

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

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN 16242:2012 sisaldab Euroopa standardi EN 16242:2012 ingliskeelset teksti.	This Estonian standard EVS-EN 16242:2012 consists of the English text of the European standard EN 16242:2012.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 14.11.2012.	Date of Availability of the European standard is 14.11.2012.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 97.195

### Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:  
Aru 10, 10317 Tallinn, Eesti; [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

### The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:  
Aru 10, 10317 Tallinn, Estonia; [www.evs.ee](http://www.evs.ee); phone 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

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.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

Management Centre: Avenue Marnix 17, B-1000 Brussels

# Contents

Page

Foreword.....	3
Introduction .....	4
1 Scope .....	5
2 Normative references .....	5
3 Terms and definitions .....	5
4 Quantities characterising humidity in air .....	8
5 Considerations and recommendations related to measuring methods .....	9
5.1 Considerations.....	9
5.2 Recommendations.....	10
6 Main features of the hygrometers .....	11
6.1 Chilled-mirror dew-point hygrometer .....	11
6.2 Electronic psychrometer.....	12
6.3 Electronic hygrometer with a capacitive sensor .....	13
6.4 Electronic hygrometer with a resistive sensor.....	13
6.5 Hair hygrometer/hygrograph .....	14
7 Instrument calibration .....	14
Annex A (informative) Formulae for calculating relative humidity and related variables .....	16
A.1 Instruments: Psychrometer, barometer – Parameters: air temperature $t$ (°C), wet bulb air temperature $t_w$ (°C), $p$ (hPa) .....	16
A.2 Instruments: RH hygrometer, thermometer, barometer - Parameters: $t$ , $RH$ , $p$ .....	17
A.3 Instruments: Dew-point hygrometer, thermometer, barometer - Parameters: $t$ , $t_d$ , $p$ .....	18
Annex B (informative) Examples for indoor climate measurements .....	19
B.1 Recognising the penetration and spread of external air across a room .....	19
B.2 Recognising if wall dampness is associated to condensation or evaporation .....	20
B.3 External dampness entering a room shown with a mixing ratio plot.....	20
Annex C (informative) Instrumental errors .....	22
C.1 Psychrometer: errors in the various hygrometric variables generated by an error of 0,1° C in a temperature reading .....	22
C.2 Psychrometer: error in determining the relative humidity due to pressure change .....	23
C.3 Error due to a thermal inertia of a case, a probe or a shield.....	23
C.4 Typical non-linearity and hysteresis of the hair hygrometer .....	24
C.4.1 Hair non-linearity and hysteresis .....	24
C.4.2 Linear and non-linear scales .....	25
Bibliography .....	28

## 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.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## 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<sup>3</sup>

Note 1 to entry: This volume density is also noted  $\rho_v$  (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