SLOVENSKI STANDARD
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Polimerni materiali - Metode izpostavitve vremenskim vplivom - 1. del: Splošna navodila (ISO/DIS 877-1:2016)

Plastics - Methods of exposure to solar radiation - Part 1: General guidance (ISO/DIS 877-1:2016)

Kunststoffe - Freibewitterung - Teil 1: Allgemeine Anleitung (ISO/DIS 877-1:2016)

Plastiques - Méthodes d'exposition au rayonnement solaire - Partie 1: Lignes directrices générales (ISO/DIS 877-1:2016)

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Plastics — Methods of exposure to solar radiation —

Part 1:
General guidance

Plastiques — Méthodes d'exposition au rayonnement solaire —

Partie 1: Lignes directrices générales

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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.

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).

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).

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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 61/SC 6.

Together with the other parts (see below), it cancels and replaces ISO 877:2009, which has been technically revised.

ISO 877 consists of the following parts.

— *Part 1: General guidance*

— *Part 2: Direct weathering and exposure behind window glass*

— *Part 3: Intensified weathering using concentrated solar radiation*

Introduction

Outdoor-exposure tests of the type specified in the three parts of this International Standard are needed to evaluate the performance of plastics when exposed to solar radiation. The results of such tests should be regarded only as an indication of the effect of exposure to direct weathering (ISO/DIS 877-2:2016, method A) or to indirect weathering using glass-filtered solar radiation (ISO/DIS 877-2:2016, method B) or to intensified solar radiation (ISO 877-3) by the methods described. Results from tests conducted in accordance with any of the parts of this International Standard will show some variability when comparing results from repeat exposures conducted at the same location at a different time. This is much more important for materials that show significant change after a year or less of exposure. In general, results from repeat exposures at the same location are necessary to determine the range of performance of a material subjected to exposure to solar radiation as specified in this International Standard. Since the type of climate can have a significant effect on the rate and type of degradation, results from exposures conducted in different types of climate are necessary to fully characterize the outdoor durability of a material. For solar-concentrating exposures conducted in accordance with ISO 877-3, exposure duration is defined in terms of the total solar UV radiant exposure because of the annual and seasonal variations in solar ultraviolet radiation.

Fresnel-reflecting concentrators of the type described in ISO 877-3, which employ solar radiation as the source of ultraviolet radiation, are utilized to provide accelerated outdoor-exposure testing of many plastics materials.

A system of classifying and characterizing climates in different parts of the world is given in Annex A.

The test method chosen is usually that designed to expose the material to the most severe conditions associated with any particular climate. It should, therefore, be borne in mind that the severity of exposure in actual use is, in most cases, likely to be less than that specified in this International Standard, and allowance should be made accordingly when interpreting the results. For example, vertical exposure at 90° from the horizontal is considerably less severe in its effects on plastics than near-horizontal exposure, particularly in tropical regions, where the sun is most powerful at high zenith angles.

Polar-facing surfaces are much less likely to be degraded than equator-facing surfaces because they are less exposed to solar radiation. However, the fact that they may remain wet for longer periods may be of significance for materials affected by moisture or for materials that are susceptible to microbial growth.

Plastics — Methods of exposure to solar radiation —

Part 1: General guidance

1 Scope

This part of ISO 877 provides information and general guidance on the selection and use of the methods of exposure to solar radiation described in detail in subsequent parts of ISO 877. These methods of exposure to solar radiation are applicable to plastics materials of all kinds as well as to products and portions of products.

It also specifies methods for determining radiant exposure.

It does not include direct weathering using black-box test fixtures, which simulate higher end-use temperatures in some applications.

NOTE ASTM G 7 [1] and ASTM D 4141 [2] describe black-box exposure tests.

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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 472, *Plastics — Vocabulary*

ISO/DIS 877-2:2016, *Plastics — Methods of exposure to solar radiation — Part 2: Direct weathering and exposure behind window glass*

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

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 4582, *Plastics — Determination of changes in colour and variations in properties after exposure to daylight under glass, natural weathering or laboratory light sources*

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

ISO 9370:2009, *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

ASTM G 179, *Standard Specification for Metal Black Panel and White Panel Temperature Devices for Natural Weathering Tests*

ASTM G 183, *Standard Practice for Field Use of Pyranometers, Pyrheliometers and UV Radiometers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 4892-1, and ISO 9370 and the following apply.

3.1
natural weathering
outdoor exposure of materials to unconcentrated sunlight, the purpose of which is to assess the effects of environmental factors on various functional and decorative parameters of interest.

4 Priciple

Specimens or, if required, sheets or other shapes from which specimens can be cut, are exposed to natural solar radiation (ISO/DIS 877-2:2016, method A), or to window-glass-filtered solar radiation (ISO/DIS 877-2:2016, method B) or to intensified solar radiation using a Fresnel-reflecting concentrator (ISO 877-3). After the prescribed exposure period, the specimens are removed from exposure and, if a characterization is required, tested for changes in optical, mechanical or other properties of interest. The exposure stage may be a given period of time or may be expressed in terms of a given total radiant exposure or UV radiant exposure. The latter is preferred whenever the main objective of the exposure is to determine resistance to solar radiation, since it minimizes the effect of variations in spectral irradiance with climate, location and time.

