SLOVENSKI STANDARD
oSIST prEN ISO 4892-1:2014

01-april-2014

Polimerni materiali - Metode izpostavljanja laboratorijskim virom svetlobe - 1. del: Splošna navodila (ISO/DIS 4892-1:2014)

Plastics - Methods of exposure to laboratory light sources - Part 1: General guidance (ISO/DIS 4892-1:2014)

Kunststoffe - Künstliches Bestrahlen oder Bewittern in Geräten - Teil 1: Allgemeine Anleitung (ISO/DIS 4892-1:2014)

Plastiques - Méthodes d'exposition à des sources lumineuses de laboratoire - Partie 1: Lignes directrices générales (ISO/DIS 4892-1:2014)

Ta slovenski standard je istoveten z: **prEN ISO 4892-1**

ICS:

83.080.01	Polimerni materiali na splošno	Plastics in general

oSIST prEN ISO 4892-1:2014 **en,fr,de**

DRAFT INTERNATIONAL STANDARD

ISO/DIS 4892-1

ISO/TC **61**/SC **6**

Secretariat: **DIN**

Voting begins on:
2014-01-23

Voting terminates on:
2014-06-23

Plastics — Methods of exposure to laboratory light sources —

Part 1:
General guidance

Plastiques — Méthodes d'exposition à des sources lumineuses de laboratoire —

Partie 1: Lignes directrices générales

[Revision of second edition (ISO 4892-1:1999)]

ICS: 83.080.01

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Reference number
ISO/DIS 4892-1:2013(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 4892-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

This third edition cancels and replaces the second edition (ISO 4892-1:1999), which has been technically revised. ISO 4892 consists of the following parts, under the general title *Plastics — Methods of exposure to laboratory light sources*:

— *Part 1: General guidance*

— *Part 2: Xenon-arc lamps*

— *Part 3: Fluorescent UV lamps*

— *Part 4: Open-flame carbon-arc lamps*

Introduction

Plastics are often used outdoors or in indoor locations where they are exposed to solar radiation or to solar radiation behind glass for long periods. It is therefore very important to determine the effects of solar radiation, heat, moisture and other climatic stresses on the colour and other properties of plastics. Outdoor exposures to solar radiation and to solar radiation filtered by window glass are described in ISO 877 [1]. However, it is often necessary to determine more rapidly the effects of light, heat and moisture on the physical, chemical and optical properties of plastics with artificial accelerated weathering or artificial accelerated irradiation exposures that use specific laboratory light sources. Exposures in these laboratory devices are conducted under more controlled conditions than found in natural environments and are intended to accelerate polymer degradation and product failures.

Relating results from accelerated weathering or artificial accelerated irradiation exposures to those obtained in actual-use conditions is difficult because of variability in both types of exposure and because laboratory tests often do not reproduce all the exposure stresses experienced by plastics exposed in actual-use conditions. No single laboratory exposure test can be specified as a total simulation of actual-use exposures.

The relative durability of materials in actual-use exposures can be very different depending on the location of the exposure because of differences in UV radiation, time of wetness, temperature, pollutants and other factors. Therefore, even if results from specific accelerated weathering or artificial accelerated irradiation exposures are found to be useful for comparing the relative durability of materials exposed in a particular outdoor location or in particular actual-use conditions, it cannot be assumed that they will be useful for determining the relative durability of materials exposed in a different outdoor location or in different actual-use conditions.

Plastics — Methods of exposure to laboratory light sources —

Part 1:
General guidance

1 Scope

1.1 This part of ISO 4892 provides information and general guidance relevant to the selection and operation of the methods of exposure described in detail in subsequent parts. It also describes general performance requirements for devices used for exposing plastics to laboratory light sources. Information regarding performance requirements is for producers of artificial accelerated weathering or artificial accelerated irradiation devices.

NOTE – In this standard, the term "light source" refers to radiation sources that emit UV radiation, visible radiation, infrared radiation or any combination of these types of radiation.

