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**Polimerni materiali - Metoda kalibracije črnih in belih standardnih termometrov ter črnih in belih ploščatih termometrov za uporabo v naravnih in umetnih vremenskih razmerah**

Plastics - Calibration method of black-standard and white-standard thermometers and black-panel and white-panel thermometers for use in natural and artificial weathering

Kunststoffe - Kalibrierverfahren für Schwarz- und Weißstandard-Thermometer und Schwarz- und Weißtafel-Thermometer für die Verwendung bei natürlicher und künstlicher Bewitterung

Plastiques - Méthode d'étalonnage des thermomètres à étalon noir et à étalon blanc et des thermomètres à panneau noir et à panneau blanc pour utilisation en vieillissement naturel et artificiel

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## Plastics - Methods for the calibration of black-standard and white-standard thermometers and black-panel and white-panel thermometers for use in natural and artificial weathering

Plastiques - Méthodes d'étalonnage des thermomètres à étalon noir et à étalon blanc et des thermomètres à panneau noir et à panneau blanc pour utilisation en vieillissement naturel et artificiel

Kunststoffe - Kalibrierverfahren für Schwarz- und Weißstandard-Thermometer und Schwarz- und Weißtafel-Thermometer für die Verwendung bei natürlicher und künstlicher Bewitterung

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## European foreword

This document (EN 16465:2015) 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of an identical text or by endorsement, at the latest by March 2016, and conflicting national standards shall be withdrawn at the latest by March 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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## Introduction

The relevant weather factors with regard to material testing both outdoors and in devices include natural and simulated solar radiation, heat, humidity and rain as well as pollutants in the air.

Different technologies are available to simulate natural solar radiation in a weathering device. One category of exposure devices, which include xenon-arc weathering devices and devices using metal halide gas discharge radiation source, is designed to simulate the entire spectral range of natural solar radiation. In these instruments and like natural solar radiation, the ultraviolet, the visible and the infrared radiation during exposure increases the specimen surface temperature above the ambient air temperature of the surrounding air.

As an influencing weathering variable, heat is characterized by the sample surface temperature. Absorbed solar radiation can heat the surface to a temperature up to a  $\Delta T$  of more than 40 K above ambient air. The possible surface temperature is characterized by a white panel or white standard temperature as its lower limit, and a black panel or standard temperature as its upper limit. It is then assumed that the actual sample temperature lies between the two cited limits. Surface temperatures of specific specimens can be higher or lower (e.g. massive black polymers and transparent polymers). The white panel/standard and black panel/standard temperatures can be easily determined using conventional measuring techniques.

In one category of exposure devices, only the short UV range of the natural solar radiation is simulated with fluorescent UV radiation source radiation. In these devices, there is no significant increase in surface temperature of a specimen, because these radiation sources have no significant visible and infrared radiation.

An additional category of exposure devices uses a mercury medium pressure radiation source to induce critical photo-degradation reactions that are typical of natural solar exposures. Even this specific radiation source does not provide significant visible and infrared radiation. For this reason, as in the previous category, these exposures do not increase significantly the specimen surface temperature above ambient.

**NOTE** For fluorescent UV and mercury medium pressure radiation sources, the ambient air temperature surrounding the specimen is the main variable influencing the specimen temperature. The relative humidity may have a small effect on the specimen temperature as well.

Black/white standard thermometers and black/white panel thermometers are defined in EN ISO 4892-1. They are used in weathering applications to characterize the temperature level (maximum and minimum temperature) under given weathering exposure conditions. The accuracy of these thermometers depends on their design and especially on a well-defined and traceable calibration method. Such methods are the content of this standard.

Two methods are defined in this standard. Each method requires calibration of a black panel/standard or white panel/standard to a traceable reference from a national metrological institute (NMI).

Historically, the contact calibration method (e.g. calibration in a water bath) has been used for weathering applications: recently a contactless calibration method has been developed.

Any requirement to use one method versus the other method is not justified, and both calibration methods are suitable for most weathering applications. However, because of a lack of data comparing the two methods as of the time of publication of this standard, preference or equivalency of results for these two methods is unknown. Both methods may provide different calibration results that are not interchangeable.

The European Committee for Standardization (CEN) draws attention to the fact that it is claimed that compliance with Method B of this document may involve the use of European patent EP1500920, concerning the surface temperature calibration process discussed in 7.2.3.

CEN takes no position concerning the evidence, validity and scope of these patent rights. The holder of these patent rights has ensured CEN that he is willing to negotiate licenses under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of these patent rights is registered with CEN. Information may be obtained from:

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## 1 Scope

This European Standard specifies traceable calibration methods of black-standard thermometers (BST), white-standard thermometers (WST), black-panel thermometers (BPT) and white-panel thermometers (WPT) for use in natural and artificial weathering:

- method A, a contact method, uses a traceable calibrated resistance standard thermometer;
- method B, a contactless method, uses a traceable calibrated pyrometer.

A basic design of types of the thermometers is described in EN ISO 4892-1.

NOTE 1 Historically method A has been used for weathering applications for many years: Method B has been developed recently. Both methods are qualified for weathering applications. They may provide different calibration results that are not interchangeable.

NOTE 2 Annex A gives information on the characteristics of BST/WST and BPT/WPT.

## 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 291, *Plastics — Standard atmospheres for conditioning and testing (ISO 291)*

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

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## 3 Terms and definitions

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

- 3.1**  
**master reference thermometer**  
**MRT**  
 instrument traceable to a national metrological institute (NMI)
- 3.2**  
**reference calibration thermometer**  
**RCT**  
 instrument used in an accredited calibration laboratory to calibrate a field calibration thermometer (FCT)
- 3.3**  
**field calibration thermometer**  
**FCT**  
 instrument used to realize a standard measurement value with respect to a recognized master reference thermometer with a stated path of traceability to recognized standards and a stated measurement uncertainty

Note 1 to entry: Field calibration thermometers are used to calibrate BST/BPT or WST/WPT field thermometers in weathering devices (for daily use).



### 3.4

#### field thermometer

instrument used permanently outdoor or in a laboratory accelerated-weathering device used for the routine measurement of temperature, with a calibration traceable to a reference calibration thermometer

## 4 Abbreviated terms

BPT	black-panel thermometer (uninsulated black panel thermometer)
BST	black-standard thermometer (or insulated black panel thermometer)
MRT	master reference thermometer
NMI	national metrological institute
RTD	resistance thermometer detector
WPT	white-panel thermometer (uninsulated white panel thermometer)
WST	white-standard thermometer (or insulated white panel thermometer)

## 5 Principle

To characterize surface temperature of specimens which are exposed to weathering conditions, either BST and WST or BPT and WPT are used, all of them combining a coated panel, an electrical sensor element, and a monitoring system.

The thermometer to be calibrated is exposed to natural or artificial radiation under controlled conditions and adjusted to the temperature reading of an independent and traceable temperature measuring system.

Method A is a contact method using a master reference thermometer traceable to a NMI standard thermometer and method B is a non-contact method using a master reference pyrometer traceable to a NMI standard thermometer.

Any requirement to prefer one method versus the other method is not permitted. However, because of a lack of data comparing the two methods as of the time of publication of this standard, equivalency of results of these two methods is unknown.

## 6 Method A

### 6.1 General

This calibration method consists of the calibration (contact method) and additional verification in a test chamber with exposure to a radiation source.

### 6.2 Apparatus

#### 6.2.1 Master reference thermometer

A master reference thermometer that is calibrated traceable to a national metrology institute (NMI) and/or a designated institute (DI) is required. Recalibration by a qualified laboratory shall be performed every year.