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Information and documentation — Management of the environmental conditions for archive and library collections

Information et documentation — Gestion des conditions environnementales pour les documents d'archive et de bibliothèque

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 46, *Information and documentation*, Subcommittee SC 10, *Requirements for document storage and conditions for preservation*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document covers much of the same ground as BSI/PAS 198[46]. The main difference is that BSI/PAS 198 was designed to be applied in British conditions with a temperate climate. Challenges vary in different climatic zones. Nevertheless, there are principles that are generally applicable.

No one set of conditions is appropriate for all collections in all circumstances because environmental specifications are tailored to the needs of a specific collection, the resources of the institution and the context within which it operates, and the local climate. This document sets out a framework for decision making relating to appropriate environmental conditions for cultural collections in the specific climatic zones.

Since archives, libraries and cultural institutions are guardians of the collective memory, their aim is to preserve material in the long term. They also have a duty to do so in a manner that minimizes the impact on the world's resources and climate. Climate change will affect cultural institutions as much as any other institution, if not more, and the use of energy, particularly from non-renewable sources, should be minimized. Wherever possible, passive (non-energy consuming) solutions are preferred, and buildings should be designed with this aim in mind.

First, the extent and composition of the collections, their significance, their current condition, the ways in which they are used, and the desired lifetime should be taken into account. For example, archive and library collections are likely to contain (in addition to bound and unbound paper and parchment and other organic materials, such as Xuan paper and silk, black and white and colour photographic prints and negatives) gramophone records, tapes and films, and, increasingly, diverse electronic media. In addition, the collections can contain all manner of artefacts in various materials. While many of these materials have similar environmental sensitivities, some have specific requirements that need to be taken into account.

The environment in which the collections are stored, used or displayed, and the resulting risks to them should also be understood. On the basis of the information gathered about the collections, regarding the nature and condition of the collections, it is possible to assess the vulnerability to factors such as temperature, relative humidity, light and pollutants, and thus what steps need to be taken to mitigate those risks. These might include the design of, or modifications to buildings, passive measures to control the environment, or improvements to storage and display techniques.

Every collecting institution can and should be able to carry out these steps, no matter how limited their resources, and irrespective of their climate. Knowledge of the collections, and of the risks, is indispensable to proper management and long term survival of the collections.

The consensus amongst conservation professionals regarding environmental parameters for exhibitions and loans is evolving rapidly. References [29], [206] and [236] give additional information on this. Although there is no doubt that a controlled environment is significant in the preservation of collections, provided that the parameters are appropriate to the materials, it is now generally accepted that daily and seasonal variations in temperature and relative humidity will not cause harm to the majority of collections.

This document also provides access to research that led to some of the changes in ISO 11799.

Information and documentation — Management of the environmental conditions for archive and library collections

1 Scope

This document provides information on recent discussions and changes in recommendations and guidance on environmental management within the cultural heritage field. Conservation research on preventive methodologies and passive control provided by specific construction methods and renovations, developments in technology for controlling the environment, and energy and climate change issues are included.

This document is intended for archives and libraries and other institutions with large volumes of collections that are based on paper. Archives and libraries also have collections that include film, magnetic media, leather, and other organic, inorganic or composite materials. These institutions have a unique challenge of extending the lifespan of these materials for access and use in the present and for future generations. The environment plays a key role in extending the lifespan of all of these materials.

This document is intended for use in preservation planning and ongoing environmental management of permanent storage conditions for archives and library collections and applies to all collections being permanently stored for an institution.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
air change rate
air flow rate to a space, expressed as volume per unit time, divided by the volume of the space in consistent units

Note 1 to entry: Air change rate is often expressed as air changes per hour.

Note 2 to entry: This term is used where there is active ventilation [see also *ventilation rate* (3.40)].

[SOURCE: ISO 16814:2008, 3.5]

3.2
thermal stratification
tendency of heated air to rise and to arrange itself in layers with the warmest air at the top

3.3
collection
holding
type of documents kept in archives and libraries regardless of their physical format

Note 1 to entry: These are mainly books, manuscripts, files, maps, graphic collections and other documents consisting of paper, but also parchment, papyrus, films, photographic materials, audio-visual recordings, magnetic and optical media, as well as bindings and protective material.

