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**Ohranjanje kulturne dediščine - Smernice za določanje lastnosti naravnega kamna, ki se uporablja pri kulturni dediščini**

Conservation of Cultural Heritage - Guidelines to characterize natural stone used in cultural heritage

Erhaltung des kulturellen Erbes - Leitfaden zur Charakterisierung von Naturstein in der Denkmalpflege

Conservation du patrimoine culturel - Guide pour la caractérisation de la pierre naturelle utilisée dans les biens culturels

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 16515**

April 2015

ICS 97.195

English Version

**Conservation of Cultural Heritage - Guidelines to characterize  
natural stone used in cultural heritage**

Conservation du patrimoine culturel - Lignes directrices  
pour la caractérisation de la pierre naturelle utilisée dans le  
patrimoine culturel

Erhaltung des kulturellen Erbes - Leitfaden zur  
Charakterisierung von Naturstein in der Denkmalpflege

This European Standard was approved by CEN on 7 February 2015.

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.

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

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## Foreword

This document (EN 16515:2015) 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of an identical text or by endorsement, at the latest by October 2015 and conflicting national standards shall be withdrawn at the latest by October 2015.

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.

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## Introduction

The characterization of a stone is an essential step for a conservation plan, in order to decide on appropriate remedial interventions, to achieve better working practices, and technologies for conservation interventions including stone replacements. Therefore, it is important that it is achieved through a consistent and uniform methodology.

This document provides cultural heritage professionals with a guidance for a common methodology for the characterization of stones used in cultural heritage. This information is used to define nature (petrography or mineralogy and texture) and properties (chemical, physical and mechanical) of stone.

The characterization of stones used in cultural heritage should be carried out and interpreted by professionals experienced in the field of materials science and/or conservation/restoration.

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## 1 Scope

This European Standard specifies a methodology for the characterization of sound or deteriorated stones by using the most appropriate analytical techniques on samples taken from the object.

This European Standard contains guidelines for the selection of methods to determine mineralogical, textural, physical, chemical and mechanical properties of natural stone used in cultural heritage monuments and objects. This information is used to define rock typology and to evaluate the stone's condition with respect to its conservation as well as for understanding of deterioration processes of natural stone. Where possible existing standards are referred to and guidance provided where different specimens are required and additional methods used. The methods described are generally destructive, however, non-destructive (NDT) methods are always preferable to methods with a minimum of destruction and those are always preferable to destructive methods.

Methods used for stone analysis can vary depending upon the objectives of the work. All investigation and analysis need be proportional to the significance of the building or artefact being investigated, its condition and the likely level of intervention. This European Standard will be used to determine the kind, extent, and objectives of the examination to be made.

## 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 1926, *Natural stone test methods — Determination of uniaxial compressive strength*

EN 1936, *Natural stone test methods — Determination of real density and apparent density, and of total and open porosity*

EN 12372, *Natural stone test methods — Determination of flexural strength under concentrated load*

EN 13755, *Natural stone test methods — Determination of water absorption at atmospheric pressure*

EN 14146, *Natural stone test methods — Determination of the dynamic modulus of elasticity (by measuring the fundamental resonance frequency)*

EN 14579, *Natural stone test methods — Determination of sound speed propagation*

EN 14580, *Natural stone test methods — Determination of static elastic modulus*

EN 15801, *Conservation of cultural property — Test methods — Determination of water absorption by capillarity*

EN 15803, *Conservation of cultural property — Test methods — Determination of water vapour permeability ( $\delta p$ )*

EN 15886, *Conservation of cultural property — Test methods — Colour measurement of surfaces*

EN 15898, *Conservation of cultural property — Main general terms and definitions*

EN 16085, *Conservation of Cultural property — Methodology for sampling from materials of cultural property — General rules*

EN 16322, *Conservation of Cultural Heritage — Test methods — Determination of drying properties*

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EN 16455, *Conservation of cultural heritage — Dissolution and determination of soluble salts in natural stone and related materials used in cultural heritage*

**3 Terms and definitions**

For the purposes of this document, the terms and definitions given in EN 15898 and EN 16085 and the following apply.

- 3.1 investigation**  
gathering of information necessary for a conservation decision making process
- 3.2 sample**  
number of specimens of material, ideally representative, removed from the cultural property for scientific investigation
- [SOURCE: EN 16085, modified]
- 3.3 sampling**  
process of removing a sample
- 3.4 specimen**  
single individual piece of stone forming one portion of a sample
- 3.5 sound material**  
stone showing an un-altered state under visual observation with the naked eye
- 3.6 deteriorated material**  
stone showing evidence of alteration under visual observation with the naked eye
- 3.7 analysis**  
investigation of natural stone which supplies important information to establish its nature and properties
- 3.8 petrography**  
description of the mineral content and the textural relationships of rock, based on observation of hand specimen and thin microscopic section

**4 Preliminary operations****4.1 Initial survey**

An initial survey of the object together with the objectives of the stone characterization and the description of the context are essential for the selection of the analytical methodology that is to be followed. Where the object is part of the immovable heritage a condition survey should be undertaken in accordance with EN 16096 or if the object is part of the moveable heritage a condition report should be made in accordance with EN 16095.

The condition report or survey should be supplemented by sufficient information to allow a preliminary assessment of the stone and its condition. This preliminary assessment should include general stone type, the macroscopic characteristics, such as colour and texture, structural aspects and apparent condition.



## 4.2 Sampling

Sampling shall be undertaken in accordance with EN 16085. In all cases, the location, the orientation, the number, the amount, the size and the shape of the specimens used should be documented in the test report.

In accordance with the initial survey, it should be stated whether the stone specimen to be characterized is derived from sound or deteriorated part of the stone.

## 5 Methodology to characterize sound and deteriorated material

### 5.1 Visual examination of specimens

A visual examination of the specimens is undertaken. When specimens are examined using a stereo-microscope this should be in accordance with EN 12407:2007, Clause 6. In the case of natural stone used in cultural heritage objects this enables an initial assessment of their condition, colour range or overall colour, porosity, grain, weathering patterns, along with other features such as cracks, veins, voids, fillings, bedding, cleavage, macro-fossils, staining, inclusions, fabrication issues, etc.

If further information is required an accurate and detailed petrographic assessment can be undertaken by an experienced professional at a later date.

### 5.2 Examination under petrographic microscope

Petrographic description of a stone material by examination of thin sections under an optical microscope in transmitted, polarized light should be carried out in accordance with EN 12407:2007 Clause 7.

The petrographic description of thin and polished sections provides information on composition, grain constituents or mineral, their type and their abundance, on texture, grain size, shape and orientation, micro-structures, discontinuities, veins, fissures, porosity, etc. In addition to the above, when applicable, petrographic examination of natural stone used in cultural heritage objects should identify weathered or otherwise altered constituents or minerals and describe the extent of that weathering or alteration.

The following information should also be included:

- a) the stratigraphy of any surface layers (if present);
- b) the width of every different weathering layer;
- c) the adhesion and cohesion between the altered layers and the sound stone;
- d) the presence of any signs of biodeterioration;
- e) the character of the weathering, providing information on the decay process;
- f) a basic hypothesis on the deterioration mechanism and agents that affect the stone.
- g) surface soiling – its nature, level of adhesion and whether this seems to be contributing to deterioration or is merely disfiguring.

Any modification of the original characteristics of the sample during the preparation of the thin sections shall be avoided.

Excessive heating (temperatures of  $> 45^{\circ}\text{C}$ ) should be avoided during the preparation of the thin sections. Exposure to water should be kept to a minimum in order to avoid the occurrence of secondary hydration and the loss of water soluble compounds from the sample.