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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 1036-2008

**Test method for coefficient of linear thermal expansion of
plastics between 30 Celsius and 30 Celsius with a vitreous
silica dilatometer**

(English Translation)

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Table of Contents

Foreword...	3
1 Scope...	5
2 Normative references...	5
3 Terms and definitions...	5
4 Principle...	6
5 Instruments...	6
6 Sample...	7
7 Specimen...	7
8 Conditioning...	8
9 Procedure...	8
10 Calculation...	9
11 Report...	9
12 Precision and deviation...	10

1 Scope

This standard specifies a method for determining the coefficient of linear expansion of plastics in the range of -30 °C ~ 30 °C using a vitreous silica dilatometer.

This standard applies to the determination of the linear expansion coefficient of plastic materials, which have a linear expansion coefficient greater than $1 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$ using a vitreous silica dilatometer.

Note: Under test temperature or pressure, plastic materials will undergo negligible creep or elastic deformation (or both), which may affect test accuracy within a certain range.

This standard is not applicable to materials with a very low linear expansion coefficient (less than $1 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$). For materials with low expansion coefficients, interferometry or capacitance techniques are recommended.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard; however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the

referenced document applies.

GB/T 2035-2008 Terms and definitions for plastics (ISO 472.1999, IDT)

GB/T 2918-1998 Plastics - Standard atmospheres for conditioning and testing (IDT
ISO 291.1997)

ASTM D4065 Standard practice for plastics. Dynamic mechanical properties.

Determination and report of procedures

3 Terms and definitions

The terms and definitions established in GB/T 2035-2008 apply to this standard.

4 Principle

This method involves placing a specimen of its original length measured into a vitreous silica dilatometer, then sequentially inserting the dilatometer into constant temperature baths at different temperatures. Once the specimen temperature and the bath temperature have reached equilibrium and the instrument reading for length changes has stabilized, the reading is recorded. The coefficient of linear expansion of the specimen can be calculated, from its expansion and contraction values.

This standard specifies $-30\text{ }^{\circ}\text{C} \sim +30\text{ }^{\circ}\text{C}$ as the general testing temperature; however, product standards may also be used. If the material has a phase transition point or glass transition point within the specified test temperature range, its coefficient of linear expansion shall be measured both above and below the transition point, to avoid excessive testing errors.

5 Instruments

5.1

Vitreous silica dilatometer. As shown in Figure 1, the distance between the inner and outer tubes shall be approximately 1 mm.

5.2

Instrument for measuring length changes. Fix it to a fixture so that its position can change with the length of the installed specimen. A certain level of accuracy is required to ensure the error is within $\pm 1.0\text{ }\mu\text{m}$. The total pressure applied to the specimen by the weight of the inner quartz tube plus the weight of the measuring instrument shall not exceed 70 kPa, to ensure that the specimen does not twist or shrink significantly.

5.3

Calipers. Capable of measuring the initial length of the specimen, which has an accuracy of $\pm 0.5\%$.

5.4 Temperature-controlled environment. Provides a constant temperature environment

for the test sample, with the temperature controlled within $\pm 0.2\text{ }^{\circ}\text{C}$.

Note: A fluid-flowing liquid bath is preferable; contact between the liquid bath and the test sample shall be avoided. If such contact cannot be avoided, choose a liquid bath that does not affect the material's physical properties.

5.5 Thermometer or thermocouple. Measure the temperature of the liquid bath using a

thermometer or thermocouple, which has an accuracy within $\pm 0.1\text{ }^{\circ}\text{C}$.

6 Sample

Prepare according to the relevant material specifications.

7 Specimen

7.1

The test specimen shall be prepared to minimize stress and anisotropy, for example, through machining, molding, or casting.

7.2

The specimen length shall be within 50 mm ~ 125 mm.

Note: If the specimen length is less than 50 mm, the sensitivity will decrease. If the length exceeds 125 mm, it will be difficult to control the temperature gradient within the aforementioned range. The length used shall be determined based on the measurement range sensitivity of the equipment, as well as the desired elongation and accuracy. Generally speaking, if the temperature is well controlled, the longer the specimen, the higher the sensitivity of the testing equipment and the higher the accuracy of the measurement results.

7.3

The specimen cross-section shall be circular, square, or rectangular, allowing for easy placement into the dilatometer without excessive friction. The cross-sectional area shall be large enough, to prevent bending or twisting. Typical specimen cross-sections are 12.5 mm x 6.3 mm or 12.5 mm x 3 mm, with a diameter of 12.5 mm or 6.3 mm.

7.4

The specimen shall be cut flat at both ends perpendicular to its long axis. If the specimen shrinks in the dilatometer, a smooth, thin sheet of iron or aluminum shall be used to secure it and help position it within the dilatometer. The sheet thickness shall be within 0.3 mm ~ 0.5 mm.

8 Conditioning

After conditioning at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and $50\% \pm 5\%$ relative humidity for at least 40 hours according to GB/T 2918-1998, the test shall be conducted. In special cases, conditioning shall be performed according to the material specifications or conditions agreed upon by both the supplier and the purchaser. In cases of dispute, the temperature deviation is $\pm 1\text{ }^{\circ}\text{C}$; the relative humidity deviation is $\pm 2\%$.

9 Procedure**9.1**

Measure the two conditioned specimens with calipers, accurate to 0.02 mm.

9.2

Attach the iron sheet to the bottom of the specimen to prevent shrinkage (see 7.4); remeasure the specimen length.

9.3

Use the same dilatometer for each specimen; carefully place it in an environment of $-30\text{ }^{\circ}\text{C}$. If using a liquid bath, ensure the specimen height is at least 50 mm below the liquid surface. Maintain the liquid bath temperature at $(-32\text{ }^{\circ}\text{C} \sim -28\text{ }^{\circ}\text{C}) \pm 0.2\text{ }^{\circ}\text{C}$. After the specimen temperature and the constant temperature bath temperature have balanced and the measuring instrument reading has stabilized for 5 ~ 10 minutes, record the measured temperature and the measuring instrument reading.

9.4

Under conditions that do not cause vibration or shaking, carefully place the vitreous silica dilatometer into an environment of $+30\text{ }^{\circ}\text{C}$. If using a liquid bath, ensure the specimen height is at least 50 mm below the liquid surface. Maintain the liquid bath temperature at a constant temperature of $(28\text{ }^{\circ}\text{C} \sim 32\text{ }^{\circ}\text{C}) \pm 0.2\text{ }^{\circ}\text{C}$. After the specimen temperature and the constant temperature bath temperature have balanced and the measuring instrument reading has stabilized for 5 ~ 10 minutes, record the measured temperature and the measuring instrument reading.