Note 2 to entry: Holdings is a term used more often in archival institutions.

3.4
dew point
measure of atmospheric moisture

Note 1 to entry: It is the temperature at which the water vapour in the air becomes saturated and condensation begins.

3.5
document
recorded information or material object which can be treated as a unit in a documentation process

3.6
effectiveness
extent to which planned activities are realized and planned results are achieved

3.7
energy
electricity, fuels, steam, heat, compressed air, and other like media

Note 1 to entry: For the purposes of this document, energy refers to the various forms of energy, including renewable, which can be purchased, stored, treated, used in equipment or in a process, or recovered.

Note 2 to entry: Energy can be defined as the capacity of a system to produce external activity or perform work.

[SOURCE: ISO 50001:2011, 3.5]

3.8
energy economy
careful management of energy resources

Note 1 to entry: This focuses on appropriate minimal consumption of energy within an institution, and incorporates both knowledge of energy performance and specific *energy efficiency* (3.9) of a building and/or mechanical systems.

3.9
energy efficiency
measures that ensure the building and system function in accordance with the design parameters by the efficient use of energy

[SOURCE: ISO 16813:2006, 3.17]

3.10
energy performance
measurable results related to *energy efficiency* (3.9), energy use and energy consumption

Note 1 to entry: In the context of *energy management systems* (3.12), results can be measured against the organization's energy policy, objectives, targets and other energy performance requirements.

[SOURCE: ISO 50001:2011, 3.12]

3.11
environment
surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans and their interrelationships

Note 1 to entry: Surroundings can extend from within an organization to the local, regional and global system.

Note 2 to entry: Surroundings can be described in terms of biodiversity, ecosystems, climate or other characteristics.

[SOURCE: ISO 14001:2015, 3.2.1]

3.12
environmental management system
part of the management system used to manage environmental aspects, fulfil compliance obligations, and address risks and opportunities

[SOURCE: ISO 14001:2015, 3.1.2]

3.13
environmental performance
performance related to the management of environmental aspects

Note 1 to entry: For an *environmental management system* (3.12), results can be measured against the organization's *environmental policy* (3.14), environmental objectives or other criteria, using indicators.

[SOURCE: ISO 14001:2015, 3.4.11]

3.14
environmental policy
intentions and direction of an organization related to environmental performance formally expressed by its top management

[SOURCE: ISO 14001:2015, 3.1.3]

3.15
glass transition
reversible change in an amorphous polymer or in amorphous regions of a partially crystalline polymer from (or to) a viscous or rubbery condition to (or from) a hard and relatively brittle one

[SOURCE: ISO 11357-2:2013, 3.1]

3.16
glass transition temperature
T_g
characteristic value of the temperature range over which the glass transition takes place

Note 1 to entry: The assigned glass transition temperature ($_g$) may vary, depending on the specific property and on the method and conditions selected to measure it.

[SOURCE: ISO 11357-2:2013, 3.2]

3.17
HVAC system
system that provides heating, ventilation or air conditioning for buildings

[SOURCE: ISO 16814:2008, 3.18]

3.18
hydrolyse
chemical decomposition in which a compound is split into other compounds by reacting with water

3.19
indicator
measurable representation of the condition or status of operations, management or conditions

[SOURCE: ISO 14031:2013, 3.15]

3.20
infiltration air
uncontrolled passage of air into a space through leakage paths in the building envelope

[SOURCE: ISO 16814:2008, 3.20]

3.21
insulation
materials that conduct heat poorly and thereby slow down heat loss from an object or space

3.22
long term storage
storage, for a period of undefined length, of material kept for permanent retention

3.23
maintenance
actions of prevention or correction to support long term functionality of repositories and the systems that support them

Note 1 to entry: Corrective action is taken to prevent recurrence whereas preventive action is taken to prevent occurrence.

3.24
management system
set of interrelated or interacting elements of an organization to establish policies and objectives and processes to achieve those objectives

Note 1 to entry: A management system can address a single discipline or several disciplines (e.g. quality, environment, occupational health and safety, energy, financial management).

