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Conservation of cultural property - Indoor climate - Part 1: Guidelines for heating churches, chapels and other places of worship

Erhaltung des kulturellen Erbes - Raumklima - Teil 1: Leitfäden für die Beheizung von Andachtsstätten

Conservation des biens culturels - Environnement intérieur - Partie 1 :
Recommandations pour le chauffage des églises, chapelles et autres édifices cultuels

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EUROPEAN STANDARD

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Conservation of cultural property - Indoor climate - Part 1: Guidelines for heating churches, chapels and other places of worship

Conservation des biens culturels - Environnement intérieur
- Partie 1 : Recommandations pour le chauffage des
églises, chapelles et autres édifices culturels

Erhaltung des kulturellen Erbes - Raumklima - Teil 1:
Leitfäden für die Beheizung von Andachtsstätten

This European Standard was approved by CEN on 8 October 2011.

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Contents

Page

Foreword.....	4
Introduction	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	6
4 General aspects to be considered before and during the application of the standard.....	8
4.1 Overall objective of any intervention.....	8
4.2 The individual character of the building	8
4.3 Professional support.....	8
4.4 The effect of installations	8
4.5 Sustainability and energy efficiency	8
5 Assessment of building, interiors and contents	8
5.1 Building structure and its condition	8
5.2 Building interiors and contents.....	9
5.3 Use of the building.....	9
5.4 Air exchange	9
6 Specification for indoor climate	9
6.1 Determine the appropriate indoor climate	9
6.2 Establish the historic indoor climate	10
6.3 Indoor climate specification for conservation	10
6.3.1 General.....	10
6.3.2 Relative humidity	10
6.3.3 Temperature	10
6.3.4 Air movement	11
6.4 Indoor climate specification for thermal comfort.....	11
6.4.1 General.....	11
6.4.2 Relative humidity	11
6.4.3 Temperature	11
6.4.4 Air movement.....	11
6.5 Compromise between thermal comfort and conservation	11
7 Heating strategies.....	12
7.1 Choice of heating strategy.....	12
7.2 Basic strategies	12
7.2.1 No heating	12
7.2.2 Conservation heating	13
7.2.3 Heating for thermal comfort	13
7.3 Distribution in space	13
7.3.1 General heating.....	13
7.3.2 Local heating	13
7.4 Distribution in time	13
7.4.1 Continuous heating	13
7.4.2 Intermittent heating	14
7.4.3 Mixed mode heating	14
8 Heating systems and their application.....	14
8.1 Warm-air heating.....	14
8.1.1 General.....	14
8.1.2 Centralised warm-air heating system.....	14
8.1.3 Decentralised warm-air heating system.....	14
8.1.4 Application	15

8.1.5	Thermal comfort	15
8.1.6	Conservation.....	15
8.2	Infrared heating	15
8.2.1	General	15
8.2.2	IR heating from gas combustion	15
8.2.3	IR heating from electric tubular and halogen quartz heaters	16
8.2.4	Thermal comfort	16
8.2.5	Conservation.....	16
8.2.6	Application	16
8.3	Radiators	16
8.3.1	General	16
8.3.2	Thermal comfort	16
8.3.3	Conservation.....	16
8.3.4	Application	16
8.4	Wall heating through pipes mounted in or on the inside of the walls	17
8.4.1	General	17
8.4.2	Thermal comfort	17
8.4.3	Conservation.....	17
8.4.4	Application	17
8.5	Under floor heating	17
8.5.1	General	17
8.5.2	Thermal comfort	17
8.5.3	Conservation.....	17
8.5.4	Application	18
8.6	Pew heating.....	18
8.6.1	General	18
8.6.2	Thermal comfort	18
8.6.3	Conservation.....	18
8.6.4	Application	18
8.6.5	Pew heating systems	18
9	Implementation	19
10	Evaluation.....	20
11	Comments on the application of this standard	20
Annex A (informative) Flow chart giving an overview of the standard		21
Bibliography.....		22

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Foreword

This document (EN 15759-1:2011) has been prepared by Technical Committee CEN/TC 346 "Conservation of cultural property", 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 2012, and conflicting national standards shall be withdrawn at the latest by May 2012.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

Churches, chapels and other places of worship such as mosques and synagogues (referred to collectively in the text of this standard as “places of worship”) are an important part of European cultural heritage. The buildings and their interiors, containing cultural heritage objects, are documents of our heritage that society agrees need to be preserved for present and future generations. The indoor climate is a critical factor in conserving the fabric of buildings and the objects they house.

