INTERNATIONAL STANDARD

ISO 4666-4

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Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing —

Part 4:
Constant-stress flexometer

Caoutchouc vulcanisé — Détermination de l'élévation de température et de la résistance à la fatigue dans les essais aux flexomètres —

Partie 4: Flexomètre à contrainte constante

Reference number
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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.

ISO 4666-4 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

ISO 4666 consists of the following parts, under the general title *Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing*:

— *Part 1: Basic principles*

— *Part 2: Rotary flexometer*

— *Part 3: Compression flexometer*

— *Part 4: Constant-stress flexometer*

Introduction

This part of ISO 4666 describes a method of compression flexometer testing with constant-stress dynamic loading. The features and usefulness of constant-stress flexometer testing are as follows:

a) In order to exactly simulate the behaviour of a rubber product in use, an important consideration is where the temperature is measured. The constant-stress flexometer measures the temperature directly at the centre of the inside of the test piece (the source of heat generation), using a device as shown in Figure 4 of this part of ISO 4666, while in Part 3 of this International Standard the temperature is measured on the surface of the test piece.

b) A servo control system based on real-time feedback of the strain or stress is used to enable the measurement of dynamic properties (viscoelastic parameters) of the rubber as a function of time during the test run.

c) The accumulation of feedback information allows the detection of an initial stage, or the first signs of breakdown due to heat generation, which was once thought to be very difficult.

It has been reported [1] how well the rise in tyre temperature correlates with the temperature rise in the constant-stress flexometer test in comparison with the result from the method in Part 3 of this International Standard.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning the flexometer specified in Clause 5.

ISO takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured ISO that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information may be obtained from:

Bridgestone Corporation, 3-1-1 Ogawahigashi-Cho, Kodaira-Shi, Tokyo 187-8531, Japan.

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

Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing —

Part 4: Constant-stress flexometer

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard 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 ensure compliance with any national regulatory conditions.

1 Scope

This part of ISO 4666 specifies a constant-stress flexometer test for the determination of the temperature rise and resistance to fatigue of vulcanized rubbers.

Many rubber products, such as tyres and belts, are tested by subjecting them to an oscillating load with a constant peak stress amplitude. In order to obtain good correlation between accelerated tests and in-service exposure of these products, this part of ISO 4666 gives instructions for carrying out measurements under such conditions.

This method is not recommended for rubber having a hardness greater than 85 IRHD.

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 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 4664-1, *Rubber, vulcanized or thermoplastic — Determination of dynamic properties — Part 1: General guidance*

ISO 4666-1, *Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing — Part 1: Basic principles*

ISO 4666-3, *Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing — Part 3: Compression flexometer*

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 4664-1 and ISO 4666-1 apply.

4 Principle

A cylindrical test piece is subjected to dynamic loading with constant peak stress cycles in compression superimposed on a static prestress.

The temperature rise of the test piece is measured, and the fatigue life of the test piece is given by the number of cycles, or the test time, until breakdown occurs. The change in height (creep) and dynamic properties are also measured as a function of time, and the compression set is measured at the end of the test.

5 Apparatus

The apparatus is shown schematically in Figure 1, and an example is shown in Figure 2.

5.1 Anvils

A pair of anvils (upper and lower) support the test piece. The lower anvil is connected to an oscillator to apply static and dynamic compression deformation to the test piece, and the upper anvil transmits the static and dynamic compression loads, via a shaft, to a load detector. The parts of the upper and lower anvils which come in contact with the test piece shall be made of a heat-insulating material of thermal conductivity 0,28 W/(m·K) maximum. A hole shall be provided in the centre of the upper anvil for insertion of a needle-type thermometer for measuring the temperature inside the test piece. An example of upper and lower anvil construction is shown in Figure 3.

5.2 Oscillator

The oscillator used to apply static and dynamic compression loads to the test piece shall have a capacity of at least 2 kN and be capable of applying an oscillating force of 0,75 kN peak amplitude at 50 Hz.

A hydraulic servo-control system is preferably used to control the oscillator.