Instrumental means of measuring irradiance, and means for integration to give the radiant exposure over a period of time, are preferred.

NOTE 1 Physical standards that change in colour, or another property, upon exposure to solar radiation have been used to determine radiant exposures. Determinations of radiant exposure using these procedures are less reliable indicators than determination of radiant exposure by actual measurement of solar radiation.

When comparing the results of exposure using ISO/DIS 877-2:2016, method A or B, with ISO 877-3, differences in specimen temperatures, ultraviolet radiant exposure levels and moisture deposition should be taken into account. Additionally, when comparing ISO/DIS 877-2:2016, method B, to ISO 877-3, the glass or other transparent material used as the filter must be identical. Comparison of results from ISO 877-3 to those from ISO/DIS 877-2:2016, method A or B, must be based on equal radiant exposure levels

The climatic conditions during the test may be monitored and reported with the other conditions of exposure.

It is recommended that a similar material of known behaviour be exposed simultaneously with the experimental material as a control.

Unless otherwise specified, test pieces for the determination of change in colour and change in mechanical properties are exposed in an unstrained state.

ISO/DIS 877-2:2016, method B, excludes the effects of wind and rain. The devices used for ISO 877-3 are typically equipped to provide moisture in the form of water spray.

Exposures in hot and wet and in hot and dry climates are often used to benchmark the outdoor durability of materials such as plastics. Information on climate classification can be found in Annex A.

NOTE 2 More detailed information about the effects of different climates and different exposure parameters on the variability of results from outdoor exposures can be found in ASTM G 141 [3].

5 Apparatus

5.1 General requirements

Exposure equipment consisting essentially of an appropriate test rack shall be used. The rack, specimen holders and other fixtures shall be made from inert materials that will not affect the test results. Noncorrosive aluminium alloy, stainless steel and ceramics have been found to be suitable. Untreated wood may be used, but may be subject to rot at locations high in moisture. Wood treated with preservatives, copper or its alloys, zinc or its alloys, iron or non-galvanized steel shall not be used. Materials with different thermal properties may affect the surface temperature and therefore the test results. Copper or its alloys, zinc or its alloys, iron or steels other than stainless steels, galvanized or

plated metals or timbers other than those above should preferably not be used in the vicinity of the test specimens.

If backing is necessary to support the test specimens or to simulate special end-use conditions, such backing shall be of inert material. Test specimens that require support to prevent sagging of the specimen but do not require backing to elevate the temperature, or require no "solid" backing, should preferably be supported with fine-strand wire netting or slit-expanded aluminium or stainless-steel backing. Use 16-gauge to 18-gauge metal with approximately 12 mm to 13 mm openings. It is recommended that the surface area of the wire netting be 60 % to 70 % open.

For tests on finished products, it is recommended that, wherever possible, the fixtures closely simulate those used in practice.

ISO 877-2 gives specific requirements for rack design for outdoor exposures, and ISO 877-3 gives specific requirements for the solar concentrator.

5.2 Apparatus for measurement of climatic factors

5.2.1 Apparatus for measurement of radiant exposure

5.2.1.1 General

All radiometers used to measure radiant exposure shall meet the requirements of ISO 9370 and shall be calibrated at least annually, the calibration being traceable to national/international radiometric references. Listed below are examples of instruments used to measure radiant exposure.

5.2.1.2 Pyranometers

A pyranometer is a radiometer used to measure global solar radiation if mounted horizontally, or hemispherical radiation if mounted at an angle. Pyranometers shall meet or exceed the requirements for a second-class pyranometer as specified in ISO 9370. In addition, pyranometers shall be calibrated at least annually, more frequently if specified, using the calibration requirements given in ISO 9370.

5.2.1.3 Pyrheliometers

A pyrheliometer is a radiometer used to measure the direct component of solar irradiance on a surface normal to the sun's rays. Pyrheliometers shall meet or exceed the requirements for a first-class pyrheliometer as specified in ISO 9370. In addition, pyrheliometers shall be calibrated at least annually, using the calibration requirements given in ISO 9370.

5.2.1.4 Total-ultraviolet radiometers

When used to define exposure stages, total-ultraviolet radiometers shall have a passband that maximizes the acceptance of radiation within the 290 nm to 400 nm wavelength region, and they shall be cosine-corrected to include ultraviolet sky radiation. Total-ultraviolet radiometers shall be calibrated at least annually, more frequently if specified, and their calibration shall be traceable to national/international radiometric references.

NOTE Traditionally, UV radiometers measuring from 295 nm to 385 nm have been used. Use of radiometers with different wavelength measurement range (for example, those that respond to 400 nm) can result in recorded UV radiant exposures that are up to 25 % to 30 % higher than the UV radiant exposure determined with radiometers that only measure up to 385 nm. See Annex A of ISO 9370:2009 for more information about the differences in measured total solar UV radiation between total ultraviolet radiometers that have differences in long wavelength UV response.

5.2.1.5 Narrow-band ultraviolet radiometers (NBUVRs)

When used to define exposure stages, NBUVRs shall be cosine-corrected if used in conjunction with either natural fixed angles or glass-filtered exposures. The acceptance angle of NBUVRs shall exceed