

# SVENSK STANDARD

## SS-EN 16322:2013



Fastställt/Approved: 2013-10-06  
Publicerad/Published: 2013-10-08  
Utgåva/Edition: 1  
Språk/Language: engelska/English  
ICS: 97.195

---

### **Bevarande av kulturarv – Testmetoder – Bestämning av porösa oorganiska materials torkegenskaper**

### **Conservation of Cultural Heritage – Test methods – Determination of drying properties**

This preview is downloaded from [www.sis.se](http://www.sis.se). Buy the entire standard via <https://www.sis.se/std-99598>

# 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](http://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.

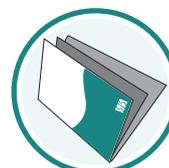
## Get to know the finished work

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](http://www.sis.se) or contact us on phone +46 (0)8-555 523 00**



Europastandarden EN 16322:2013 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 16322:2013.

The European Standard EN 16322:2013 has the status of a Swedish Standard. This document contains the official version of EN 16322:2013.

© 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 uppllysningar 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](http://www.sis.se) - där hittar du mer information.



EUROPEAN STANDARD

**EN 16322**

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2013

---

ICS 97.195

English Version

## Conservation of Cultural Heritage - Test methods - Determination of drying properties

Conservation du patrimoine culturel - Méthodes d'essai -  
Détermination des propriétés de séchage

Erhaltung des kulturellen Erbes - Prüfverfahren -  
Trocknungsverhalten

This European Standard was approved by CEN on 24 August 2013.

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

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

---

<b>Contents</b>	<b>Page</b>
Foreword.....	3
Introduction .....	4
1 Scope.....	5
2 Normative references.....	5
3 Terms and definitions .....	5
4 Principle.....	6
5 Symbols and abbreviations .....	6
6 Test equipment.....	6
7 Preparation of the specimens.....	6
7.1 Number and dimensions of the test specimens .....	6
7.2 Pre-conditioning of the specimens .....	7
8 Test procedure .....	7
9 Expression of results.....	9
9.1 Determination of the drying curve.....	9
9.2 Calculation of the drying rate .....	9
9.2.1 Calculation of the drying rate corresponding to the first drying phase $D_1$ .....	9
9.2.2 Calculation of the drying rate corresponding to the second drying phase $D_2$ .....	9
9.2.3 Determination of the knick-point.....	9
9.3 Calculation of drying index.....	10
10 Test report .....	10
Annex A (normative) Numerical example.....	11
Annex B (informative) Influence of ventilation on the drying curve .....	14

## **Foreword**

This document (EN 16322:2013) 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 April 2014, and conflicting national standards shall be withdrawn at the latest by April 2014.

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

## SS-EN 16322:2013 (E)

### Introduction

This test method can be applied if it does not change the value of the cultural property according to the ethical code of conservation practice.

The drying properties of materials can be calculated from a curve that indicates the weight loss of the mass of water inside the sample, as a function of time, during a drying experiment. Usually the drying of specimens saturated with water consists of two phases.

The first drying phase is characterised by transport of liquid water to the surface followed by evaporation. The surface remains wet allowing evaporation at a constant rate, as water moves to the surface fast enough to compensate for the losses due to evaporation. The evaporation at the surface is determined to a large extent by the test boundary conditions. These are temperature, relative humidity and the flow velocity of the ambient air. The slope of the drying curve during the first drying phase therefore reflects these conditions.

The second drying phase starts when the amount of water brought to the surface becomes too small to keep the surface wetted and the rate of evaporation decreases. Transport of liquid water to the surface is no longer possible and only the less efficient vapour diffusion mechanism remains available.

Some materials, e.g. adobe or sandstones containing clay, do not dry in this typical two-phase drying curve. For example, in the case of material treated with water repellent, the first drying phase does not exist.

## 1 Scope

This European Standard specifies a method for the determination of the drying behaviour of porous inorganic materials used for and constituting cultural property. The method may be applied to porous inorganic materials either untreated or subjected to any treatment or ageing.

## 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 15898, *Conservation of cultural property - Main general terms and definitions*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15898 and the following apply.