This European Standard is motivated by the need to reflect the special characteristics of places of worship, conditions which are not addressed in standards for the heating of other kinds of buildings. The defining characteristics of these buildings are their construction (often early building techniques); the fact that they were not designed as living or working spaces; their intermittent use; and the vulnerability of their surface decoration and contents. Originally, most historic places of worship had little or no heating. Nowadays, buildings in cold climate regions may be heated in order to:

- a) provide thermal comfort for worshippers, staff and visitors (referred collectively in this text as “users”);
- b) improve the indoor climate conditions for the conservation of the building and its contents;
- c) achieve a combination of (a) and (b) in buildings where both conservation and thermal comfort have to be considered.

The conventional climate requirements for thermal comfort can sometimes be in conflict with the requirements for conservation and may therefore call for compromise.

A decision on changing or replacing the heating system in a place of worship generally depends on a variety of factors: the pattern of use of the building (e.g. frequency, numbers of users, opening hours for visitors), its liturgical uses, the significance, condition, and vulnerability of the building and its often valuable contents, thermal comfort of the users, costs (installation, operation and maintenance), energy efficiency and sustainability, visual and audible impact, aesthetics, impact on the building structure, safety, and national laws and regulations.

This standard provides guidelines in order to facilitate the best possible decision on behalf of the end users. The standard is divided into the following steps:

- a) assessment of the building, its interior and contents;
- b) determine an indoor climate specification with respect to conservation and thermal comfort;
- c) determine an appropriate heating strategy;
- d) select and design an appropriate heating system;
- e) implement the proposed changes;
- f) evaluate the effectiveness of the heating system with respect to the specification.

This is the first standard in a series of standards on indoor climate and climate control in cultural heritage buildings. The air exchange of a building has a fundamental influence on its indoor climate and climate control; general considerations are given in Clause 5. Ventilation will be dealt with fully in the second part of the series of standards on indoor climate in cultural heritage buildings, prEN 15759-2, *Conservation of cultural property — Indoor climate — Part 2: Ventilation*.

EN 15759-1:2011 (E)**1 Scope**

This European Standard provides guidelines for the selection of heating strategies and heating systems in churches, chapels and other places of worship such as mosques and synagogues, in order to prevent damage to cultural property while at the same time creating an indoor climate that allows for a sustainable use of these buildings. It applies to most kinds of places of worship regardless of size and construction. This European Standard applies not only to the introduction of new heating systems but also to the replacement of old ones.

This European Standard applies to buildings that are part of cultural heritage or that house cultural heritage objects. This European Standard deals with indoor climate conditions, heating strategies and technical solutions for their implementation but not with the technical equipment itself.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

prEN 16095¹⁾, *Conservation of cultural property — Condition report of movable heritage — Visual inspection and description of the condition of movable heritage*

prEN 16096¹⁾, *Conservation of cultural property — Condition survey of immovable heritage*

prEN 16242¹⁾, *Conservation of cultural property — Procedures and instruments for measuring humidity in the air and moisture exchanges between air and cultural property*

EN ISO 7730, *Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (ISO 7730:2005)*

EN ISO 11079:2007, *Ergonomics of the thermal environment — Determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects (ISO 11079:2007)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 climate
statistics of temperature, humidity, atmospheric pressure, wind, rainfall, and other meteorological elements in a given location over a long period of time

3.2 preservation heating
heating used to improve the indoor climate for conservation purposes

1) Under publication.

3.3**continuous heating**

permanent heating of a building throughout the cold period of the year

3.4**cultural heritage**

tangible and intangible entities of significance to present and future generations

3.5**dew point**

temperature to which humid air must be cooled for water vapour to condense into liquid water

3.6**general heating**

heating of the whole building volume

3.7**historic climate**

description of the climate over a representative period of time

3.8**indoor climate**

climate inside a room or a building

3.9**intermittent heating**

heating of a building operated for limited periods of time

3.10**local heating**

heating a limited space in the building

3.11**microclimate**

climate in part of a building or a room where the climate differs from the surrounding climate

3.12**mixed mode heating**

combination of continuous and intermittent heating, where the building is continually kept at a low temperature and heated to a higher temperature only when it is used

3.13**natural indoor climate**

indoor climate of a building without heating, forced ventilation or any other kind of active climate control

3.14**outdoor climate**

climate outside of a building

3.15**target range of RH variations**

range of RH variations that must be maintained to avoid climate induced damages

3.16**thermal comfort**

state of mind that expresses satisfaction with the surrounding environment

3.17**thermal stratification**

vertical layering of air temperatures in a building

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EN 15759-1:2011 (E)**4 General aspects to be considered before and during the application of the standard****4.1 Overall objective of any intervention**

The reason for a proposed intervention shall be clearly defined with respect to the conservation and use of the building. As long as the historic indoor climate is not causing any damage, it need not necessarily be altered unless change in use or other requirements make it necessary. Heating is not an objective in itself.

