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Rubber, vulcanized or thermoplastic — Resistance to ozone cracking

Part 1:
Static and dynamic strain testing

Caoutchouc vulcanisé ou thermoplastique — Résistance au craquelage par l'ozone

Partie 1: Essais sous allongement statique et dynamique

FDIS stage

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Foreword

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This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This seventh edition cancels and replaces the sixth edition (ISO 1431-1:2022), which has been technically revised.

The main changes are as follows:

— ~~—~~ sealing edges of a test piece has been added in ~~7.1;~~7.1;

— ~~—~~ ~~Annex D~~Annex D has been added.

A list of all parts in the ISO 1431 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at ~~www.iso.org/members.html~~www.iso.org/members.html.

Introduction

Ozone is generally present in small amounts in the atmosphere. However, even very small amounts of ozone can cause cracking in susceptible rubbers under tensile strain, resulting in loss of strength. Hence, it is necessary to test the resistance of rubbers to exposure to ozone.

Because of the uncertainties of natural exposure, testing for ozone resistance of rubbers is normally done in the laboratory using specially designed ozone cabinets.

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, temperature and relative humidity [5]. [5] In addition, tests are carried out on thin test pieces deformed in tension and the significance of attack for articles in service can be quite different owing to the effects of size and of the type and magnitude of the deformation.

Explanatory notes on the nature of ozone cracking are given in Annex A. Annex A.

Rubber, vulcanized or thermoplastic- — Resistance to ozone cracking — —

Part 1: Static and dynamic strain testing

WARNING 1 — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of any other restrictions.

WARNING 2 — Certain procedures specified in this document can involve the use or generation of substances, or the generation of waste, that can constitute a local environmental hazard. Reference should be made to appropriate documentation on safe handling and disposal after use.

1 Scope

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

~~Visual~~Either visual observation ~~and/~~or image analysis, or both, are used to evaluate the formation and growth of cracks. The changes in physical or chemical properties resulting from exposure can also be determined.

Reference and alternative methods for determining the ozone concentration are described in ISO 1431-3.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1382, *Rubber — Vocabulary*

ISO 1431-~~-~~3, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 3: Reference and alternative methods for determining the ozone concentration in laboratory test chambers*

ISO 18899~~:2013~~, *Rubber — Guide to the calibration of test equipment*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1382 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— —ISO Online browsing platform: available at https://www.iso.org/obphttps://www.iso.org/obp

— —IEC Electropedia: available at https://www.electropedia.org/https://www.electropedia.org/

3.1
threshold strain
highest tensile strain at which 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

Note 1 to entry: It is important to distinguish threshold strain from *limiting threshold strain* (3.2).(3.2).

3.2
limiting threshold strain
tensile strain below which the time required for the development of ozone cracks increases very markedly and can become virtually infinite

3.3
dynamic strain
strain (normally a tensile strain) varying sinusoidally with time at somea selected repetition rate or frequency

Note 1 to entry: The maximum strain and the repetition rate are used to describe the dynamic strain conditions.

4 Principle

Test pieces are exposed, under static tensile strain, under continuous dynamic strain or under alternate periods of dynamic and static strain, in a closed chamber at a specified temperature and, at high or unspecified humidity, to an atmosphere containing a fixed concentration of ozone. The test pieces are examined periodically for cracking.

Three alternative procedures are described for exposure and evaluation of cracking:

a) a) The presence or absence of cracks is determined after exposure for a fixed period of time at a given static strain, dynamic strain or combination of dynamic and static strains. The presence or absence of cracks is determined by either visual observation and/or image analysis, or both. If required, an estimate of the degree of cracking is made.

   If required, after the exposure, physical or chemical properties are measured to determine the deterioration of the sample materials by comparing with those of the original pieces.

b) b) The time tountil the first appearance of cracks is determined at any given static strain, dynamic strain or combination of dynamic and static strains.

c) c) The threshold and limiting threshold strain are determined for any given exposure period by either visual observation and/or image analysis (valid only for static tensile strain tests).), or both.

5 Apparatus

WARNING — Attention is drawn to the highly toxic nature of ozone. Efforts should be made to minimize the exposure of workers at all times. In the absence of more stringent or contrary national safety regulations in the user's country, it is recommended that 0,1 parts of ozone per million parts of air of the surrounding atmosphere by volume be regarded as an absolute maximum concentration, while

the maximum average concentration should be appreciably lower. Unless a totally enclosed system is being used, an exhaust vent to remove ozone-laden air is advised.

The usual laboratory apparatus and, in particular, the following shall be used.

5.1 Test chamber without humidity control. This shall be a closed, non-illuminated chamber, thermostatically controlled to within ±2 °C of the test temperature, lined with, or constructed of, a material (e.g. aluminium) that does not readily decompose ozone. The dimensions shall be such that the requirements of ~~5.7~~5.7 are met. The chamber may be provided with a window through which the surface of the test pieces can be observed. A light to examine test pieces may be installed, but this shall remain switched off at all other times. ~~See Figure 1.~~See Figure 1.