TECHNICAL SPECIFICATION

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First edition

Plastics — Test method for exposing polyolefins outdoors combining natural weathering and artificial irradiation

Plastiques — Procédé d'exposition de polyolefines en plein air combinant une irradiation naturelle et artificielle

PROOF/ÉPREUVE

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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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The performance of polyolefin plastics and products exposed outdoors is reduced by various environmental factors such as UV radiation, heat, humidity, acid rain, etc. Therefore, the estimation of the lifetime is an important consideration in designing against performance degradation of materials and products for the outdoor use. Although the outdoor exposure test method provides degradation caused by the actual environmental factors, it carries a disadvantage of requiring a prolonged testing period. Outdoor weathering supported with artificial radiation are also available. In all cases, these methods are often not effective in regions with a low amount of direct radiation. In response to the questionnaire conducted, over 150 experts by an expert committee on weathering, the majority of respondents agreed on the need of a method for outdoor weathering supported with artificial radiation that would be appropriate for the regional climate, especially for the cloudy regions. That is, a document to be developed which comprise the advantage of outdoor exposure that would generate actual environmental exposure and the advantage of shortening the exposure time by utilizing the artificial irradiation. This test method is developed to provide outdoor weathering supported with artificial irradiation by continuously and sequentially exposing specimens to natural weathering during daytime and artificial radiation at night time.

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 patents concerning apparatus described in Annex B.

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

The holder of this patent right has ensured ISO that he/she 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 the patent database available at www.iso.org/patents.

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Plastics — Test method for exposing polyolefins outdoors combining natural weathering and artificial irradiation

1 Scope

This document specifies methods for exposing specimen to alternating outdoor weathering supported with artificial radiation. This method utilizes, as much as possible, the natural outdoor exposure which are then assisted by the artificial radiation during night time and in cloudy conditions.

This document is applicable to polyolefin materials as well as to products and portions of products.

The artificial and natural outdoor exposures and their practices applicable to this document are described in ISO 4892-1, ISO 4892-3 and ISO 877-1, ISO 877-2 and ISO 877-3, respectively.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 877-1, *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, *Plastics — Methods of exposure to solar radiation — Part 3: Intensified weathering using concentrated solar radiation*

ISO 4582, *Plastics — Determination of changes in colour and variations in properties after exposure to glass-filtered solar radiation, natural weathering or laboratory radiation sources*

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

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

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

IEC 60068-2-5, *Environmental testing — Part2-5: Tests — Test S: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 877-3 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
outdoor weathering supported with artificial radiation
continuous exposure to natural and artificial weathering sequence in outdoors that provides accelerated weathering

Note 1 to entry: In general, exposure sequence of natural outdoor weathering during the daytime and artificial irradiation at nighttime (or cloudy day) is used.

4 Principle

The basic principle of this method is to combine both, the natural weathering (to solar radiation) and the laboratory weathering/irradiation, as described in ISO 877-1, ISO 877-2, ISO 4892-1, and ISO 4892-3, respectively, in continuous cycles of exposures all outdoors. Specimens prepared from the material or taken from parts of the products or full product are exposed to natural weathering (to solar radiation) [see Figure 1 a)] and then continue to subject the specimens to artificial radiation source with other factors controlled during the night time [see Figure 1 b)]. A similar combination would also apply when cloudy condition prevents direct solar radiation exposure. After the prescribed exposure combination in time intervals, the specimens are removed from the exposure and tested for changes in visual, optical, mechanical and/or other properties of interest. The exposure stage may be given as interval of time, or may be expressed in terms of a given total solar or solar ultraviolet radiant exposure, separately for natural and for artificial exposure whichever is found to be more appropriate for that particular property of interest. In general terms, the sun tracking may be used and an automated device for changing from daylight exposure to artificial exposure is recommended.

NOTE According to the World Meteorological Organization, cloudy conditions mean at least 50 % of the sky will be covered by clouds — there will be more clouds than sunshine. "Mostly cloudy" means that 80 % to 90 % of the sky will be covered by clouds.

a) Day time (natural)

(b) Night time (artificial)

Figure 1 — Outdoor weathering supported with artificial radiation

5 Apparatus

5.1 General

The design of the apparatus may vary, but it shall be constructed from an inert material and provide uniform irradiance in accordance with ISO 4892-1, during the artificial irradiation step, along with means for measuring the temperature. In general, day and night automatically operates according to sunrise and sunset time. Cloudy, rain condition operates either manually or automatically depending on the equipment available. When necessary, the equipment for sun-tracking or humidity control of test chamber or spraying water on the specimen surface or occurrence of condensation should be prepared.

