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## Glass — Determination of coefficient of mean linear thermal expansion

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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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7991 was prepared by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

# Glass — Determination of coefficient of mean linear thermal expansion

## 1 Scope and field of application

This International Standard specifies a method for determining the coefficient of mean linear thermal expansion of glass in the elastic solid-like state, well below the transformation temperature (see ISO 7884-8).

This International Standard applies to all glasses of normal bulk-production compositions. It does not apply to fused silica, glass ceramics or other glasses of similarly low linear thermal expansion coefficients.

## 2 References

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

IEC Publication 584-1, *Thermocouples — Part 1: Reference tables.*

## 3 Definition

For the purposes of this International Standard, the following definition applies.

**coefficient of mean linear thermal expansion,** $\alpha(t_o; t)$ : The ratio of the change in length of a specimen within a temperature interval to that temperature interval, related to the initial specimen length.

It is given by the following equation:

$$\alpha(t_o; t) = \frac{1}{l_o} \times \frac{l - l_o}{t - t_o} \qquad \ldots (1)$$

where

$t_o$ is the initial or reference temperature;

$t$ is the actual (constant or variable) specimen temperature;

$l_o$ is the length at temperature $t_o$ of the specimen of glass under test (usually a rod made from the glass);

$l$ is the specimen length at temperature $t$.

For the purposes of this International Standard, the nominal reference temperature, $t_o$, is 20 °C; therefore the coefficient of mean linear thermal expansion is denoted by $\alpha(20\ °C; t)$.

## 4 Apparatus

**4.1 Device for measuring the specimen length,** to an accuracy of 0,1 %.

**4.2 Push-rod dilatometer,** capable of determining changes in length of the specimen of $2 \times 10^{-5}\ l_o$ (i.e. 2 µm per 100 mm).

The contact force of the extensometer should not exceed 1 N. That force shall act through contacts of planes with spherical faces the radii of curvature of which shall be not less than the rod diameter of the specimen. In some special assemblies (see figure 1) parallel planes are needed.

The specimen-holding assembly shall ensure that the specimen is held firmly in position and shall prevent even small changes in its alignment with respect to the push-rod axis throughout the test (see examples given in the annex).

If the specimen-holding assembly is made of vitreous silica, see the precautions given in 7.2.

From time to time, a performance test shall be carried out using a reference material (see clause 8).

**4.3 Furnace,** compatible with the dilatometer assembly, for temperatures up to 50 °C above the expected transformation temperature. The working position of the furnace relative to the dilatometer assembly shall be defined with a repeatability of 0,5 mm in both the axial and the radial directions.

Within the range of testing temperatures (i.e. up to temperatures about 150 °C below the highest expected transformation temperature, $t_g$, and at least up to 300 °C), the furnace shall be capable of maintaining a constant temperature to ± 2 °C over the whole specimen length.

**4.4 Furnace control device,** suitable for the desired rate of increase in temperature up to (5 ± 1) °C/min within the test range (see 6.1) and for a cooling rate of (2 ± 0,2) °C/min for the annealing procedure according to 5.2.