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## Rubber, vulcanized or thermoplastic — Resistance to weathering

*Caoutchouc vulcanisé ou thermoplastique — Résistance aux  
intempéries*

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# Contents

	Page
<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Principle</b> .....	<b>2</b>
<b>5 Exposure to direct weathering, to weathering using glass-filtered daylight or to intensified weathering by daylight using Fresnel mirrors</b> .....	<b>2</b>
<b>6 Exposure to laboratory light sources</b> .....	<b>2</b>
<b>7 Changes in colour</b> .....	<b>3</b>
7.1 Apparatus.....	3
7.1.1 Instrumental assessment.....	3
7.1.2 Visual assessment.....	3
7.2 Test piece.....	3
7.3 Procedure.....	3
7.3.1 General.....	3
7.3.2 Instrumental assessment.....	3
7.3.3 Visual assessment.....	3
<b>8 Changes in other appearance properties</b> .....	<b>3</b>
<b>9 Changes in physical properties</b> .....	<b>3</b>
9.1 General.....	3
9.2 Apparatus.....	4
9.3 Test pieces.....	4
9.4 Procedure.....	4
<b>10 Expression of results</b> .....	<b>4</b>
10.1 Change in colour.....	4
10.1.1 Instrumental measurements.....	4
10.1.2 Visual measurements.....	4
10.2 Changes in other appearance properties.....	5
10.3 Changes in physical properties.....	5
<b>11 Test report</b> .....	<b>6</b>
<b>Annex A (informative) Weathering reference materials</b> .....	<b>7</b>
<b>Annex B (informative) Some properties which can be determined to assess change after exposure</b> .....	<b>10</b>
<b>Bibliography</b> .....	<b>11</b>

## 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This third edition cancels and replaces the second edition (ISO 4665:2006), which has been technically revised with the following changes:

- normative references have been updated, small editorial changes made for clarification and compression set added to mechanical properties that could be measured.

## Introduction

A number of different exposure techniques can be used to provide information on the effects of environmental stresses such as light, heat, and water on rubbers. Each of these has its own particular application and relevance. Explanation of, and guidance on, methods for exposure to natural and artificial weathering is given in ISO 877-1 and ISO 4892-1. Particular guidance on exposure to determine resistance to ozone is given in ISO 1431-1. The methods for exposure to weathering standardized for plastic materials are essentially suitable for rubbers, and hence this International Standard refers to the relevant ISO standards for plastics for the apparatus and procedures.

It is desirable that the procedures for the determination of changes in properties are the same whatever exposure is used and that the results should be expressed in a uniform manner. Such procedures are specified in this International Standard.

Exposure to weathering alters the properties of the material, particularly in the surface layer. The test method used to determine changes in properties should be selected after consideration of the properties of the material which are important in its proposed application and taking into account the fact that degradation might be concentrated at the surface layer. The methods chosen ought to be capable of measuring change in properties with sufficient precision within the ranges which are important in practice, so as to provide significant criteria of change.

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# Rubber, vulcanized or thermoplastic — Resistance to weathering

## 1 Scope

This International Standard specifies methods for the exposure of vulcanized or thermoplastic rubbers to natural or artificial weathering and methods for the determination of changes in colour, appearance, and physical properties resulting from exposure.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 877-1:2009, *Plastics — Methods of exposure to solar radiation — Part 1: General guidance*

ISO 877-2:2009, *Plastics — Methods of exposure to solar radiation — Part 2: Direct weathering and exposure behind window glass*

ISO 877-3:2009, *Plastics — Methods of exposure to solar radiation — Part 3: Intensified weathering using concentrated solar radiation*

ISO 1431-1, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing*

ISO 4892-1, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 4892-4, *Plastics — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon-arc lamps*

ISO 18314-1, *Analytical colorimetry — Part 1: Practical colour measurement*

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 877 and ISO 4892 and the following apply.

### 3.1

#### control

material exposed alongside the test material for comparison

Note 1 to entry: The control, for example, may be a material of similar or related composition to the test material or a material having a known response to the exposure conditions.