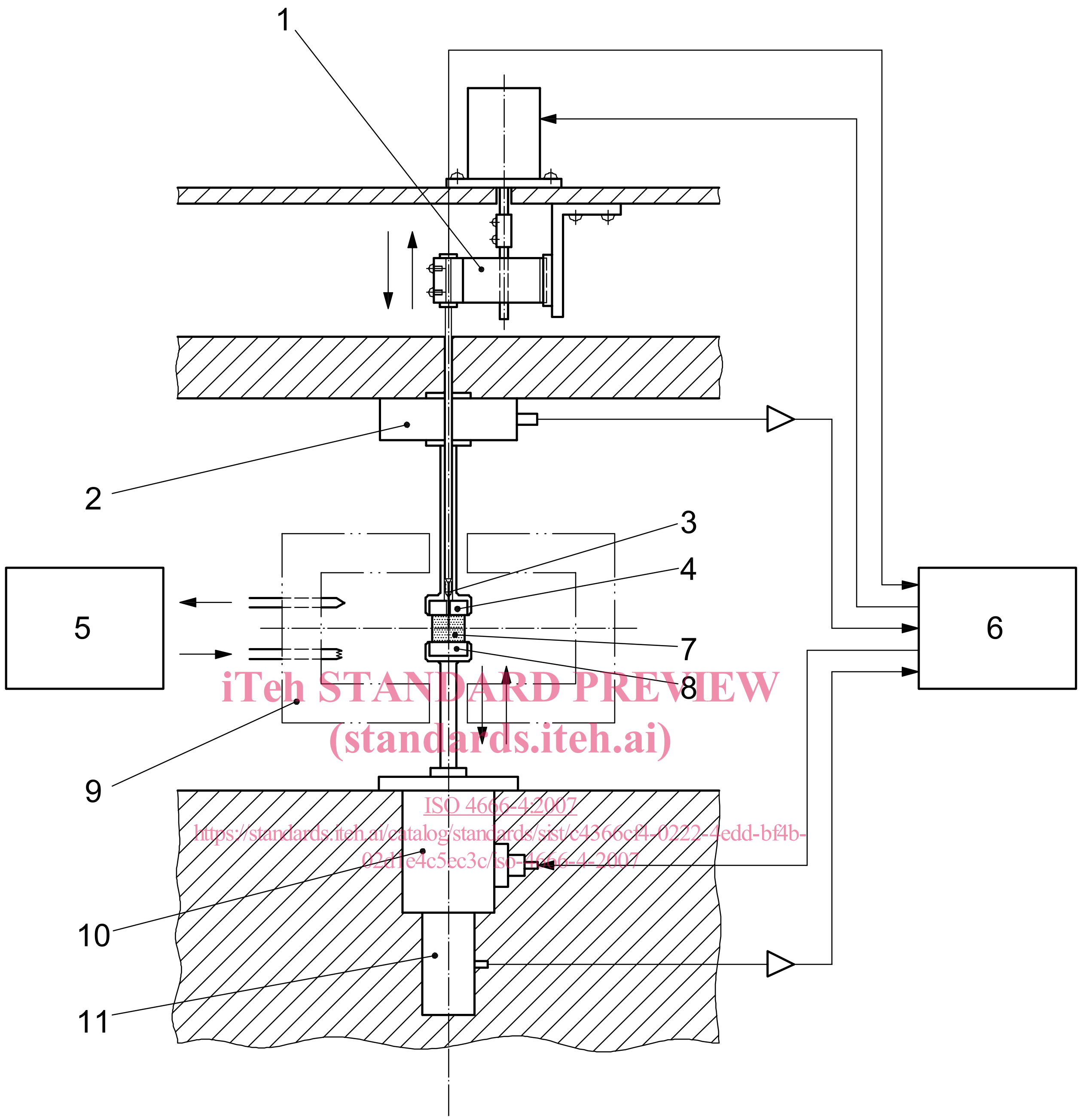
The maximum stroke is preferably 20 mm to 25 mm.

