SVENSK STANDARD
SS-EN 15758:2010

Fastställd/Approved: 2010-09-20
Publicerad/Published: 2010-10-26
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 97.195

Bevarande av kulturarv – Metoder och instrument för mätning av luft- och yttemperaturer

Conservation of Cultural Property – Procedures and instruments for measuring temperatures of the air and the surfaces of objects

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Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.

Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.

Denna standard är framtagen av kommittén för Bevarande av kulturarv, SIS/TK 479.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15758

September 2010

ICS 97.195

English Version

Conservation of Cultural Property - Procedures and instruments for measuring temperatures of the air and the surfaces of objects

Conservation des biens culturels - Méthodes et instruments de mesure de la température de l'air et de la surface des objets

Erhaltung des kulturellen Erbes - Verfahren und Geräte zur Messung der Temperatur der Luft und der Oberflächen von Gegenständen

This European Standard was approved by CEN on 23 July 2010.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 15758:2010: E

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Foreword

This document (EN 15758:2010) has been prepared by Technical Committee CEN/TC 346 “Conservation of Cultural Property”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by March 2011, and conflicting national standards shall be withdrawn at the latest by March 2011.

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

This standard is intended to assist in providing an acceptable environment for tangible cultural heritage. The temperature of the air and of object surfaces constitute important aspects of that environment. Temperature is one of the factors which can have a profound effect on the preservation of objects. Physical characteristics of materials change as they absorb or release heat. Objects expand and contract as the temperature changes, become rigid and brittle if the temperature falls below the glass transition temperature, or are mechanically damaged by the melting and freezing of water. The rates of some important chemical reactions, such as the degradation of cellulose (paper, textiles) increase with rising temperature. Temperature influences the activity of fungi and insects responsible for the bio-deterioration of organic materials. Temperature may affect some minerals and masonry crystallisation. Temperature also has an important indirect effect: a rise in temperature causes lowering of the relative humidity, which results in the drying of moisture absorbing materials such as wood, paper or leather. Such drying may lead to shrinkage and embrittlement. When direct radiation from sun, lamps or radiant heaters reaches objects, the consequent temperature rise causes drying even when the relative humidity of the surrounding air remains constant. Whatever the air temperature, the water vapour may condense on cold surfaces if their temperature drops below the dew point.

The control of levels and variability of temperature contributes to a proper environment for cultural property and thereby reduces the risk of deterioration. Such control is an important preventive measure which will minimise the need for future conservation interventions.

This standard recommends procedures for measuring the temperature of the air and of the surfaces of cultural property in indoor and outdoor environments as well as specifying the minimum characteristics of instrument for such measurements. Although standards exist for measuring the air or surface temperature in other fields like meteorology, industry or medicine, this standard focuses on the specific requirements of cultural property. One of the main concerns has been the use of non-contact or remote methods to make possible measuring temperatures of fragile and precious surfaces without any physical contact. However, taking measurements of the object surface, whether using contact or non-contact methods, involves a degree of risk to the object and should not be undertaken without clear justification nor without consultation with a suitably qualified and experienced conservator, preferably as part of an interdisciplinary team.

This document is one of the series of European Standards intended for use in the study of environments of cultural property.

Any measuring system which meets or exceeds the requirements of this European Standard can be used. The description or listing of certain instruments signifies only that they are recommended. It is up to users to analyze the quality of instruments available on the market and verify whether they conform to this document.

1 Scope

This European Standard recommends the procedures for measuring the temperature of the air and of the surfaces of cultural property in indoor and outdoor environments, as well as specifying the minimum characteristics of instruments for such measurements.

This document contains recommendations for accurate measurements to ensure the safety of objects and it is addressed to any people with the responsibility of the environment, its diagnosis, the conservation or maintenance of buildings, collections, or single object.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN ISO 7726:2001, *Ergonomics of the thermal environment — Instruments for measuring physical quantities (ISO 7726:1998)*

3 Terms and definitions

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

3.1
air temperature
T
temperature read on a thermometer which is exposed to air in a position sheltered from direct solar radiation or other energy sources

NOTE This is expressed in degrees Celsius (°C).

