SLOVENSKI STANDARD

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Polimerni materiali - Metoda za ugotavljanje toplotno ojačenih ravnih površin s simulacijo sončnega obsevanja

Plastics - Method for estimating heat build up of flat surfaces by simulated solar radiation

Kunststoffe - Verfahren mit simulierter Sonnenstrahlung zur Bewertung der Aufheizung auf ebenen Oberflächen

Plastiques - Méthode d'estimation de l'échauffement de surfaces planes par rayonnement solaire simulé

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Plastics - Method for estimating heat build up of flat surfaces by simulated solar radiation

Plastiques - Méthode d'estimation de l'échauffement de surfaces planes par rayonnement solaire simulé

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European foreword

This document (EN 16795:2015) has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2016 and conflicting national standards shall be withdrawn at the latest by June 2016.

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Introduction

Solar radiation causes the temperature of irradiated surfaces to rise substantially above the temperature of the surrounding air. The resulting surface temperature depends on the climatic parameters at the location in question, the spectral absorption of the surface, the geometric dimensions and on the specific structure of the object. Generally, the darker the colour, the more the sun's energy is absorbed and the higher is the heat build-up.

The performance characteristics of most of the materials are also defined by the in service temperature. Such materials can be window profiles or other polymeric carrier materials. The micro climate at house walls is also essential defined by the absorbed solar radiation (depending on the material properties). The same applies for interior room and automobile temperatures.

The examples reveal the significance of the knowledge of the temperature of sun irradiated surfaces. If the temperature magnitude is estimated to be critical, provisions can be taken to optimize the in-service micro climate, e.g. reduction of the in-service temperature by improvement of the spectral reflection characteristics or appropriate change in design and improving the air conditioning.

1 Scope

This European Standard specifies a method for estimating the temperature increase of a flat polymer surface, due to its solar radiant energy absorption, compared to the ambient temperature.

For that purpose, a specimen and black and white reference plates are exposed to simulated solar radiation under specified conditions (simulated solar radiation, ambient air temperature, convective flow). For opaque specimens, a thermally sensitive electrical element at the backside or a pyrometer is used to measure the surface temperature. For translucent specimens, a pyrometer is used to measure surface temperature.

NOTE Some specific polymeric materials are translucent (transparent) and might have a transmittance window in a wavelength range where the used pyrometer is sensitive (e.g. polyethylene). The surface temperature of these materials cannot be measured with the contact and the contactless method.

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.

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

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 terms and definitions given in ISO 9370 apply.

4 Abbreviations

BST black-standard thermometer

CHT chamber air temperature

RTD resistance temperature detector

WST white-standard thermometer

5 Principle

5.1 A xenon or metal halide arc lamp, fitted with filters, is used to simulate the spectral irradiance of global solar radiation.

5.2 Specimens are exposed to various levels of simulated global solar radiation, heat, and relative humidity and air flow under controlled environmental conditions, including:

a) the irradiance level;

b) the air flow directed over the test specimen;

c) the ambient air temperature during the exposure to simulated global solar radiation;

d) the relative humidity in the chamber during the exposure to simulated global solar radiation.

5.3 The procedure may include measurements of the global irradiance in the plane of the specimens.

5.4 The procedure includes measurements of the surface temperature in the plane of the specimens.

5.5 It is recommended to expose simultaneously with the test specimens a black standard (BST) and white standard (WST) thermometer as specified in EN ISO 4892-1 to provide a standard for comparative purposes.

5.6 Comparison of results obtained from specimens exposed in different apparatus should not be made unless an appropriate statistical relationship has been established between the apparatuses for the particular material exposed.

6 Apparatus

6.1 General

The equipment comprises a test chamber, an ozone-free radiation source which generates UV, visible, and infrared radiation similar to solar radiation. A contactless surface temperature device (pyrometer) or contact temperature measuring systems may be part of the device.