5.3 Displacement detector

The displacement detector shall be capable of measuring the motion of the lower anvil (the deformation of the test piece in compression) to within 0,01 mm, and shall have a response time suitable for the maximum frequency used.

5.4 Load detector

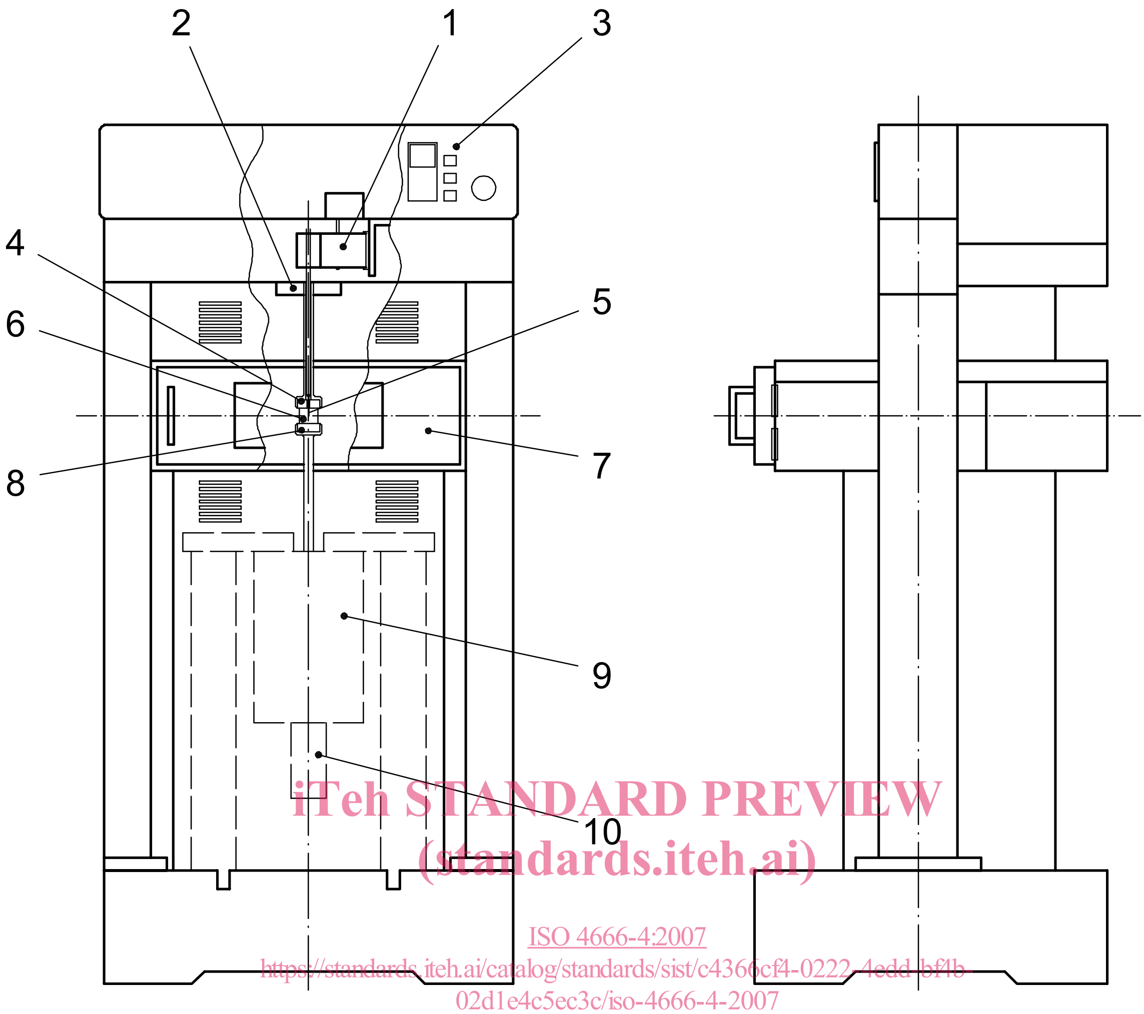
The load detector shall be capable of measuring the compression load up to a maximum of 2,0 kN in 5 N increments, shall have a response time suitable for the maximum frequency used, and shall have a high natural frequency.



