INTERNATIONAL STANDARD

**ISO 877-1**

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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*

Reference number
ISO 877-1:2009(E)



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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.

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 877-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

Together with the other parts (see below), it cancels and replaces ISO 877:1994, which has been technically revised.

ISO 877 consists of the following parts, under the general title *Plastics — Methods of exposure to solar radiation*:

— *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 877-2:2009, method A) or to indirect weathering using glass-filtered solar radiation (ISO 877-2:2009, 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 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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 472, *Plastics — Vocabulary*

ISO 877-2:2009, *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:—[1)], *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

1) To be published. (Revision of ISO 9370:1997)

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 and ISO 9370 apply.

NOTE ASTM G 113 [3] defines terms used for artificially accelerated and natural weathering exposures. Submission of these definitions has been proposed for inclusion in ISO 472 and/or ISO 9370, or ISO 877, as appropriate.

## 4 Principle

Specimens or, if required, sheets or other shapes from which specimens can be cut, are exposed to natural solar radiation (ISO 877-2:2009, method A), or to window-glass-filtered solar radiation (ISO 877-2:2009, 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 877-2:2009, 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 877-2:2009, 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 877-2:2009, 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 877-2:2009, 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 [4].



 