1.2 This part of ISO 4892 also provides information on the interpretation of data from artificial accelerated weathering or artificial accelerated irradiation exposures. More specific information about methods for determining the change in the properties of plastics after exposure and reporting these results is given in ISO 4582.

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 293, *Plastics — Compression moulding of test specimens of thermoplastic materials*

ISO 294-1, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

ISO 294-2, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 2: Small tensile bars*

ISO 294-3, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 3: Small plates*

ISO 295, *Plastics — Compression moulding of test specimens of thermosetting materials*

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

ISO 3167, *Plastics — Multipurpose test specimens*

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 4892-2, *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*

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

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE Definitions of other terms that are related to weathering tests are found in ASTM G 113 [2].

3.1
control
⟨weathering testing⟩ material which is of similar composition and construction to the test material and which is exposed at the same time for comparison with the test material

NOTE 1 to entry: An example of the use of a control material would be when a formulation different from one currently being used is being evaluated. In that case, the control would be the plastic made with the original formulation.

3.2
file specimen
portion of the material to be tested which is stored under conditions in which it is stable and which is used for comparison between the exposed and unexposed states

3.3
artificial accelerated weathering
exposure of a material in a laboratory weathering device to conditions which may be cyclic and intensified compared with those encountered in outdoor or in-service exposure

NOTE 1 to entry: This involves a laboratory radiation source, heat and moisture (in the form of relative humidity and/or water spray, condensation or immersion) in an attempt to produce more rapidly the same changes that occur in long-term outdoor exposure.

NOTE 2 to entry: The device may include means for control and/or monitoring of the light source and other weathering parameters. It may also include exposure to special conditions, such as acid spray to simulate the effect of industrial gases.

3.4
artificial accelerated irradiation
exposure of a material to a laboratory radiation source intended to simulate window-glass-filtered solar radiation or radiation from interior lighting sources and where specimens may be subjected to relatively small changes in temperature and relative humidity in an attempt to produce more rapidly the same changes that occur when the material is used in an indoor environment

NOTE 1 to entry: These exposures are commonly referred to as fading or lightfastness tests.

3.5
reference material
material of known performance

3.6
reference specimen
portion of the reference material that is to be exposed

4 Principle

4.1 General

Specimens of the samples to be tested are exposed to laboratory light sources under controlled environmental conditions. The methods described include the requirements which have to be met for the measurement of the irradiance and radiant exposure in the plane of the specimen, the temperature of specified white and black sensors, the chamber air temperature and the relative humidity.

4.2 Significance

4.2.1 When conducting exposures in devices that use laboratory light sources, it is important to consider how well the accelerated-test conditions simulate the actual-use environment for the plastic being tested. In addition, it is essential to consider the effects of variability in both the accelerated test and actual exposures when setting up exposure experiments and when interpreting the results from artificial accelerated weathering or artificial accelerated irradiation exposures.

4.2.2 No laboratory exposure test can be specified as a total simulation of actual-use conditions. Results obtained from artificial accelerated weathering or artificial accelerated irradiation exposures can be considered as representative of actual-use exposures only when the degree of rank correlation has been established for the specific materials being tested and when the type and mechanism of degradation are the same. The relative durability of materials in actual-use conditions can be very different in different locations because of differences in UV radiation, time of wetness, relative humidity, temperature, pollutants and other factors. Therefore, even if results from a specific exposure test conducted in accordance with any of the parts of this International Standard are found to be useful for comparing the relative durability of materials exposed in a particular environment, it cannot be assumed that they will be useful for determining the relative durability of the same materials in a different environment.

4.2.3 Even though it is very tempting, it is invalid to assign to all materials a “general acceleration factor” relating “*x*” hours or megajoules of radiant exposure in an artificial accelerated weathering or artificial accelerated irradiation exposure to “*y*” months or years of actual exposure. Such acceleration factors are invald for the following reasons:

a) acceleration factors are material-dependent and can be significantly different for each material and for different formulations of the same material;

b) variability in the rate of degradation in both actual-use and artificial accelerated weathering or artificial accelerated irradiation exposures can have a significant effect on the calculated acceleration factor;

c) acceleration factors calculated based on the ratio of irradiance between a laboratory light source and solar radiation (even when identical passbands are used) do not take into consideration the effects of temperature, moisture and differences in relative spectral irradiance between the laboratory light source and solar radiation.

