Irish Standard
I.S. EN 16242:2012

Conservation of cultural heritage - Procedures and instruments for measuring humidity in the air and moisture exchanges between air and cultural property

I.S. EN 16242:2012

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard – national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation - recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces:

This document is based on:
EN 16242:2012

Published:
23 November, 2012

This document was published under the authority of the NSAI and comes into effect on:
23 November, 2012

ICS number:
97.195

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Údarás um Chaighdeáin Náisiúnta na hÉireann

I.S. EN 16242:2012

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16242

November 2012

ICS 97.195

English Version

Conservation of cultural heritage - Procedures and instruments for measuring humidity in the air and moisture exchanges between air and cultural property

Conservation des biens culturels - Modes opératoires et instruments de mesure de l'humidité de l'air et des échanges d'humidité entre l'air et les biens culturels

Erhaltung des kulturellen Erbes - Verfahren und Geräte zur Messung der Luftfeuchte und des Austausches von Feuchtigkeit zwischen Luft und Kulturgut

This European Standard was approved by CEN on 8 September 2012.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 16242:2012: E

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Foreword

This document (EN 16242:2012) has been prepared by Technical Committee CEN/TC 346 “Conservation of cultural heritage”, 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of an identical text or by endorsement, at the latest by May 2013, and conflicting national standards shall be withdrawn at the latest by May 2013.

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

Humidity plays a key role in the conservation of cultural heritage because most materials and/or deterioration mechanisms are directly or indirectly affected by humidity levels or changes. This European Standard is a guide intended to assist in providing an acceptable environment for cultural heritage objects. Humidity in air, expressed in a number of ways, is an important aspect of that environment. Therefore, the control of levels and variability of humidity reduces the risk of deterioration and is an important preventive measure, minimising the need for future conservation interventions.

This European Standard is a guide to specifying adequate procedures for measuring humidity in air and the minimum characteristics of instruments for such measurements so that they are carried out to an appropriate level of accuracy. Although standards exist for measuring humidity in air in other fields like meteorology or ergonomics of thermal environments, this standard focuses on the specific requirements of cultural objects.

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

1 Scope

This European Standard gives guidance and specifies procedures and instruments for the measurement of relative humidity (RH) in air, in outdoor or indoor environments. It indicates how RH can be directly measured or how it can be calculated from air temperature, wet-bulb temperature and dew-point temperature. This standard contains recommendations for accurate measurements of ambient conditions and moisture exchanges between air and cultural heritage objects. It is addressed to anyone in charge of environmental diagnosis, conservation or maintenance of buildings, collections or single objects.

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 15757:2010, *Conservation of Cultural Property - Specifications for temperature and relative humidity to limit climate-induced mechanical damage in organic hygroscopic materials*

EN 15758:2010, *Conservation of Cultural Property - Procedures and instruments for measuring temperatures of the air and of the surfaces of objects*

EN 60751, *Industrial platinum resistance thermometers and platinum temperature sensors (IEC 60751)*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*

ISO/IEC Guide 98-3 *Uncertainty of measurement -- Part 3: Guide to the expression of uncertainty in measurement (GUM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15758:2010 and the following apply.

3.1
absolute humidity *(AH)*

volume density of water vapour, i.e. the mass of vapour contained in the unit volume of moist air $AH = \frac{m_v}{V}$,

expressed in g/m^3

Note 1 to entry: This volume density is also noted ρv (v for volume)

3.2
atmospheric (or barometric) pressure *(p)*
pressure is the force per unit area exerted by the air column above the measuring point, expressed in hPa (hectopascal)

Note 1 to entry: 1 hPa = 1 mbar (millibar)

3.3
barometer
instrument for measuring atmospheric pressure

3.4
dew-point hygrometer
instrument for measuring the temperature at which a cooled parcel of air becomes saturated with water vapour

3.5
dew-point temperature *(DP)*
temperature to which air is cooled at constant pressure and constant water vapour content in order for saturation to occur

Note 1 to entry: This is expressed in degrees Celsius (°C). [EN 15758: 2010]

3.6
dry air
atmospheric air without water vapour

3.7
dry-bulb temperature *(T, t)*
actual air temperature. In a *psychrometer*, the temperature reached by the thermometer having the dry bulb

Note 1 to entry: Capital *T* is used when the measurement is expressed in Kelvin (K); lowercase *t* when expressed in degrees Celsius (°C).

3.8
equilibrium moisture content *(EMC)*
moisture content at which a material neither loses nor gains moisture from the surrounding atmosphere at given relative humidity and temperature levels. Expressed in g/kg as the ratio of the mass of water m_w contained in the material and the dry mass m_{dm} of the same material, i.e.: $EMC = \frac{m_w}{m_{dm}}$

3.9
frost-point temperature
temperature to which moist air must be cooled, at constant pressure and humidity mixing ratio, in order that it shall be saturated with respect to ice, expressed in degrees Celsius (°C)

3.10
hygrograph
instrument for measuring relative humidity (see hygrometer) and recording over time

Note 1 to entry: Generally, a mechanically or electrically driven drum supporting a strip chart with RH graduation where an ink pen traces a time plot of the ambient humidity.

3.11
hygrometer
instrument measuring relative humidity

Note 1 to entry: It generally comprises a sensor, which is set in equilibrium with the air, and a system that transforms the signal from the sensor into humidity readings.

3.12
mixing ratio or humidity mixing ratio *(MR)*

ratio of the mass of water vapour m_v to the mass of dry air ma, i.e. $MR = \frac{m_v}{m_a}$, expressed in g/kg

3.13
moist air
mixture of dry air and water vapour

3.14
psychrometer
instrument for measuring the dry- and wet-bulb temperatures to calculate relative humidity and other related variables

Note 1 to entry: It consists of two identical thermometers, one of which is sheathed in wet wicking, and a fan to ensure their ventilation at a constant velocity in order to reach equilibrium with air. Thermometer readings are expressed in degrees Celsius (°C). Some electronic instruments provide readings of relative humidity (%), dew point (°C) and other related variables.

3.15
relative humidity *(RH)*
ratio of the actual vapour pressure of the air to the saturation vapour pressure

[SOURCE: EN 15757:2010]

3.16
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

3.17
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 1 to entry: This is expressed as ± percent of the range.

[SOURCE: EN 15758:2010]

3.18
resolution
smallest difference between indications of a displaying device that can be meaningfully distinguished

3.19
response time
time interval between the instant when the parameter under investigation 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 1 to entry: 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.

[SOURCE: EN 15758:2010]

3.20
saturation vapour pressure *($e_{sat}(t)$)*
maximum pressure of the water vapour in equilibrium with plane surface of pure water, expressed in hPa (hectopascal)

3.21
sensor
device that senses either an absolute value or a change in a physical quantity and converts them into a useful signal for an information-gathering system