### 3.2

#### **file test piece**

portion of the material to be tested which is stored under conditions in which it is stable and is used for comparison between the exposed and the original state

### 3.3

#### **masked area**

portion of the exposed test piece which is protected from light exposure by masking

### 3.4

#### **weathering reference material**

reference material whose weathering degradation properties are well documented and repeatable when exposed to identical conditions

### 3.5

#### **exposure stage**

interval of exposure between determinations of change in properties, expressed as time or radiant exposure

## 4 Principle

Test pieces are exposed to natural or artificial weathering and the resulting changes in colour, appearance, and selected physical properties are determined.

## 5 Exposure to direct weathering, to weathering using glass-filtered daylight or to intensified weathering by daylight using Fresnel mirrors

Carry out the exposure in accordance with the relevant method of ISO 877, with the following additions and modifications:

- For tests under strain, prepare the test pieces and place them under strain in accordance with ISO 1431-1.
- It is recommended that one or more of the weathering reference materials described in [Annex A](#) be used as a control, the material selected depending on the type of rubber compound under test. The effects of natural weathering on these materials in a range of climates are detailed in Reference [1] and Reference [2].
- Condition the test pieces in accordance with ISO 23529.

## 6 Exposure to laboratory light sources

Carry out the exposure in accordance with ISO 4892-1 and, as relevant, ISO 4892-2, ISO 4892-3, or ISO 4892-4, with the following additions and modifications:

For tests under strain, prepare the test pieces and place them under strain in accordance with ISO 1431-1.

It is recommended that one or more of the weathering reference materials described in [Annex A](#) be used as a control, the material selected depending on the type of rubber compound under test. The effects of natural weathering on these materials in a range of climates are detailed in Reference [1] and Reference [2].

Condition the test pieces in accordance with ISO 23529.

NOTE 1 The general guidance on weathering of plastics given in ISO 4892-1 is applicable to rubbers.

NOTE 2 In general, an open-flame carbon-arc lamp is not recommended because it is not representative of sunlight.



## 7 Changes in colour

### 7.1 Apparatus

#### 7.1.1 Instrumental assessment

Use a colour or colour change apparatus meeting the requirements described in ISO 18314-1.

#### 7.1.2 Visual assessment

Use the grey scale in accordance with ISO 105-A02.

### 7.2 Test piece

The test piece shall be in any form which allows sufficient flat area for the determination of colour change.

NOTE It is convenient to use a test piece required for the determination of change in physical properties.

### 7.3 Procedure

#### 7.3.1 General

The choice of instrumental or visual assessment of colour change shall be made by agreement between the interested parties.

#### 7.3.2 Instrumental assessment

Measure the colour of the test piece before and after each exposure stage in general accordance with ISO 18314-1. If required, also measure the colour of a file test piece or a masked area.

#### 7.3.3 Visual assessment

Compare the contrast rating of the exposed test piece and an unexposed file test piece, and if required, a masked area, after each exposure stage, in accordance with the procedure given in ISO 105-A02.

## 8 Changes in other appearance properties

Examine each test piece visually after each exposure stage for changes in appearance using, if appropriate, the procedure given in a relevant International Standard. Some examples of parameters used to assess change in appearance are listed in [Annex B](#).

Ozone cracking shall be assessed in accordance with ISO 1431-1.

NOTE Cracking or crazing in rubber test pieces exposed outdoors can result from light ageing as well as from ozone attack. A distinction is not always possible, particularly with light-coloured rubbers. Sunlight crazing is characterized by shallow cracks and usually occurs independently of strain, whereas a threshold strain has to be exceeded for ozone cracking to occur. Where there is doubt, it is useful to expose an unstrained test piece alongside the strained test piece for comparison.

## 9 Changes in physical properties

### 9.1 General

The properties measured may be those specified in an International Standard for the material or as agreed between the interested parties. Some suitable properties are listed in [Annex B](#).