The general requirement of the apparatus for natural outdoor and artificial exposures are given in ISO 877-1, ISO 877-2, ISO 4892-1 and ISO 4892-3, respectively.

5.2 Test chamber

An example of an apparatus is shown in Annex B. It consists of a box containing artificial radiation sources and a screen for preventing bugs to the artificial radiation source during night time hours. In Figure B.1, the test chamber is positioned on an actuator that moves in axis as well as on a tracking actuator which enables the sample holder to move in longitudinal and lateral directions. The box is made to allow specimen exposure to solar radiation and artificial radiation source by a simple movement at each exposure cycle. The artificial radiation sources should be placed in such a way to provide maximum exposure uniformity.

5.3 Artificial radiation source

5.3.1 Artificial radiation source

5.3.1.1 General

UVA-340 radiation source given in ISO 4892-3 and metal halide radiation source specified in IEC 60068-2-5 can be used. Irradiance uniformity shall be in accordance with the requirements specified in ISO 4892-1. Requirements for periodic repositioning of specimens when irradiated within the exposure area is less than 90 % of the peak irradiance are described in ISO 4892-1.

5.3.1.2 Metal halide lamp

The tolerances of the spectral irradiance of metal halide radiation source should be in line with IEC 60068-2-5 for global solar radiation. The irradiance between 280 nm and 3 000 nm shall be > 1 000 W/m^2 but < 1 200 W/m^2.

5.3.1.3 Fluorescent UVA-340 lamp

UVA-340 (type 1A) lamps according to ISO 4892-3 shall be used.

NOTE Fluorescent UVA-340 lamps do not simulate the entire global solar irradiance. Only the short-wave UV radiation of the global solar radiation up to 360 nm is appropriately simulated.

5.4 Radiometer

When radiometers are used, they shall be in accordance with the requirements of ISO 9370.

5.5 Black-standard/black-panel thermometer

The black-standard or black-panel thermometer used shall be in accordance with the requirements given in ISO 4892-1.

5.6 Specimen holder

Specimen holders can be in the form of an open rack, leaving the backs of the specimens exposed, or they can be made to provide the specimens with a solid backing. They shall be made from inert materials that will not affect the results of the exposure, e.g. non-oxidizing alloys of aluminium or stainless steel. Brass, carbon steel or copper shall not be used in the vicinity of the test specimens. The backing used might affect the results. This in particular is of concern with transparent specimens, and the use shall be agreed on between the interested parties.

5.7 Apparatus to assess changes in properties

If an International Standard relating to the determination of the properties chosen for monitoring the changes in properties exists (see, in particular, ISO 4582), the apparatus specified by the relevant International Standard shall be used.

6 Test specimens

For test specimen details refer to ISO 4892-1. A typical maximum size of the test specimen in sheet form is 70 mm × 150 mm.

7 Test conditions

7.1 Radiation

The radiant exposure shall be measured separately for natural and artificial weathering.

For natural weathering, either total solar radiant exposure or UV radiant exposure shall be measured, according to ISO 9370.

NOTE Total solar radiant exposure can be measured by means of a calibrated pyranometer which is mounted in the specimen plane.

For artificial weathering, irradiance shall be controlled at the levels indicated in Table 2. The respective radiant exposure shall be measured. Other irradiance levels may be used when agreed on by the interested parties. The irradiance and the pass band in which it was measured shall be included in the test report.

7.2 Relative humidity of air inside the chamber

The specimen may be exposed under the condition in which the relative humidity is allowed to vary or adjusting the relative humidity to the designated level.

7.3 Temperature

7.3.1 Black-standard and black-panel temperature (BPT)

Black-standard or black-panel temperature (BPT) shall be measured.

7.3.2 White-standard and white-panel temperature (WPT)

White standard or white panel temperature (WPT) shall be measured.

7.3.3 Specimen temperature

The specimen temperature is measured on the back of the sample and shall be monitored during the test.

7.3.4 Air temperature (AT)

The air temperature (AT) shall be monitored during the test. If the box containing the artificial radiation source is placed in front of the samples and irradiated, the air temperature shall not exceed the specimen's on-set temperature for thermal oxidation (OST). Report this on-set temperature in the test report.

7.4 Time setting of sunrise and sunset

Sunrise and sunset time of the exposure location are to be used.