Note 2 to entry: The system elements include the organization's structure, roles and responsibilities, planning and operation, performance evaluation and improvement.

Note 3 to entry: The scope of a management system can include the whole of the organization, specific and identified functions of the organization, specific and identified sections of the organization, or one or more functions across a group of organizations.

[SOURCE: ISO 14001:2015, 3.1.1]

3.25
mechanical ventilation
ventilation provided by mechanically powered equipment

[SOURCE: ISO 16814:2008, 3.22]

3.26
monitoring
determining the status of a system, a process or an activity

Note 1 to entry: To determine the status, there might be a need to check, supervise or critically observe.

[SOURCE: ISO 14001:2015, 3.4.8]

3.27
natural ventilation
ventilation through leakage paths (infiltration) and intentional openings (ventilation) in the building envelope or room enclosure, which relies on pressure differences without the aid of powered air-moving components

[SOURCE: ISO 16814:2008, 3.24]

3.28
occupied zone
area designed for occupancy that is dependent on the geometry and the use of the room and specified case by case

Note 1 to entry: Usually used only for areas designed for human occupancy and defined as a volume of air that is confined by horizontal and vertical planes. The vertical planes are usually parallel with the walls of the room.

[SOURCE: ISO 16814:2008, 3.28]

3.29
outdoor air
air entering the system, or opening from outdoors before any air treatment

[SOURCE: ISO 16814:2008, 3.31]

3.30
outdoor air intake
opening through which outdoor air is admitted

[SOURCE: ISO 16814:2008, 3.30]

3.31
performance
measurable result

Note 1 to entry: Performance can relate either to quantitative or qualitative findings.

Note 2 to entry: Performance can relate to the management of activities, processes, products (including services), systems or organizations.

[SOURCE: ISO 14001:2015, 3.4.10]

3.32
process
set of interrelated or interacting activities which transforms inputs into outputs

Note 1 to entry: A process can be documented or not.

[SOURCE: ISO 14001:2015, 3.3.5]

3.33
relative humidity
RH
mass of water vapour in the air by volume divided by mass of water vapour by volume at saturation at the same temperature

[SOURCE: ISO 16814:2008, 3.34]

3.34
repository
building or room designed or arranged and used specifically and exclusively for long term storage of archive or library material

3.35
requirement
need or expectation that is stated, generally implied or obligatory

Note 1 to entry: "Generally implied" means that it is custom or common practice for the organization and interested parties that the need or expectation under consideration is implied.

Note 2 to entry: A specified requirement is one that is stated, for example in documented information.

Note 3 to entry: Requirements other than legal requirements become obligatory when the organization decides to comply with them.

[SOURCE: ISO 14001:2015, 3.2.8]

3.36
sub-cool
process of cooling air below its initial dew point temperature to dehumidify via condensation

Note 1 to entry: The condensation dehumidification is followed by a reheat stage to manage temperature and relative humidity.

3.37
sustainability
maintenance of ecosystem components and functions for future generations, to address economic efficiency, social issues and environmental preservation

[SOURCE: ISO 16813:2006, 3.27]

3.38
systems
processes undergoing assessment

Note 1 to entry: Examples include heating, cooling, domestic hot water, lighting, ventilation and relevant automation or control.

[SOURCE: ISO 23045:2008, 3.3]

3.39
ventilation
process of supplying or removing air by natural means or mechanical means to or from a space for the purpose of controlling air contaminant levels, humidity, odours or temperature within the space

[SOURCE: ISO 16814:2008, 3.44]

3.40
ventilation rate
airflow rate at which outdoor air enters a building or enclosed space

[SOURCE: ISO 16814:2008, 3.45]

4 General

To manage the environment in an archive or library, objectives for planning and decisions should be determined. It should be determined what purpose environmental management will serve in meeting the preservation needs of the collections. Environmental management is often the major form of preservation action that can be carried out for all collections to prevent or slow down the deterioration of the most common materials found in archive and library collections. Determining the expected lifespan for the collections will help to determine limits to exposure to high temperature and high relative humidity and the priority within the collections for maintaining the best environment possible. To do this appropriately, the knowledge of the collections and the specific vulnerabilities of materials and formats is vital.

