information only.

Introduction

Various committees have been working for many years at national and international levels to produce agreed test methods for measuring the chemical and physical properties of glass as a material and glassware as finished articles. Because the international standardization part of the work has mostly been carried out under the aegis of the International Organization for Standardization, through its Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, the aim of the work has always been slanted towards this type of ware. Even so, the test methods and classifications proposed to date are equally applicable to other kinds of glass and to glassware which is not necessarily used only for laboratory purposes.

It has been suggested that a collection of the information produced by the various committees would provide useful guidance to users and to manufacturers of glassware. This International Standard is, therefore, intended to give such guidance but it is strongly emphasized that a classification according to one test procedure is not necessarily related to classification by another test procedure.

Although not concerning normal bulk-production glass, Technical Committee ISO/TC 172, *Optics and optical instruments*, has established some International Standards for test procedures for optical glass, for example for acid resistance (ISO 8424) and for testing the resistance to attack by aqueous alkaline phosphate-containing detergent solutions (ISO 9689).

To make these guidelines complete, some test methods are also cited which do not have a classification (which is needed for most physical test methods) but that are sometimes of great interest for the glass user or glass manufacturer.

Guidelines on types of glass of normal bulk-production composition and their test methods

1 Scope

This International Standard establishes a survey of glass types and of methods for testing their chemical and physical properties to give, for example, consumers and producers of glass of normal bulk-production composition the possibility to compare the different types of glass and test methods and to decide which are of interest for a special demand or use. For this purpose, these comprehensive guidelines give a classification of the different glass types of normal bulk-production composition according to the chemical composition and indicate the different test methods and, where they exist, the classifications according to chemical resistance.

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 standard 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 718:1990, *Laboratory glassware — Thermal shock and thermal shock endurance — Test methods*.

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 3585:1991, *Borosilicate glass 3.3 — Properties*.

ISO 4802-1:1988, *Glassware — Hydrolytic resistance of the interior surfaces of glass containers — Part 1: Determination by titration method and classification*.

ISO 4802-2:1988, *Glassware — Hydrolytic resistance of the interior surfaces of glass containers — Part 2: Determination by flame spectrometry and classification*.

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

ISO 7459:1984, *Glass containers — Thermal shock resistance and thermal shock endurance — Test methods*.

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

3 Main types of glass of normal bulk-production composition

The main types of glass of normal bulk-production composition are classified in table 1.

NOTE — In many cases it is customary to divide glass into different " types " according to the use or shape (laboratory glass, bottle glass, optical glass, flat glass, hollow glass) and in a general way this division is a kind of classification. Another possibility is a classification according to the chemical composition. This leads to the types listed in table 1, which of course cannot be absolutely pure concerning the composition ranges.

Table 1 — Classification of main types of glass of normal bulk-production composition according to their chemical composition

Descriptors	Alkali/alkaline earth/silicate glass[1]	Borosilicate glass		Alkaline earth/alumino-silicate glass	Alkaline lead silicate glass
		Alkaline-earth free (Borosilicate glass 3.3)[2]	Containing alkaline earths (Known as “neutral glass”[3]		
Key oxides % (*m/m*)	Na_2O, CaO > 10	B_2O_3 > 8	B_2O_3 > 8	Al_2O_3 > 10	PbO > 10
Typical field of composition					
SiO_2 % (*m/m*)	70 to 75	≈ 81	≈ 75	52 to 60	54 to 58
Alkali oxides ($Na_2O + K_2O$) % (*m/m*)	12 to 16	≈ 4	4 to 8	—	up to 15
Alkaline-earth oxides % (*m/m*) (MgO + CaO + BaO + SrO)	10 to 15	—	up to 5	up to 15	up to 4
Al_2O_3 % (*m/m*)	0,5 to 2,5	2 to 3	2 to 7	17 to 25	up to 4
B_2O_3 % (*m/m*)	—	12 to 13	8 to 12	—	—
PbO % (*m/m*)	—	—	—	—	up to 35
Cœfficient of mean linear thermal expansion, $10^{-6}K^{-1}$ α (20 °C; 300 °C)	8 to 10	3.3	4 to 5	≈ 4	7 to 9
Hydrolytic resistance Acid resistance Alkali resistance	Medium, low Very high Medium	Very high Very high Medium	Very high Very high Medium	High, very high Low Low	Medium Low, medium Medium
Main fields of application	Container bottle (glass); float glass; drawn sheet glass	Laboratories for chemical, pharmaceutical and food industries[4] Technical purposes with demands for high chemical and thermoshock resistance	Pharmaceutical containers Technical purposes with demands for high chemical resistance	Purposes with demands for high thermal resistance: high-temperature thermometers, resistors capable of high thermal and electrical loading, combustion tubes	Noble table glasses; lamp stems; cathode ray tubes; radiation-shielding glass

NOTE — The given compositions are mean levels of typical glass types. They are only for information and shall not be understood as “limit values. It is known that actual glasses differ to a certain degree, which does not affect the chemophysical properties.

1) This is the oldest glass type, which makes the largest percentage of the worldwide glass production; also belonging to this type are glasses with higher BaO and SrO contents such as alkaline-earth oxides, with reduced alkali content (e.g. for X-ray protection, as used in cathode ray tube components), and also certain crystal glasses (drinking glasses).

2) In accordance with ISO 3585.

3) See ISO 4802-1 and ISO 4802-2.

4) See ISO 4803.