NOTE Acceleration factors determined for a specific formulation of a material are valid, but only if they are based on data from a sufficient number of separate exterior or indoor environmental tests and artificial accelerated weathering or artificial accelerated irradiation exposures so that results used to relate times to failure in each exposure can be analysed using statistical methods. An example of a statistical analysis using multiple laboratory and actual exposures to calculate an acceleration factor is described by J.A. Simms [3].

4.2.4 There are a number of factors that may decrease the degree of correlation between accelerated tests using laboratory light sources and exterior exposures (more specific information on how each factor may alter the stability ranking of materials is given in Annex B):

a) differences in the relative spectral irradiance of the laboratory light source and solar radiation;

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b) irradiance levels higher than those experienced in actual-use conditions;

c) exposure cycles that use continuous exposure to radiation from a laboratory light source without any dark periods;

d) specimen temperatures higher than those in actual conditions;

e) exposure conditions that produce unrealistic temperature differences between light- and dark-coloured specimens;

f) exposure conditions that produce very frequent cycling between high and low specimen temperatures, or that produce unrealistic thermal shock;

g) unrealistic levels of moisture in the accelerated test compared to actual-use conditions;

h) the absence of biological agents, pollutants or acidic precipitation or condensation.

4.3 Use of accelerated tests with laboratory light sources

4.3.1 Results from artificial accelerated weathering or artificial accelerated irradiation exposures conducted in accordance with any of the parts of this International Standard are best used to compare the relative performance of materials. Comparisons between materials can only be made when the materials are tested at the same time in the same exposure device. Results can be expressed by comparing the exposure time or radiant exposure necessary to reduce the level of a characteristic property to some specified level. A common application of this is a test conducted to establish that the level of quality of different batches does not vary from that of a control of known performance.

4.3.1.1 It is strongly recommended that at least one control be exposed with each test for the purpose of comparing the performance of the test materials to that of the control. The control material should be of similar composition and construction and be chosen so that its failure modes are the same as that of the material being tested. It is preferable to use two controls, one with relatively good durability and one with relatively poor durability.

4.3.1.2 Sufficient replicates of each control and each test material being evaluated are necessary in order to allow statistical evaluation of the results. Unless otherwise specified, use a minimum of three replicates for all test and control materials. When material properties are measured using destructive tests, a separate set of specimens is needed for each exposure period.

4.3.2 In some specification tests, test materials are exposed at the same time as a weathering reference material (e.g. blue wool test fabric). The property or properties of the test material are measured after a defined property of the reference material reaches a specified level. If the reference material differs in composition from the test material, it may not be sensitive to exposure stresses that produce failure in the test material or it may be very sensitive to an exposure stress that has very little effect on the test material. The variability in results for the reference material may be very different from that for the test material. All these differences between the reference material and the test material can produce misleading results when the reference material is used as a control or to determine the length of the exposure period.

NOTE 1 Definitions of control and reference materials that are appropriate to weathering tests are given in Clause 3.

NOTE 2 Weathering reference materials can also be used to monitor the consistency of the operating conditions in an exposure test. Information about the selection and characterization of reference materials used for this purpose can be found in ASTM G 156 [4]. ISO/TR 19032 [5] describes a procedure which uses the change in the carbonyl index of a specific polyethylene weathering reference material to monitor conditions in both natural weathering and artificial accelerated weathering exposures.

4.3.3 In some specification tests, properties of test specimens are evaluated after a specific exposure time or radiant exposure using a test cycle with a prescribed set of conditions. Results from any accelerated exposure test conducted in accordance with any of the parts of this International Standard should not be used to make a “pass/fail” decision for materials, based on the level of a specific property after a specific exposure