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

GB/T 1685.1-2026

**Rubber, vulcanized or thermoplastic-Determination of stress
relaxation in compression-Part 1:Testing at constant
temperature**

硫化橡胶或热塑性橡胶 压缩应力松弛的测定 第1部分：恒定温度下试验
(English Translation)

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1 Scope

This Standard specifies two methods for determining the decrease in force of vulcanized or thermoplastic rubber when compressed to and maintained at a constant strain at a specified test temperature.

The test specimens come in two types, cylindrical and ring-shaped. Different specimen sizes and shapes yield different test results. Results can only be compared when the specimens share the same shape and dimensions.

Ring-shaped specimens are particularly suitable for determining stress relaxation in a liquid environment.

This Standard does not specify tests at temperatures below standard laboratory temperature. This method may be used for low-temperature testing, but the reliability of the results has not been verified.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) 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 528, Rubber, vulcanized or thermoplastic -- Determination of tensile stress-strain properties (GB/T 528-1998, eqv ISO 37:1994) GB/T 1690, Rubber, vulcanized or thermoplastic -- Determination of the effect of liquids (GB/T 1690-2006, ISO 1817:2005, MOD) GB/T 2941, Rubber -- General procedures for preparing and conditioning test specimens for physical test methods (GB/T 2941-2006, ISO 23529:2004, IDT) GB/T 3452.1, Fluid power systems-O-rings-Part 1: Inside diameters, cross-sections, tolerances and size identification code (GB/T 3452.1-2005, ISO 3601-1:2002, MOD) GB/T 3512, Rubber, vulcanized or thermoplastic -- Accelerated ageing and heat resistance tests (GB/T 3512-2001, eqv ISO 188:1998) GB/T 14838, Rubber and rubber products -- Determination of precision for test method standards (GB/T 14838-1993, neq ISO/TR 9272:1986) ISO 4287, Geometrical Product Specifications (GPS) -- Surface texture. Profile method -- Terms, definitions and surface texture parameters

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Compression stress relaxation

It refers to the phenomenon where the compressive force decreases over time following the application of a constant compressive deformation, expressed as a percentage of the initial force.

4 Principle

At a specified test temperature, a vulcanized or thermoplastic rubber test specimen is compressed to and maintained at a constant strain, and the reduction in compressive force is measured.

Method A. Compress the test specimen at the test temperature and measure all compressive forces at the test temperature.

Method B. Compress the test specimen at standard laboratory temperature and measure all compressive forces. The specimen is stored at the test temperature.

NOTE 1: The test results obtained using Method A and Method B are not comparable. The choice of method depends on the purpose of the test. Therefore, Method A is preferred for basic research and applications involving high-temperature sealing. Method B is recommended for applications involving temperature cycling from ambient to high temperatures.

NOTE 2: For specific purposes, other methods may be used, such as compressing the specimen at

standard laboratory temperature and measuring the compressive force at different temperatures.

5.1 Compression device

It consists of two parallel, highly polished flat plates. The plates must possess high surface smoothness, parallelism, and rigidity. The compression plates are manufactured from chrome-plated material, stainless steel, or other corrosion-resistant materials, and the specimen is compressed between the two plates.

After the compression device is disassembled, the flatness of the compression plates shall be within 0.01 mm. The surface roughness R_a shall be no coarser than 0.4 μm (see ISO 4287). When the compression device is assembled without a test specimen, the gap between the two compression plates shall not exceed 0.01 mm.

After the specimen is installed and the load is applied, the deflection of either compression plate must not exceed 0.01 mm.

The compression plates shall be of sufficient dimensions to ensure that the entire compressed specimen remains within the compression area of the plates and is able to expand freely in the lateral direction.

For ring-shaped specimens, the compression plates shall have a through-hole with a diameter of at least 2 mm at their center to allow for pressure equalization and the circulation of liquid within the ring-shaped specimen.

Connect the compression device to the appropriate equipment. Compress the test specimen to the specified amount of compression at the specified speed. Measure the compression force with an accuracy of 1%.

Throughout the test, the device is capable of adjusting and maintaining a specific amount of compression, and it can be placed inside a constant-temperature chamber set to the specified test temperature.

5.2 Force-measuring device

The force-measuring device shall be capable of measuring the applied force within the required range with an accuracy of 1%. Preference shall be given to a device capable of monitoring the compressive force throughout the entire test. Such a device allows for the continuous measurement of compressive stress variations over time. Throughout the test, the deformation of the specimen shall be maintained within ± 0.01 mm.

Another method involves using a compression testing machine to measure the applied force at specified time intervals. In this case, the force required to cause a slight increase in the compression of the test specimen is measured. This additional compression shall be kept to a minimum. In any event, for lever-type stress relaxation instruments, the applied force must not exceed 1 N. For stress-strain type stress relaxation instruments, the applied

force must not exceed the stress corresponding to a strain of 0.05 mm. The entire force generated by the additional compression on the specimen must be exerted on the force-measuring device. The measurement accuracy of the compression device must be maintained within ± 0.01 mm for each measurement.

5.3 Test chamber

The requirements of GB/T 3512 shall be met. For tests conducted in air, an air oven providing uniform heating and equipped with an appropriate temperature control device shall be used. The temperature control accuracy shall fall within the tolerance range specified in 7.2. For tests conducted in liquid, the compression device shall be fully immersed in the specified test liquid; if the liquid is volatile or toxic, the compression device shall be fully immersed within a sealed container. This ensures that the liquid can circulate freely through the central hole of the compression plate. The temperature of the test liquid shall be maintained within the specified range using a suitable controlled heater. Alternatively, the liquid and the compression device may be placed in a specified oven.

5.4 Temperature measurement device

Use sensor elements that meet the requirements. The temperature sensor shall be installed within the compression plate at a distance of no more than 2 mm from the surface of the test specimen.

6.1.1 Requirements

Test specimens are prepared by compression molding or cut from molded sheets or products in accordance with GB/T 2941.

NOTE: Data obtained using specimens of different sizes cannot be compared.

6.1.2 Cylindrical specimen

Cylindrical specimens. Type I. diameter ϕ is $10.0 \text{ mm} \pm 0.2 \text{ mm}$, height h is $10.0 \text{ mm} \pm 0.2 \text{ mm}$. Type II. diameter ϕ is $13.0 \text{ mm} \pm 0.5 \text{ mm}$, height h is $6.3 \text{ mm} \pm 0.3 \text{ mm}$.

NOTE: The results obtained from the two types of specimens cannot be compared.

6.1.3 Ring-shaped specimen

Ring-shaped test specimens can be cut from flat test material using a rotary cutter. The cross-section is square. Equipment suitable for preparing small ring-shaped test specimens is described in Annex B of GB/T 528.

Specimen dimensions.

Thickness. $2.0 \text{ mm} \pm 0.2 \text{ mm}$ Inner diameter. $15.0 \text{ mm} \pm 0.2 \text{ mm}$ Radial width. $2.0 \text{ mm} \pm 0.2$