INTERNATIONAL STANDARD

ISO 877

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Plastics — Methods of exposure to direct weathering, to weathering using glass-filtered daylight, and to intensified weathering by daylight using Fresnel mirrors

Plastiques — Méthodes d'exposition directe aux intempéries, ou d'exposition indirecte sous verre, et à la lumière du jour intensifiée par des miroirs de Fresnel

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Contents

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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.

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.

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

This second edition cancels and replaces the first edition (ISO 877:1976), which has been technically revised.

Annex A forms an integral part of this International Standard. Annexes B and C are for information only.

Introduction

Outdoor-exposure tests of the type specified in this International Standard are needed to evaluate the performance of plastics when exposed to daylight. The results of such tests should be regarded only as an indication of the effect of exposure to direct weathering (Method A), or to indirect weathering using glass-filtered daylight (Method B) or to intensified daylight (Method C) by the methods described. Results obtained after exposure for a given time may not be comparable to those obtained after other exposures of equal time using the same method. When identical materials are exposed at different times for extended periods of several years, they generally show comparable behaviour after equal-exposure intervals. However, even in long-term tests, the results may be affected by the season in which the tests are started. This is particularly true when exposure tests are performed in accordance with Method C, using the Fresnel-reflecting concentrators described in this International Standard.

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

However, some plastics materials, especially those that may tend to be comparatively moisture-sensitive, may not exhibit losses in certain properties at the same rate as in outdoor, natural exposures.

The results of short-term outdoor-exposure tests can give an indication of the relative outdoor performance, but should not be used to predict the absolute long-term performance of a material. Even results of tests carried out for longer than 24 months can show an effect of the season in which the exposure was started. Comparisons of non-full-year exposure will exhibit seasonal effects.

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

It is noted that the test method chosen is usually 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.

Plastics — Methods of exposure to direct weathering, to weathering using glass-filtered daylight, and to intensified weathering by daylight using Fresnel mirrors

1 Scope

This International Standard specifies methods of exposing plastics to solar radiation, either by direct exposure to natural weathering (Method A), to indirect solar radiation by modification of its spectral distribution with glass to simulate ageing of plastics behind building or automotive window glass (Method B), or to solar radiation intensified by the use of Fresnel mirrors to achieve acceleration of the weathering processes (Method C). The purpose is to assess changes produced after specified stages of such exposures.

This International Standard specifies the general requirements for the apparatus and operating procedures for using the test methods described. Although this International Standard does not include direct weathering using black-box test fixtures, attention is drawn to this method of exposure testing of materials under conditions simulating their end-use temperatures.[1)]

Methods B and C exclude the effects of weathering influences such as wind and rain, although the Method C apparatus used to produce intensified solar radiation is equipped to provide moisture in the form of water spray.

When comparing the results of exposure using Method C with results using Methods A and B, differences in specimen temperatures, ultraviolet radiant exposure levels and moisture deposition should be taken into account. Additionally, when comparing Method C exposures to Method B exposures, the glass or other transparent materials used as filters should be identical. Exposure results being compared should be for ultraviolet radiant exposure levels that agree closely with each other.

This International Standard also specifies methods for determining radiation dosage. The methods are applicable to plastics materials of all kinds and to products and portions of products.

NOTE 1 For the determination of changes in properties after exposure, see ISO 4582.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 105-A01:—[2)], *Textiles — Tests for colour fastness — Part A01: General principles of testing.*

ISO 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour.*

1) ASTM G 7-89, *Standard practice for atmospheric environmental exposure testing of nonmetallic materials* and ASTM D 4141-82 (reapproved 1987), *Standard practice for conducting accelerated outdoor exposure tests of coatings.*

2) To be published. (Revision of ISO 105-A01:1989)

ISO 105-B01:1989, *Textiles — Tests for colour fastness — Part B01: Colour fastness to light: Daylight.*

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 293:1986, *Plastics — Compression moulding test specimens of thermoplastic materials.*

ISO 294:1975, *Plastics — Injection moulding test specimens of thermoplastic materials.*

ISO 2557-1:1989, *Plastics — Amorphous thermoplastics — Preparation of test specimens with a specified maximum reversion — Part 1: Bars.*

ISO 2818:1994, *Plastics — Preparation of test specimens by machining.*

ISO 3167:1993, *Plastics — Multipurpose test specimens.*

ISO 4582:1980, *Plastics — Determination of changes in colour and variations in properties after exposure to daylight under glass, natural weathering or artificial light.*

ISO 4892:1981, *Plastics — Methods of exposure to laboratory light sources.*

WMO, *Guide to meteorological instruments and methods of observation,* WMO No. 8, Fifth Edition, World Meteorological Organization, Geneva, 1983.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 direct (beam) solar radiation: Solar flux, coming from a small solid angle centred on the sun's disc, incident on a surface perpendicular to the axis of that solid angle.

Convention dictates that the plane angle of direct radiation is about 6°.

3.2 direct weathering; direct exposure: By convention, weathering (or exposure) due to radiation, incident on a surface, which is unmodified by either transmission through transparent materials or reflection by mirrors.

3.3 Fresnel-reflector system: Flat mirrors arranged in an array such that they reflect onto a target having an illuminated area which simulates the shape and size of the flat mirror.

3.4 natural weathering: Long-term exposure of materials to the elements, usually conducted on fixed-angle or seasonally adjusted racks (see ASTM G 7-89[1]).

These exposures are used to assess the effects of environmental factors on various functional and decorative parameters of interest.

3.5 pyrheliometer: Radiometer used to measure the direct (beam) solar irradiance incident on a surface normal to the sun's rays.

3.6 pyranometer: Radiometer used to measure the total solar radiant energy incident upon a surface per unit time per unit area.

The energy measured includes direct and diffuse radiant energy as well as radiant energy reflected from the background.

4 Principle

Specimens or, if required, sheets or other shapes from which specimens can be cut, are exposed to direct natural daylight, or to window glass-filtered daylight, or to intensified sunlight using a Fresnel-mirror concentrator, as specified. After the prescribed exposure interval, the specimen(s) are removed from exposure and tested for changes in optical, mechanical or other properties of interest. The exposure stage may be a given interval of time, or may be expressed in terms of a given total solar or solar-ultraviolet-radiation dosage. The latter is preferred whenever the main objective of the exposure is to determine resistance to light ageing, since it minimizes the effect of variations in the quality and intensity of solar radiation with climate, location and time.

Methods of assessing the radiation dosage may comprise one or more of the following:

— instrumental means of measuring irradiance, and means for integration to give the light dosage over a period of time;

— evaluation of physical standards which change in colour or in other well-defined properties upon exposure to light, the degree of change indicating the light dosage.

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

Climatic conditions and variations thereof during the test are monitored and reported with other conditions of exposure.