

SVENSK STANDARD

SS-EN 16682:2017



Fastställt/Approved: 2017-03-06
Publicerad/Published: 2017-03-07
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 97.195

Bevarande av kulturarv – Metoder för mätning av fukt- eller vatteninnehåll i material från fasta kulturminnen

Conservation of cultural heritage – Methods of measurement of moisture content, or water content, in materials constituting immovable cultural heritage

This preview is downloaded from www.sis.se. Buy the entire standard via <https://www.sis.se/std-8025358>

Standarder får världen att fungera

SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.

Delta och påverka

Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

Ta del av det färdiga arbetet

Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standardpaket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

Utveckla din kompetens och lyckas bättre i ditt arbete

Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på www.sis.se eller ta kontakt med oss på tel 08-555 523 00.



Standards make the world go round

SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.

Take part and have influence

As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

Get to know the finished work

We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

Increase understanding and improve perception

With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

If you want to know more about SIS, or how standards can streamline your organisation, please visit www.sis.se or contact us on phone +46 (0)8-555 523 00



Europastandarden EN 16682:2017 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 16682:2017.

The European Standard EN 16682:2017 has the status of a Swedish Standard. This document contains the official version of EN 16682:2017.

© Copyright/Upphovsrätten till denna produkt tillhör SIS, Swedish Standards Institute, Stockholm, Sverige. Användningen av denna produkt regleras av slutanvändarlicensen som återfinns i denna produkt, se standardens sista sidor.

© Copyright SIS, Swedish Standards Institute, Stockholm, Sweden. All rights reserved. The use of this product is governed by the end-user licence for this product. You will find the licence in the end of this document.

Uppllysningar 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

EN 16682

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2017

ICS 97.195

English Version

Conservation of cultural heritage - Methods of measurement of moisture content, or water content, in materials constituting immovable cultural heritage

Conservation du patrimoine culturel - Méthodes de mesurage de la teneur en humidité, ou teneur en eau, de matériaux constituant un patrimoine culturel immatériel

Erhaltung des kulturellen Erbes - Verfahren zur Bestimmung des Feuchte- bzw. Wassergehalts in Materialien des unbeweglichen kulturellen Erbes

This European Standard was approved by CEN on 25 December 2016.

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents	Page
European foreword.....	5
Introduction	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	8
4 Symbols and abbreviations	13
5 Moisture and water content in materials.....	14
5.1 Moisture content	14
5.1.1 General.....	14
5.1.2 Dry versus wet mode	14
5.1.3 Gravimetric versus volumetric mode	15
5.2 Water content.....	15
5.3 Comparison between moisture content and water content.....	15
6 Absolute and relative methods	16
6.1 Absolute methods	16
6.2 Relative methods.....	16
6.3 Comparison between absolute and relative methods	17
7 Taking and handling samples.....	18
8 Calibration	18
8.1 General.....	18
8.2 Instrument calibration.....	19
8.2.1 General.....	19
8.2.2 Calibration for moisture content.....	19
8.2.3 Calibration for water content	19
8.3 Reproducibility	19
8.3.1 Instruments for absolute measurements.....	19
8.3.2 Instruments for relative measurements	19
8.3.3 Comparison between absolute and relative methods	19
9 Use of existing European Standards concerning modern building materials.....	20
10 Test report.....	20
Annex A (normative) Absolute methods.....	22
A.1 Generalities	22
A.2 Gravimetric method	22
A.2.1 General.....	22
A.2.2 Apparatus.....	23
A.2.3 Procedure.....	23
A.3 Drying procedures in the gravimetric method.....	23
A.3.1 General.....	23

A.3.2 Oven drying	24
A.3.2.1 General	24
A.3.2.2 Apparatus	24
A.3.2.3 Drying procedure	24
A.3.3 Vacuum drying	25
A.3.3.1 General	25
A.3.3.2 Apparatus	25
A.3.3.3 Drying procedure	25
A.3.4 Compressed-air drying	25
A.3.4.1 General	25
A.3.4.2 Apparatus	25
A.3.4.3 Drying procedure	26
A.3.5 Adsorption drying	26
A.3.5.1 General	26
A.3.5.2 Apparatus	26
A.3.5.3 Drying procedure	26
A.3.6 Thermo-gravimetric analysis (TGA)	27
A.3.6.1 General	27
A.3.6.2 Apparatus	27
A.3.6.3 Procedure	27
A.4 Karl Fischer titration	28
A.4.1 General	28
A.4.2 Apparatus	28
A.4.3 Procedure	29
A.4.4 Volumetric KF titration (V-KFT)	30
A.4.4.1 General	30
A.4.4.2 Apparatus	30
A.4.4.3 Procedure	30
A.4.5 Coulometric KF titration (C-KFT)	31
A.4.5.1 General	31
A.4.5.2 Apparatus	31
A.4.5.3 Procedure	31
A.4.6 Oven-vaporization KF titration (OV-KFT)	32
A.4.6.1 General	32
A.4.6.2 Apparatus	32
A.4.6.3 Temperature	32

SS-EN 16682:2017 (E)