### 3.1

#### **porous inorganic material**

material including natural stones as sandstone, limestone, marble, and others as well as artificial materials such as mortar, plaster, brick and others

### 3.2

#### **drying rate**

mass of water transported through the specimen per area and time

### 3.3

#### **drying curve**

graphical representation of water loss over time showing in most inorganic porous materials two distinct drying phases

### 3.4

#### **first drying phase**

characterised by transport of liquid water to the surface followed by evaporation

### 3.5

#### **second drying phase**

characterised by a decrease in liquid water transport and an increase in water vapour diffusion limited by hygric material properties

### 3.6

#### **knick-point of the drying curve**

time of transition between the first and the second drying phases shown on the drying curve

### 3.7

#### **drying index**

area under the curve derived by graphical or mathematical methods

## SS-EN 16322:2013 (E)

### 4 Principle

Determination of the drying behaviour of porous inorganic materials saturated with water and subjected to drying in a controlled environment.

### 5 Symbols and abbreviations

$m_{\max}$	mass of the saturated sealed specimen, in kg;
$m_i$	mass of the sealed specimen at time $t_i$ , in kg;
$m_f$	final mass of the sealed specimen at time $t_f$ , in kg;
$t_i$	time elapsed from the beginning of the test, in h;
$t_k$	time at which the knick-point is reached in h;
$t_f$	final time of the test, in h;
A	area of the drying face, in $m^2$ ;
$D_1$	drying rate corresponding to the first drying phase, in $kg/m^2 h$ ;
$D_2$	drying rate corresponding to the second drying phase, in $kg/m^2 h^{1/2}$ ;
ID	drying index;
$M_i$	residual amount of water of the specimen at time $t_i$ per unit area, in $kg/m^2$ ;
$\beta$	vapour transfer coefficient.

### 6 Test equipment

- 6.1 A chronometer with an accuracy of at least 1 s.
- 6.2 A ventilated oven which can maintain a temperature of  $(60 \pm 2) ^\circ C$ .
- 6.3 An analytical balance with an accuracy of at least 0,01 g.
- 6.4 A linear measuring device (calliper) with an accuracy of at least 0,1 mm.
- 6.5 Climatic chamber with temperature of  $(23 \pm 1) ^\circ C$  and relative humidity  $(50 \pm 3) \%$ .
- 6.6 Sand paper with grain size of 82  $\mu m$  (corresponding to grit number P180 according to the FEPA <sup>1)</sup> classification).
- 6.7 Desiccator filled with desiccant such as self-indicating silica gel or other drying agent.

### 7 Preparation of the specimens

#### 7.1 Number and dimensions of the test specimens

The test specimens shall have a regular shape such as cubes or cylinders. They shall have minimum dimensions on any side of 10 mm. Large samples give greater experimental accuracy.

---

<sup>1)</sup> FEPA – Federation of European Producers of Abrasives

The number and dimensions of specimens are dependent on the heterogeneity of the material. Each series shall consist of at least 3 specimens. In case of anisotropy, each series shall always be tested according to the same orientation, if any. All dimensions should not differ by  $\pm 0,5$  mm.

In case of non homogeneous materials such as mortars containing coarse aggregates, the dimensions shall be at least three times (and preferably five times) that of the largest grain size.

In cases where sampling constraints exist the number and dimensions of samples may need to vary from the requirements given above, however every effort should be made to ensure that the minimum requirements for reliability are satisfied.

## 7.2 Pre-conditioning of the specimens

The test surface shall be flat and wet or dry polished with sand paper (6.6). After polishing, the specimens shall be washed with water, gently brushed with a soft brush and immersed in deionised water for 30 min.

In case of water-sensitive materials, for example gypsum containing materials, only dry polishing and compressed air shall be used. The above procedure does not apply to treated specimens or specimens taken from exposed surfaces.

Specimens are saturated with water by capillary rising absorption for 24 h and then total immersion until constant mass is achieved. Constant mass is reached when the difference between two successive weightings at an interval of 24 h is not greater than 0,1 % of mass of the specimen. After this immersion the surface of the specimens is patted dry. All faces, except the test surface, are then sealed with a water impermeable (both in liquid and vapour form) material such as latex, aluminium foil, etc.

## 8 Test procedure

Specimens prepared according to Clause 7 are placed in a climatic chamber at temperature  $(23 \pm 1)$  °C and relative humidity  $(50 \pm 3)\%$  in such a way that drying occurs through the upper side. The drying behaviour is recorded by periodic weighing.

As the air flow conditions have significant influence on the drying rate during the first drying phase, these conditions should be kept constant and reproducible. The influence is illustrated in Annex B.

The first weight reading at  $t = 0$  is  $m_{\max}$ . In order to obtain enough data during the first drying phase, the measurement interval at the beginning of the drying shall be chosen in accordance with the specimen height and the materials under investigation. The following figure indicates this influence showing drying curves obtained under standard conditions for different materials.