It is advisable to collect data relating to the collections, including:

— the materials present in the collections, and the quantities of each;

— the significance of the items, and the aspects of the items that form the basis of their significance;

— the desired lifetime of the items;

— the present condition of the collections;

— the ways in which the collections are used, including storage, handling, display or loan;

— the history of any conservation or other interventions that might affect the stability or vulnerability.

The quantities need only be approximate, but it is important that all materials present are identified.

The significance of an item is the key to why it is in the collections: it is important to understand what aspect of it gives it its significance, as it is this that should be preserved.

All materials deteriorate slowly even under the best conditions. It is not helpful to say that items should be preserved "in perpetuity", as this implies that infinite resources should be spent on doing so. It may be more useful to speak about the point at which the original significance of the item is lost, or when it has become "unfit for use". It has been suggested[29] that each institution should select a planning horizon that is realistic for their circumstances (possibly 50, 100, 500 years, or longer) and, on the basis of the nature of the collections and the present storage environment, to predict when the item will cease to be fit for purpose. If the point at which the item become unusable comes before the planning horizon, it indicates that there is a choice of doing something about the lifetime or, if resources do not allow action, accepting that this point is the item's lifetime. If the point of non-usability is beyond the planning horizon, it indicates that nothing needs to be changed. If the point of non-usability is somewhere close to the planning horizon, it indicates that nothing needs to be changed in the present because a review at set intervals may involve new information and a new starting point.

The long term planning horizon has been explored recently in a series of papers based on research carried out at the Centre for Sustainable Heritage, University College of London[241]. In this research, surveys of public users of archive and library materials studied what is considered "unfit for use" in terms of the threshold of damage, or extent of physical change that is assessed as damage. This research is significant for the environmental management of collections because the changes considered were discolouration and mechanical deterioration, such as tears and missing pieces, often an indicator of brittle and fragile materials. These physical changes are often seen in archive and library materials that have been maintained in inappropriate environments for long periods of time.

An assessment of the present condition may indicate whether items are stable, at risk or actively deteriorating which may provide information on the suitability or unsuitability of the current environment.

The institution will need to collect data relating to the environments in which collections are stored, handled, displayed or loaned, including:

— records of the internal and external temperature and relative humidity;

— records of the levels of visible and ultraviolet light to which items are exposed, and the duration of such exposure;

— records of gaseous and particulate pollutants to which items are exposed;

— where active methods of environmental control are used, such as mechanical ventilation, filtration, heating, cooling, humidification and dehumidification, records shall be made of the control settings and any alterations made to them (e.g. seasonal variations) and the amount of energy used by each of these systems.

Where possible, records should be made of the conditions in each different environment in which collections are housed.

All environmental monitoring equipment should be maintained and calibrated regularly, in accordance with the manufacturers' recommendations.

All the above records should be kept permanently and shall be reviewed regularly to see whether there are seasonal or longer term trends.

On the basis of the information gathered above, the institution will be able to assess the environmental risks to the collections.

On the basis of the environmental risk assessment, the institution will be able to set an environmental specification for the storage, handling, display and loan of items. As appropriate, this will set the permissible upper and lower limits, rate of change and fluctuations for temperature and relative humidity, the maximum permissible visible and ultraviolet light exposure, and the maximum permissible gaseous and particulate pollutant concentrations.

Where active methods of environmental control are used, the institution should endeavour to minimize the amount of non-renewable energy consumed.

5 Management of environment for optimization of preservation and sustainability

Achieving long term, sustainable preservation of archive and library materials requires that institutions approach the process of preservation with a different mindset than has been common in the past. Because no one set of environmental conditions or building operations is appropriate for all collections in all circumstances, and because it is no longer practical to achieve preservation while disregarding energy costs and consumption of non-renewable resources, it is helpful to approach the topic of sustainable preservation with a goal of optimising preservation with a building's operation. Defined, an optimal preservation environment is one that achieves the best possible preservation for collections at the least possible energy cost, and that is sustainable over time.