6.2 Test chamber

The design of the test chamber may vary, but it shall be constructed from inert material and shall be equipped with a blower which generates a defined airflow to be directed across the specimens. In addition to the controlled lamp wattage, the test chamber shall provide for control of ambient temperature. For exposures that require control of humidity, the test chamber shall include humidity-control facilities that meet the requirements of EN ISO 4892-1.

NOTE 1 If the lamp system (one or more lamps) is centrally positioned in the chamber, the effect of any eccentricity of the lamp(s) on the uniformity of exposure can be reduced by using a rotating frame carrying the specimens or by repositioning or rotating the lamps.

NOTE 2 The required irradiance level can be adjusted by means of the lamp wattage. In this case, the lamp wattage is controlled not the irradiance.

6.3 Laboratory radiation source

6.3.1 General

The radiation source shall comprise one or more xenon-arc or metal halide radiation sources which emit radiation from below 270 nm in the ultraviolet through the visible spectrum and into the infrared. In order to simulate global solar radiation, filters shall be used to remove short-wavelength UV radiation (<290 nm). In addition, filters to remove infrared radiation (>800 nm) may be used to prevent unrealistic heating of the test specimens.

6.3.2 Spectral irradiance of xenon and metal halide arc lamps with global solar radiation filters

Table 1 specifies the minimum and maximum levels of the relative spectral irradiance, in the visible and infrared wavelength range. Filters are a useful tool to achieve these values.

In order to simulate global solar radiation, filters shall be used to remove short-wavelength UV radiation (<290 nm). In addition, if values in Table 1 are not met, filters to remove infrared radiation (>800 nm) may be used to prevent unrealistic heating of the test specimens.

NOTE Solar spectral irradiance for a number of different atmospheric conditions is described in CIE Publication No. 85 [1]. The benchmark global solar irradiance used in this standard is that defined in Table 4 in CIE No. 85:1989.

Table 1 — Relative spectral irradiance of laboratory radiation sources simulating global solar radiation

Spectral passband (λ = wavelength in nm)	Relative spectral portion[a] %
$290 \leq \lambda \leq 800$	60 ± 9
$800 \leq \lambda \leq 3\ 000$	40 ± 9

[a] The minimum and maximum tolerance will not necessarily sum to 100 % because they represent tolerance of the measurement data used. For any individual spectral irradiance, the percentages calculated for the passbands in this table will sum to 100 %. For any individual simulated global solar radiation, the calculated percentage in each passband shall fall within the minimum and maximum limits given. Contact the manufacturer of the simulated global solar radiation apparatus for specific spectral irradiance data.

6.3.3 Irradiance uniformity

The irradiance at any position in the area used for specimen exposure shall be at least 80 % of the maximum irradiance.

NOTE The surface temperature might vary with the irradiance uniformity on sample level.

6.4 Radiometer

The radiometer used shall comply with the requirements given in ISO 9370.

6.5 Test chamber temperature and relative humidity

The chamber temperature sensor shall be located, radiation-shielded, possibly combined with a sensor which measures the relative humidity close to the exhaust air duct.

For exact calibration of the chamber temperature and relative humidity sensor it is necessary to move a calibrated working reference standard and the instrument sensor to about the same position so that a balanced temperature and humidity can be set for the measuring sensors and the ambient air. Calibration takes place as soon as the whole system is in thermal balance.

NOTE Typically, the thermal equilibrium is achieved after 30 min up to 1 h.

6.6 Surface temperature measurement device

6.6.1 Pyrometer

6.6.1.1 Minimum requirements for the pyrometer

A pyrometer may be used to measure the surface temperature of the test specimen on sample level.

The minimum requirements for the pyrometer are the following:

a) temperature range: 20 °C to 150 °C (traceably calibrated by a black body radiator);

b) spectral response: 8 µm to 14 µm;

c) IR detector: e.g. silicon based thermopile;

d) uncertainty: ± 0,6 % (in the considered temperature range);