INTERNATIONAL STANDARD

ISO 12493

First edition
2011-07-15

Rubber, vulcanized — Determination of stress in tension upon heating

Caoutchouc vulcanisé — Détermination de la contrainte en traction lors du chauffage

Reference number
ISO 12493:2011(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12493 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

Introduction

Vulcanized rubber held under a constant stress will contract as the test temperature is raised, while a test piece held under a constant strain will develop an increased stress. These are features of the Gough-Joule effect in rubber and, unless they are taken into account at the design stage, any resulting changes in forces and dimensions can affect the performance of some products, such as rotary seals, used at high temperatures and high strains (see Reference [1] in the Bibliography).

This International Standard describes a test method for the determination of the change in tensile stress that results from an increase in test temperature.

Rubber, vulcanized — Determination of stress in tension upon heating

1 Scope

This International Standard specifies a method for measuring the stress in tension which is developed in vulcanized rubber when it is heated (thermal stress). The thermal stress is measured for various pre-strain and temperature conditions as a function of time.

2 Normative references

The following referenced documents are indispensable for the application 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 5893, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

ISO 18899:2004, *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 following terms and definitions apply.

3.1
thermal stress
σ_T
force per initial unit area which is developed in the test piece upon heating

NOTE It is expressed in N/m^2 or Pa.

3.2
maximum thermal stress
max. σ_T
peak value of the thermal stress recorded during the test

3.3
thermal stress after a specified time
$\sigma_{T,\,t}$
stress induced in the test piece upon heating for a specified time t

3.4
pre-strain
elongation to which the test piece is subjected at the beginning of the test

NOTE It is expressed as pre-strain = $\frac{l_f - l_i}{l_i}$

where

l_i is the initial length;

l_f is the length after elongation.

3.5
pre-stress
force per initial unit area which results from the pre-strain

NOTE It is expressed in N/m^2 or Pa.

4 Principle

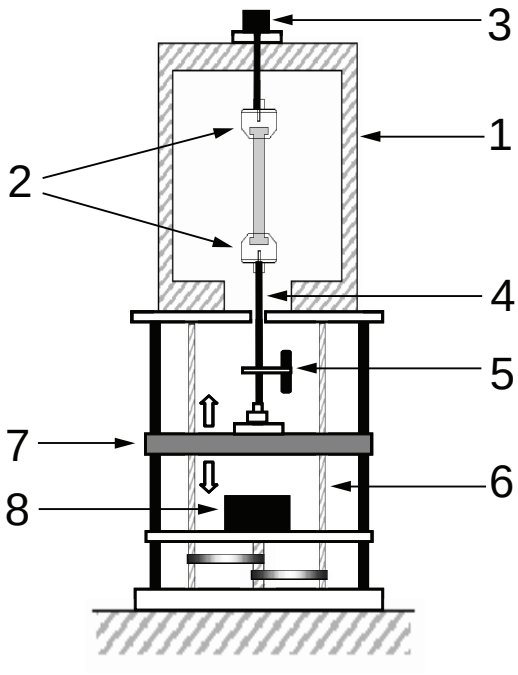
A test piece is held at a constant pre-strain in a tensile mode at standard laboratory temperature. When the pre-stress resulting from the given pre-strain has reached an apparent equilibrium value, the temperature of the test piece is increased. The thermal stress developed at the elevated temperature is measured for various pre-strain conditions as a function of time.

5 Apparatus

5.1 Thermal-stress testing machine

An example of a test machine for measuring the thermal stress developed in rubbery materials when heated is shown in Figure 1. Two clamps hold the test piece in a temperature-controlled chamber, with the upper clamp connected to a load cell and the bottom clamp connected to a crosshead. The crosshead is moved using a screw driven by a motor to impose a pre-strain on the test piece. The thermal stress developed when the temperature is raised is transmitted to the load cell and the output is recorded to give the variation in stress as a function of time.

The test machine shall comply with ISO 5893 with force measurement to class 1 and the machine shall be capable of setting the pre-strain to within ±0,1 at a speed of (20 ± 2,5) mm/min.



Key

1 temperature-controlled chamber
2 clamps
3 load cell
4 rod
5 linear variable differential transformer
6 screw
7 crosshead
8 motor

Figure 1 — Example of thermal-stress testing machine

5.2 Temperature-controlled chamber

The temperature-controlled chamber shall be capable of raising the temperature at a rate of at least 30 °C/min and maintaining the test piece at the required temperature as specified in ISO 23529. A suitable volume for the chamber is 3 litres to 5 litres. A temperature-sensing device shall be located within the chamber near the test piece.

5.3 Thickness- and width-measuring devices

Instruments for measuring the thickness and width of the test piece shall be in accordance with ISO 23529.

6 Calibration

The test apparatus shall be calibrated in accordance with the schedule given in Annex A.

7 Test piece

7.1 Dimensions

The test piece shall be prepared by cutting from moulded flat sheet and shall have the shape and dimensions shown in Figure 2. In addition, the thickness shall be (2 ± 0,2) mm. The test piece shall have a smooth surface and be free from irregularities.