Optimization requires a holistic understanding of the collections and the building that contains them. It is not simply about temperature, relative humidity and other environmental factors, but about overall risk management for the collections, an awareness of the challenges or benefits that the local outdoor climate may provide, and knowledge of how the building and any mechanical systems that are designed to temper those outdoor conditions. Documenting and understanding those factors forms three critical questions that should be addressed as institutions manage the change from prescriptive environmental standards to locally determined best practices for preservation and energy usage.

— What is the current preservation environment that is maintained?

— Could it or must it be improved?

— Is more energy used than necessary to achieve that environment?

Like many aspects of collections management, creating and optimizing a sustainable preservation environment is not a onetime project, but rather an ongoing process that should be monitored and maintained over time.

A team of interdisciplinary colleagues, in the form of an environmental management team consisting of individuals from collections management and preservation, facilities management or engineering, and institutional administration, will have the requisite skills and knowledge to shepherd this change. The process requires a leader, often from the collections or facilities staff, to champion the process and oversee the work of the group. The goal is to encourage joint decision making, taking into account the needs of preservation, facilities, and administration on issues that involve collections preservation environments. In order to achieve this level of communication, it is recommended that team members strive to gain a working understanding of their colleagues' responsibilities, meaning that collections staff should learn about the building space and any mechanical systems that create the environment for their collections, while facilities staff should learn more about the institution's collections and their preservation needs.

It may be advisable to refer to the educational and assessment tools (see Clause 15) as a group and/or consult with professional colleagues in similar institutions, consultants in environmental management specifically for cultural institutions and international (i.e. ICOM, IFLA and ICA) and national and academic institutions.

Once the team is formed, optimization is a process that is continuous and includes the following steps:

— documentation;

— data gathering;

— analysis;

— experimentation and implementation;

— assessment and maintenance.

Documentation is the process of creating a shared repository of information about outdoor climate, building characteristics, collections and their preservation needs, and any mechanical systems that may impact the collections environment. Some information will be available through existing documents, while other information, such as mechanical system layout or location of various collections, may need to be discovered as part of the process.

Data gathering is the practice of using data loggers, building management systems, or other sources of temperature, relative humidity, air flows, light or pollution measurements, to provide information about long term environmental trends in collections and other building areas. The goal is to have representative information that will allow for data driven decision making regarding environmental conditions for the preservation of collections materials. Data should be gathered from any space where collections are stored, exhibited, worked on, or otherwise present for any length of time. The length of time for data gathering may vary, but to understand the behaviour of environments in response to changing outdoor conditions, a minimum of one year is recommended. In all circumstances, the longer the data gathering period, the more useful the information will be for assessment and strategic decision making as it provides a way to track environmental conditions and building and mechanical system performance over time.

Where automated monitoring systems are used, these should be capable of indicating any out of specification condition without delay by means of an alarm or similar system. Sophisticated computer-based data monitoring systems may be installed, which can aid with planning of preventive maintenance and can also provide trend logging. Attention should be paid to the placement of the sensors to ensure that the data are representative of the room as a whole. It is unwise to rely solely on a sensor in the return air duct.

The analysis step is the process of examining the available data to identify and assess preservation risks based on conditions of temperature, relative humidity, light, pollution, or other related factors. This analysis may be as simple as comparing recording data to the target ranges of conditions, or may entail more detailed analysis through the use of various tools/metrics (see Clause 15). Beyond identification, another key aspect of the analysis step is to compare levels of risk from various threats to determine where priorities for risk mitigation (lowering relative humidity to reducing mould risk, lowering temperature to reduce rates of chemical decay) lie. In addition, the data analysis, when performed by the environmental management team, may help identify opportunities for more sustainable operation of preservation environments, such as occasions of overheating or humidification of spaces. As the team performs the analysis, the identified risks and opportunities, whether for collections preservation or for energy savings, should be documented. Once documented, the team should assign priority for addressing the risks or opportunities.

Experimentation with, and implementation of, new environmental conditions or building or mechanical system operational settings allows the team to test and identify new strategies that may be used for either preservation benefit, energy savings without negatively impacting preservation quality, or both. Proposed changes in management and approach should be tested, normally for periods of two to four weeks, and conducted in multiple seasons if necessary. The team should continue data gathering for the affected space throughout the test period, then analyse the data to assess whether the adjustment