4.2 The individual character of the building

This European Standard is based on the notion that places of worship in general share enough common characteristics for a standard to be meaningful. On the other hand, it recognizes that the control of the indoor climate of each building is a complex task which requires taking into account many factors particular to the individual building, its contents, its use and its context. Therefore, this European Standard shall be applied with understanding and respect for the individual character of each building.

4.3 Professional support

The process of designing a new or altering an existing heating system shall be carried out by a multidisciplinary team in close consultation with the users of the building. The team shall include all relevant expertise, including specialists professionally qualified in the conservation of structures and heritage items, and in all other relevant technical aspects involved.

4.4 The effect of installations

For all installations related to changes in the heating system, the following factors shall be considered:

- structural alterations to the building related to ducting, pipe work, cabling etc shall be avoided unless absolutely necessary. The need for equipment rooms shall be considered at an early stage;
- installations involving damage to walls or the excavation of floors shall be subject to prior inspection comment and agreement by the relevant experts and authorities. Special attention must be paid to hidden paint layers and to the under floor archaeology of the building, including tombs and earlier construction phases;
- reduction of additional damaging interventions, the lifespan of the proposed installations shall be given greater priority than is generally the case for modern buildings;
- installations chosen shall be as visually unobtrusive as possible;
- account shall be taken of any light and sound emitted by heating installations which may be disturbing to the users.

4.5 Sustainability and energy efficiency

Sustainability in general and energy efficiency in particular should be considered at each step in the application of this standard. Given the specification for indoor climate based on conservation aspects and the use of the building, heating strategies and systems shall be chosen in order to minimise the use of energy and the environmental impact.

5 Assessment of building, interiors and contents**5.1 Building structure and its condition**

Before deciding on a new or modified heating system, it is important to establish whether:

- the perceived need for intervention is related to the climate envelope of the building itself rather than the need for a new or improved the heating system;
- parts of the building would be at risk if the heating strategy or heating system was altered.

For these purposes, a condition survey of the building is required. The European Standard prEN 16096 provides guidelines for condition survey of immovable cultural heritage objects. In the survey, special attention shall be paid to the building envelope: moisture transport, air tightness and thermal insulation. The survey shall also include the condition and functionality of existing heating installations.

5.2 Building interiors and contents

The condition of the surface decoration and significant contents shall be surveyed. The European Standard prEN 16095 provides guidelines on condition report, visual inspection and description of movable cultural heritage. In the survey, special attention shall be paid to the condition of wall paintings, some of which may be hidden under layers of plaster or paint, and to that of stone monuments, stained glass, painted and unpainted woodwork, canvas paintings, textiles (e.g. banners), metalwork (e.g. lecterns and brasses) and objects of mixed materials such as organs.

5.3 Use of the building

The initial assessment shall include a description of the heating demand in relation to the present and planned use of the building, and is to take into account patterns of worship and visiting; liturgical arrangements, performances and secular activities.

5.4 Air exchange

The air exchange of a building, whether it is due to mechanical ventilation, natural ventilation or infiltration, (leakage) can have a significant influence on the indoor climate and hence on climate control decision-making. Although this standard is limited to heating, it is essential to consider the two in tandem. When choosing a heating strategy and designing a heating system, the following aspects of air exchange shall be taken into account:

- unnecessary air exchange will increase both energy and power demand in order to counteract its effects on temperature and/or humidity;
- depending on outdoor climate conditions in relation to indoor conditions, air exchange can sometimes reduce humidity levels, sometimes having the reverse effect; therefore it has to be considered in parallel with heating strategies designed to control internal humidity;
- controlled ventilation can be an alternative to heating when high humidity is a problem;
- air exchange creates air motions that may affect conditions both for thermal comfort and for conservation.

6 Specification for indoor climate

6.1 Determine the appropriate indoor climate

In order to determine the appropriate indoor climate with respect to conservation and thermal comfort, the following steps shall be taken:

- a) establish the historic indoor climate;
- b) determine an indoor climate specification for conservation;
- c) determine an indoor climate specification for thermal comfort;