A.4.7	KF titration of selected materials.....	33
A.5	Azeotropic distillation.....	34
A.5.1	General.....	34
A.5.2	Apparatus.....	34
A.5.3	Procedure.....	35
A.6	Calcium carbide test.....	35
A.6.1	General.....	35
A.6.2	Apparatus.....	36
A.6.3	Procedure.....	36
Annex B (normative) Relative methods.....		41
B.1	Generalities.....	41
B.2	Electrical resistance (conductance).....	41
B.3	Capacitance (dielectric).....	42
B.4	Relative humidity in equilibrium with the material.....	43
B.4.1	General.....	43
B.4.2	Drilled cavity.....	43
B.4.3	External sealed box (ESB).....	44
B.4.4	Apparatus.....	44
B.4.5	Procedure.....	44
Annex C (informative) Other relative methods.....		49
C.1	Generalities.....	49
C.2	Microwave.....	49
C.3	Evanescent-field dielectrometry.....	50
C.4	Time-domain reflectometry.....	50
C.5	Nuclear magnetic resonance.....	51
C.6	Near-infrared spectroscopy (NIRS).....	51
C.7	Ultrasound pulses.....	52
C.8	Thermography.....	52
Annex D (informative) Methods with special safety requirements.....		57
D.1	Generalities.....	57
D.2	X-ray.....	57
D.3	Gamma rays.....	58
D.4	Neutron scattering.....	58
Bibliography.....		61

European foreword

This document (EN 16682:2017) 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 September 2017, and conflicting national standards shall be withdrawn at the latest by September 2017.

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

According to the CEN-CENELEC Internal Regulations, the national standards organizations 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The specific field of cultural heritage is characterized by particular needs and in most cases the existing standards devised for normal materials cannot be applied. The moisture content, or the water content, in materials is of primary relevance for the preservation of cultural heritage. High content can be very damaging (e.g. salt dissolution and mobilization, fungal infestation, corrosion, swelling) as well as low content (e.g. salt crystallization, shrinkage, wood cracking) or alternating high/low content. It is therefore important to determine and control this variable to assess the risk of damage and take preventive conservation measures.

Different methods exist to measure moisture content, or water content, in modern building materials, based on different physical or chemical principles but most of them are not applicable to cultural heritage and need to be adapted to this aim.

Generally, non-destructive methods are recommended but their accuracy may be limited. In turn, the most accurate methods require sampling and can only exceptionally be used. Readings taken with non-destructive methods may not be comparable especially because they are expressed in different units. The interpretation of measurements may be obscured by a number of factors (e.g. material, salts, temperature) to which the methods are subject.

This European Standard considers and specifies characteristics, operative methodologies, pros and cons of all methods of measurements and establishes a uniform presentation of data and units. It is addressed to anyone who needs to measure or interpret readings of moisture content, or water content, in building materials (particularly masonry and wood), and in general to whoever is responsible for the preservation and maintenance of heritage buildings.

1 Scope

This European Standard is aimed to inform and assist users in the choice and use of the most appropriate method to obtain reliable measurements of the moisture content, or water content, in wood and masonry (including brickwork, stonework, concrete, gypsum, mortars, etc.) in the specific case of the built cultural heritage.

It provides a basic framework to take and interpret this kind of measurements on the above cultural heritage materials that have undergone weathering, pest attack, salt migration or other transformations over time.

It specifies four absolute methods (i.e. gravimetric, Karl Fischer titration, azeotropic distillation and calcium carbide); explains their characteristics, pros and cons, and gives specifications for the transformation of readings into the same unit to make measurements taken with different methods comparable.

It specifies the three principal relative methods (i.e. electrical resistance, capacitance, and relative humidity in equilibrium with the material), pointing out their characteristics and uncertainties when used in the field of cultural heritage.

In addition, it provides an informative overview of ten other relative methods, their characteristics, pros and cons.

It gives specifications for the calibration of the various methods. It also compares the above methods in relation to their accuracy, sampling requirement, sample size, laboratory or field use, and other problems encountered in the field of cultural heritage to prevent instrument misuse, reduce uncertainties and avoid reading misinterpretation.

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 374-1, *Protective gloves against chemicals and micro-organisms - Part 1: Terminology and performance requirements*

EN 420:2003+A1:2009, *Protective gloves - General requirements and test methods*

EN 455-1:2000, *Medical gloves for single use - Part 1: Requirements and testing for freedom from holes*

EN 772-10:1999, *Methods of test for masonry units - Part 10: Determination of moisture content of calcium silicate and autoclaved aerated concrete units*

EN 837-1:1996, *Pressure gauges - Part 1: Bourdon tube pressure gauges - Dimensions, metrology, requirements and testing*

EN 1428:2012, *Bitumen and bituminous binders - Determination of water content in bituminous emulsions - Azeotropic distillation method*

EN 13183-1:2002, *Moisture content of a piece of sawn timber - Part 1: Determination by oven dry method*

EN 13183-2:2002, *Moisture content of a piece of sawn timber - Part 2: Estimation by electrical resistance method*

EN 13183-3:2005, *Moisture content of a piece of sawn timber - Part 3: Estimation by capacitance method*