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

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**Plastics - Determination of dynamic mechanical properties -
Part 12: Non-resonance compressive vibration method
(English Translation)**

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1 Scope

This document describes a method for testing the complex compressive modulus E^* and compression loss factor of polymers in non-resonant compressive vibration modes in the range of 0.01 Hz~100 Hz. The test subjects are semi-rigid polymers with a dynamic compressive storage modulus ranging from 1 MPa to 1 GPa, and their shapes are right-angled prisms, cylinders, or tubes.

This document is applicable to the study of the compressive complex modulus of semi-rigid plastics, and also to the study of the dynamic properties of semi-rigid plastics in the glass transition region as a function of temperature and frequency.

2 Normative references

The provisions of the following documents constitute the essential clauses of this document through normative references in this text. Among them, for any dated reference, only the version corresponding to that date applies to this document; for any undated reference, the latest version (including all amendments) applies to this document.

GB/T 5471 Plastics - Compression moulding of test specimens of thermosetting materials

(GB/T 5471-2008, ISO 295.2004, IDT)

GB/T 9352 Plastic - Compression moulding of test specimens of thermoplastic materials
(GB/T 9352-2008, ISO 293.2004, IDT)

GB/T 17037.1 Plastics - Injection moulding of test specimens of thermoplastic materials -
Part 1.General principles, and moulding of multipurpose and bar test specimens (GB/T
17037-2019, ISO 294-1.2017, MOD)

GB/T 33061.1 Plastics - Determination of dynamic mechanical properties - Part 1.

General principles (GB/T 33061.1-2025, ISO 6721-1.2019, MOD)

GB/T 46607.1 Plastics - Injection moulding of test specimens of thermosetting powder
moulding compounds (PMCs) - Part 1.General principles and moulding of multipurpose test
specimens (GB/T 46607.1-2025, ISO 10724-1.1998, MOD)

3 Terms and definitions

For the purpose of this document, the terms and definitions defined in GB/T 33061.1 apply.

4 Principle

At a frequency significantly lower than the resonant frequency of the clamped/free longitudinal state, a distinct sinusoidal compressive force or deformation is applied to the specimen. The amplitudes of the force applied to the specimen and displacement, and the phase angle between them, are measured. The compressive storage modulus, compressive loss modulus, and compressive loss factor in the complex compressive modulus are then calculated.

5.1.1 General rules

The loading device shall be able to apply sinusoidal compressive force or deformation to the specimen and measure the amplitudes of the force and displacement of the specimen and the phase angle between them. The loading assembly can have different designs; Figure 1 shows a schematic diagram of one such design. The vibrator V generates a sinusoidal force, which is applied to one end of the specimen S through the compression plate C1. The amplitude and frequency of the vibration table displacement are variable and monitored by the displacement sensor D. If the specimen is placed in a temperature-controlled chamber, the component between V and C1 shall have a stiffness much higher than that of the specimen and a lower thermal conductivity.

NOTE: Each component of the loading device has much higher stiffness than the specimen, but bolted connections increase the flexibility of the equipment.

At the other end of the specimen, compression plate C2 is connected to force sensor F,

which is supported by a rigid frame. The component between C2 and F shall have sufficient stiffness and low thermal conductivity.

The aforementioned loading device can be replaced by other solutions. For example, the force on the specimen can be calculated using the current of the vibrator.

may involve the calibration of the electronic equipment (see 5.2).

5.2 Electronic data processing equipment

It shall be able to record force and displacement amplitudes, the phase angle between force and displacement cycles, and the frequency. The accuracy of force and displacement amplitudes is $\pm 0.5\%$, the accuracy of the phase angle between force and displacement cycles is $\pm 0.05^\circ$, and the accuracy of the frequency is $\pm 1\%$.

5.3 Temperature measurement and control

It shall be in accordance with GB/T 33061.1.

The test specimen and compression plate shall be placed in a temperature-controlled chamber, which shall have a passage for purging air or a suitable inert gas.

The temperature control range of the temperature control chamber shall cover the temperature variation range required by the test (e.g., $-100\text{ }^\circ\text{C}$ ~ $250\text{ }^\circ\text{C}$), and the chamber shall have programmable temperature control capability.

The accuracy of the device for measuring the temperature of the air or inert gas surrounding the specimen shall be at least $\pm 0.5\text{ }^\circ\text{C}$.

5.4 Device for measuring specimen dimensions

It shall be in accordance with GB/T 33061.1.

The accuracy of the device for measuring the dimensions of the specimen shall be at least $\pm 0.5\%$ or $\pm 0.05\text{ mm}$.

6.1 Specifications and dimensions

The specimen shape shall be a right prism or cylinder, and the size of its cross-sectional area shall be selected so that the instrument can produce the correct compressive displacement of the specimen and measure its force value within the range that meets the measurement accuracy requirements.

The influence of the specimen dimensional ratio shall be considered. The length-to-width (diameter) ratio shall be 1~2. For specimens with a large length-to-width (diameter) ratio, observe whether the specimen bends or bulges during the application of preload compressive force (see 9.4).

NOTE: The dimensions and length-to-width (diameter) ratio of the specimen will affect the test results.

A length-to-width (diameter) ratio of 1~2 is beneficial to avoid bending or bulging.

6.2 Preparation

The preparation of specimens shall be carried out in accordance with the relevant material specifications. Depending on the material and processing method (such as compression molding or injection molding), specimen preparation shall follow the provisions of GB/T 9352, GB/T 17037.1, GB/T 5471, or GB/T 46607.1. If no relevant material specifications exist, they shall be agreed upon by the relevant parties. During the processing of the specimen ends, the surfaces shall be smooth, flat, parallel, and perpendicular to the longest axis of the specimen.

When machining the end faces of the specimen, a lathe or milling machine is used to ensure that the parallelism of the two end faces of the specimen is 0.025 mm/100 mm.

When a sample exhibits significant anisotropy, specimen preparation shall be performed separately in the two principal directions.

7 Number of specimens

It shall be in accordance with GB/T 33061.1.

8 Conditioning

It shall be carried out according to GB/T 33061.1.

9.1 Test environment

Select the test temperature and gas (air or inert gas) according to the test type and purpose.

9.2 Measure the specimen dimensions and install the specimen

Before the test, select three locations along the length of the specimen and measure its width and thickness or diameter, and calculate the average cross-sectional area. The specimen length shall be accurate to $\pm 0.5\%$ or ± 0.05 mm (whichever is more accurate).

The specimen is mounted between the compression plates, with the center line of its long axis aligned with the center line of the loading device, and both ends of the specimen parallel to the surface of the compression plates.