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

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**Rubber, vulcanized or thermoplastic -- Resistance to ozone
cracking -- Static strain test
(English Translation)**

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1 Scope

This Standard specifies procedures intended for use in estimating the resistance of vulcanized or thermoplastic rubbers to cracking when exposed, under static tensile strain, to air containing a definite concentration of ozone and at a definite temperature in circumstances that exclude the effects of direct light.

This Standard applies to rubber, vulcanized or thermoplastic.

NOTE Great caution is necessary in attempting to relate standard test results to service performance since the relative ozone resistance of different rubbers can vary markedly depending on the conditions, especially ozone concentration and temperature. In addition, tests are carried out on thin test pieces deformed in tension and the significance of attach for articles in service can be quite different owing to the effects of size and of type and magnitude of the deformation.

Explanatory notes on the natural ageing under ozone cracking are given in Annex

A.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition dated applies to this document. For undated references, the latest edition of the referenced document (including any amendments)

applies to this Standard.

GB/T 528-2009, Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties (ISO 37.2005, IDT)

GB/T 2941-2006, Rubber - General procedures for preparing and conditioning test pieces for physical test methods (ISO 23529.2004, IDT)

GB/T 11206-2009, Standard test method for rubber deterioration - Surface cracking

3 Terms and definitions

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

3.1

threshold strain highest tensile strain at which a rubber can be exposed at a given temperature to air containing a given concentration of ozone without ozone cracks developing on it after a given exposure period

4 Principle

Test pieces of rubber vulcanized or thermoplastic are exposed, under static tensile strain, in a closed chamber at a constant temperature, to an atmosphere containing a fixed concentration of ozone. The test pieces are examined periodically for cracking.

Three alternative evaluation procedures are described for selected values of ozone concentration and exposure temperature.

5.1 Test chamber

This shall be a closed, non-illuminated chamber, thermostatically controlled to within $\pm 2^{\circ}\text{C}$ of the test temperature, lined with, or constructed of, a material (for example aluminium) that does not readily decompose ozone. The chamber can be provided with a window through which the surface of the test pieces can be observed. A light to examine test pieces can be installed, but this shall remain switched off at all other times.

5.2 Source of ozonized air

The ozonized air shall be largely free of nitrogen oxides in order to avoid errors in the ozone concentration.

One of the following items of apparatus shall therefore be used.

5.3 Means of adjusting the ozone concentration

When an ultra-violet lamp is used, the ozone concentration can be controlled by adjusting either the voltage applied to the tube or the input-gas flow rate, or by shielding part of the

tube from the UV light.

5.4 Means of determining the ozone concentration

A means of sampling the ozonized air from the vicinity of the test pieces in the chamber and a means of estimating the ozone content are specified in ISO 1431-3. If required, the methods given in Annex B can also be a reference.

5.5 Means of adjusting the gas flow

A mechanism shall be provided that is capable of adjusting the average velocity of the flow of ozonized air in the test chamber to a value of not less than 8 mm/s and preferably to a value between 12 mm/s and 16 mm/s, calculated from the measured gas flow rate in the chamber divided by the effective cross-sectional area of the chamber normal to the gas flow.

5.6 Mounting test pieces for static strain testing

Clamps shall be provided to hold the test pieces at the required elongation and with both sides in contact with the ozonized air in such a manner that the longitudinal axis of each test piece is substantially parallel to the direction of gas flow. The clamps shall be made of a material (for example aluminium) which does not readily decompose ozone.

6 Test pieces

6.1

Standard test pieces shall be as specified in 6.2 or 6.3.

Test pieces shall be cut from moulded sheet, or, if required, from a finished product, in accordance with GB/T 2941-2006. Test pieces shall have an undamaged test surface; ozone resistance shall not be assessed on surfaces that have been cut or buffed.

6.2 Wide test piece

This test piece shall consist of a strip of not less than 10 mm in width, of thickness $2.0 \text{ mm} \pm 0.2 \text{ mm}$ and of length not less than 40 mm between the grips before stretching.

The ends of the test piece held in the grips can be protected with an ozone-resistant lacquer. Care shall be taken when selecting the lacquer to ensure the solvent used does not appreciably swell the rubber.

6.3 Narrow test piece

This test piece shall consist of a strip of width $2.0 \pm 0.2 \text{ mm}$, thickness $2.0 \pm 0.2 \text{ mm}$ and length 50 mm, between enlarged tab ends 6.5 mm square (see Figure 3). This test piece shall not be used for procedure A.

7.1 Conditioning in the unstrained state

For all tests, the minimum time between vulcanization and straining of the test pieces shall be 16 h.

7.2 Conditioning in the strained state

After stretching, the test pieces shall be conditioned for a period of between 48 h and 96 h in an essentially ozone-free atmosphere in the dark; the temperature for this conditioning shall normally be a standard laboratory temperature (see GB/T 2941-2006), but other temperatures can be used if appropriate for particular applications.

The test pieces shall not be touched or otherwise disturbed in any way during the conditioning period.

8.1 Ozone concentration

The test shall be carried out at one of the following ozone concentrations, expressed in volume fraction.

8.2 Temperature

The preferred test temperature is $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Other temperatures, such as $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$ or $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$, can be used if they are more representative of the anticipated service environment, but the results obtained will differ from those obtained at $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

8.3 Relative humidity

The relative humidity of the ozonized air shall normally be not more than 65% at the test temperature.

8.4 Maximum elongation

Tests shall normally be carried out using one or more of the following strain levels.

$(5 \pm 1) \%$, $(10 \pm 1) \%$, $(15 \pm 2) \%$, $(20 \pm 2) \%$, $(25 \pm 2) \%$, $(30 \pm 2) \%$, $(40 \pm 2) \%$, $(50 \pm 2) \%$, $(60 \pm 2) \%$, $(80 \pm 2) \%$

9.1 General

Adjust the rate of flow and temperature of the ozonized gas and its ozone concentration to that required and place the strained test pieces suitably conditioned, in the test chamber. Maintain the test conditions at the required levels.