Key

1 position controller
2 load detector
3 needle-type temperature detector
4 upper anvil
5 temperature controller
6 computer control unit
7 test piece
8 lower anvil
9 heating chamber
10 oscillator
11 displacement detector

Figure 1 — Principle and fundamental structure of a constant-stress flexometer

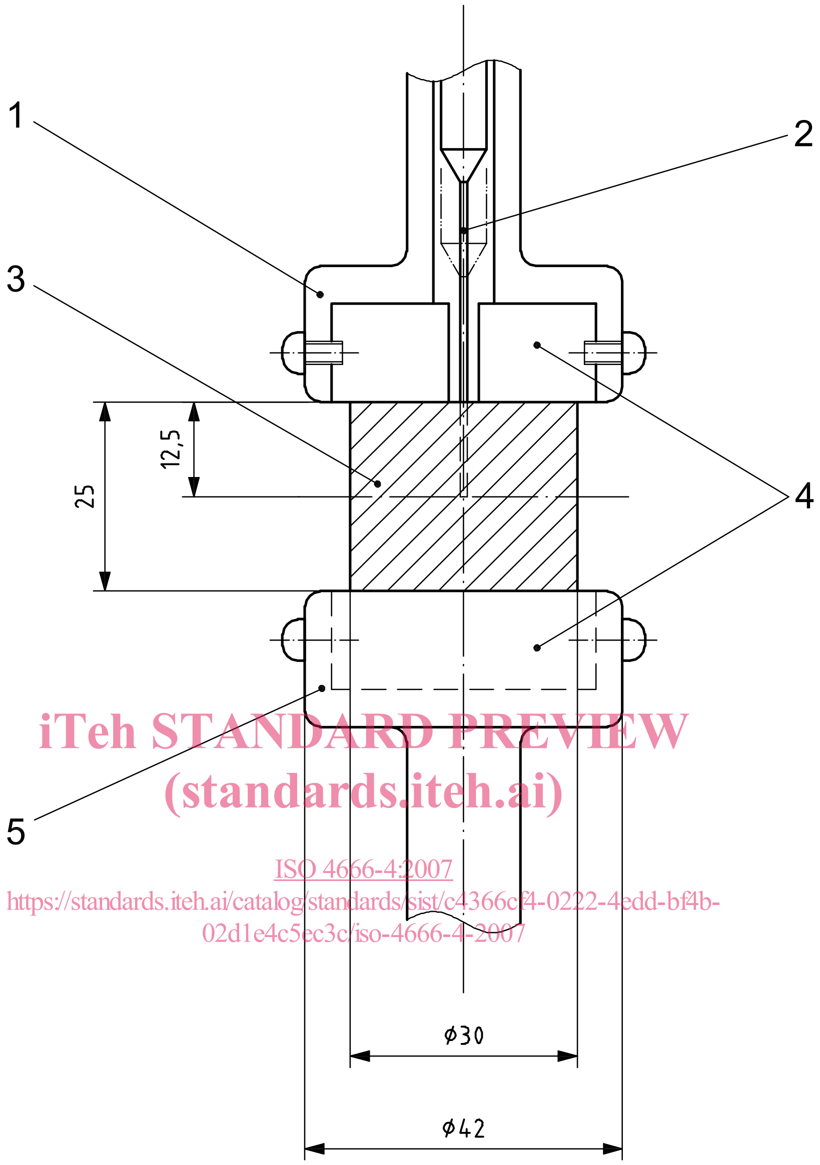


Key

1 position controller
2 load detector
3 temperature controller
4 upper anvil
5 needle-type temperature detector
6 test piece
7 heating chamber
8 lower anvil
9 oscillator
10 displacement detector

Figure 2 — An example of a constant-stress flexometer

Dimensions in millimetres



Key

1 upper anvil

2 needle-type temperature detector

3 test piece

4 thermal insulator

5 lower anvil

Figure 3 — An example of upper and lower anvils for a constant-stress flexometer