3.2
black-globe thermometer
thermometer consisting of a black globe in the centre of which is placed a temperature sensor, and which records the effective air-radiant temperature which results from a thermal balance between air temperature, radiation coming from the different heat sources and convective motions

3.3
blackbody strip target
low thermal inertia, blackbody target, like a strip of black textile, which assumes an effective air-radiant temperature resulting from a thermal balance between air temperature, radiation coming from light, heat sources and convective motions

NOTE The surface temperature of the blackbody target is then measured with a quasi-contact or a remote thermometer.

3.4
blackbody
body which absorbs all the ultraviolet, visible and infrared radiation impinging on it, i.e. having surface emissivity 1

3.5
contact sensor
sensor placed in direct physical contact with the surface and devised to reach thermal equilibrium with it

NOTE The sensor may be pressed against the surface or coupled to it with a glue or paste in order to improve the heat exchange and achievement of the thermal equilibrium.

3.6
dew-point temperature
temperature to which air is cooled at constant pressure and constant water vapour content in order for saturation to occur

NOTE This is expressed in degrees Celsius (°C).

3.7
emissivity
relative power of a surface to emit heat by radiation expressed as the ratio of the radiant energy emitted by a surface to that emitted by a blackbody at the same temperature

NOTE This ranges from 0 to 1.

3.8
infrared thermometer
thermometer which permits remote measurements of surface temperature by measuring the flux of infrared radiation emitted and reflected from the target

3.9
measuring range
interval of values that are intended to be measured, or that are potentially measurable, or that have been measured, specified by their upper and lower limits

3.10
probe
small device placed in or on the object to make measurements or to protect the sensor

NOTE This is usually designed not to influence significantly the result.

3.11
quasi-contact thermometer
total radiation thermometer measuring the surface temperature of a target which comprises a sensor located in the focal point of a concave mirror, shielded against the infrared radiation from the surrounding sources

NOTE The thermometer is placed close to the target but not in contact with it. It measures and converts into the temperature the flux of infrared radiation emitted by the target.

3.12
radiometric temperature
temperature measured with an infrared thermometer

NOTE This is expressed in degrees Celsius (°C).

3.13
repeatability
ability of the measuring instrument to reproduce the same output when successively measuring the same value of the air or the surface under investigation, taken under the same conditions

NOTE This is expressed as ± percent of the range.

3.14
resolution
smallest difference between indications of a displaying device that can be meaningfully distinguished

3.15
response time
time interval between the instant when the air, or the surface temperature, is subjected to a specified abrupt change and the instant when the response reaches and remains within specified limits around its final steady value

NOTE The response time is typically expressed as the time needed to reach 63,2 % of the final value and in this case is called time constant, or 90 % or 95 % of it. The 90 % response time is 2,3 times longer than the time constant and the 95 % response time is three times longer. The response time is independent of the span of the output change.

3.16
sensor
device that senses either the absolute value or a change in a physical quantity and converts it into a useful input signal for an information-gathering system

3.17
stability
ability of a measuring instrument to keep its metrological characteristics constant over a period of time

NOTE Stability should be expressed in terms of variation of temperature response in a year (°C/yr).

3.18
surface temperature
TS
temperature of a given surface of an object

NOTE This can be measured with contact thermometers, quasi-contact total radiation thermometers or remote infrared thermometers. The surface temperature is generally different from the air temperature, and varies between different objects and different places on the same object. It is expressed in degrees Celsius (°C). In general, the measured surface temperature is not representative of the whole object.

3.19
target surface
surface being in thermal equilibrium with the sensor

3.20
thermometer
instrument to measure temperature which comprises a sensor which is placed in thermal equilibrium with the air (if it measures the air temperature) or the surface, sometimes a probe that contains and protects the sensor, and a system that transforms the input from the sensor into an output expressed in degrees Celsius (°C)

3.21
time constant
time interval between the instant when the air, or the surface temperature, is subjected to a specified abrupt change and the instant when the response reaches 1 – 1/e = 0,632 (63,2 %) and remains within specified limits around its final steady value

NOTE See also response time.

3.22
uncertainty (of measurement)
uncertainty is a non-negative parameter characterizing the dispersion of the values attributed to a measured quantity