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MEMORY OF THE WORLD PROGRAMME

Safeguarding the Documentary Heritage

A Guide to
Standards, Recommended Practices and Reference Literature
Related to the Preservation of Documents of All Kinds

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Preface

The most significant evidence of the intellectual and cultural endeavours of mankind is contained in documents. They take many forms, from papyri through parchment and paper to the modern electronic documents. As with many other man-made artefacts, however, documents are vulnerable and fragile. There is a significant danger that a substantial number, part of the collective memory of mankind, will be lost. Only a dramatic increase of effort will ensure the survival of the documents kept in the repositories worldwide. Preservation of the documents is not an aim in itself. It is, however, a pre-requisite for access to information, which is itself a fundamental democratic right. The Memory of the World-Programme is, therefore,working to promote the preservation of, and the access to, the documentary heritage of mankind.

The first topic examined by the Sub-Committee of Technology was how to facilitate access to documents. The Sub-Committee made several recommendations - especially for the consideration of the use of digital techniques. These recommendations are currently under review and will be re-issued shortly together with recommendations on the harmonization of access to electronic documents within the Memory of the World Programme.

With this guide, the Sub-Committee on Technology is addressing the other important element of the Memory of the World Programme; namely preservation. The guide gives an overview of the recommendations and measures related to the issue of safeguarding the documentary heritage. It is not attempting to deal in depth with all aspects of preservation, but to provide a guide or pointer to standards, recommended practices and reference literature related to the basic topic of preservation of documents. The guide covers the various information and data carriers in terms of their physical nature - occasionally bridging the boundaries of different traditional groupings of documents. An additional chapter deals with the strategic aspects of capturing and safeguarding electronic documents and publications - although their physical preservation problems are dealt with in the chapters for magnetic and optical media.

In order to keep pace with the technological development, especially in the field of audiovisual and electronic documents, this guide will be periodically updated.

The Sub-Committee on Technology welcomes any comments and suggestions.

Dietrich Schüller

Chairman
Sub-Committee on Technology

Safeguarding the Documentary Heritage

1. Introduction

This document offers a guide to the important standards, recommended practices and reference works in the field of the preservation and conservation of documents of all types. It does not attempt to include all the publications for a particular type of document - only the most important ones. The level of authority of the publications varies. They range from *de-facto* standards that are widely accepted by the practitioners in the field to formal International Standards produced by the International Standards Organisation (ISO). International co-operation in standardisation work is generally coordinated by ISO which defines itself as:

> *" - - a world-wide 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 organisations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (TEC) on all matters of electrotechnical standardisation."*

A standard can be used either as a guideline or as a source of specifications. Standards by themselves, however, are only an introduction to the subject. In the use of a standard it is important that the user is familiar with the subject in question, thus being able to relate the information and the circumstances to each other. In particular, standards and other publications must not be used as the sole source of information about conservation techniques. Seek advice from experts and practitioners in the field before trying to conserve any document. Much protection can be offered by ensuring that documents are stored in appropriate containers, are not subject to fluctuations of temperature and relative humidity and are handled with care. Specialist treatment is available for all types of document, from the most ancient to the most recent, and professional advice should be sought from appropriate museums, libraries and archives before undertaking any work on them. Specific advice is also often available in the standards quoted.

Standards are very important, but unfortunately standards often become modified by users after some time which can make the standard out-dated and even impede the easy exchange of information. A good example of this are the Machine Readable Cataloguing Formats (MARC) which are all based on the ISO 2709-1981 standard. However, many countries have developed their own national version and this makes the exchange of bibliographic records more difficult. Other examples include the many Document Type Definitions (DTDs) which are based on the SGML standard.

The documents in the archives and libraries of the world are indispensable sources for many scholarly disciplines. They are also sources for more informal purposes: self-education, entertainment and general interest. No evaluation of politics, history, everyday life, music and performing arts would be possible without these documents.

Information should be available to all people as freely and as easily as possible. Preservation of that information in all formats ensures access and should be pursued actively for that reason.

The safeguarding of all these documents has until recently been primarily associated with the keeping of books and other written materials. This is partly, perhaps, because textual libraries have existed for more than 4000 years, while audio-visual archives have been in existence for only less than 100 years. The newest forms of document have been in common existence for less than a decade. There are, however, fundamental differences between the different types of documents.

Printed matter represents human thoughts by the use of a stock of symbols. A certain amount of redundancy is intrinsic in speech and writing. Letters, sometimes even words, may be omitted without any real detriment to communication. Good examples are the scripts of Semitic languages which generally do not represent all vowels which are spoken. But still, even complex texts like philosophical tracts can be communicated by these languages.

In contrast, the audiovisual document is an analogue representation of a physical status or event: every part of such a document is information. While a speck of mould in a book does not normally hamper the understanding of the text, comparable damage on a photograph would cover up information, and, on a magnetic tape, it could even render the tape unreadable. Seen, therefore, from the perspective of redundancy, audio-visual documents call for a higher degree of protection and security than written materials. Digital data can also be similarly endangered.

The modern electronic documents are to some extent insubstantial - many exist for part of the time only as a pulse of energy (for example, E-Mail messages passed over a telephone wire). They do, however, have certain safeguards built into them to help ensure the safe and complete arrival and storage of a message. They also have to be stored at some point on a physical carrier for later access.

One factor that most, if not all documents, have in common is their reliance on polymeric materials. The traditional materials of paper, parchment, leather, palm leaves etc. are all natural polymers. The newer media of tapes, discs and films rely on man-made polymers such as PVC and polyester. The rate of chemical de-composition of the various polymers varies greatly. Some will last - and have lasted - for millennia; others may struggle to survive for a decade.

All polymers decay. The decay cannot be stopped - but it can be slowed down by careful handling and favourable storage. It can also be greatly accelerated by careless handling and poor storage. All the storage conditions given in standards and other publications are for guidance. If the conditions are met, the decay does not stop. The figures quoted for temperature and humidity levels are a compromise between the rate of decay on the one hand and the costs of maintaining the conditions, of transfer and of conservation on the other. The conditions can be relaxed but at the expense of more rapid decay.

Format of the Guide

The various types of documents covered in this guide are divided into five groups:

Paper and Other Traditional Materials
Photographic and Micrographic Materials
Mechanical Carriers
Magnetic Materials
Optical Materials

There is an additional chapter covering the particular problems of preserving Electronic Publications, Electronic Documents and Virtual Information plus chapters giving some general preservation information and a glossary.

The **Paper and Other Traditional Materials** group include paper, parchment, leather and palm leaves. Seals. Inks and pigments are also included in this group. This is the oldest and largest group of documents.

The **Photographic Materials** group include all types of still photographic images - black and white and colour; negative and positive; transparency and print - on all types of carriers - paper, glass, cellulose and other materials and includes micrographs of all types.

The **Mechanical Carriers** group covers sound recordings on cylinders and discs.

The **Magnetic Materials** group include all forms of magnetic material - tapes, hard discs and floppy discs.

The **Optical Materials** group includes all laser read and written materials including CD-Audio, CD-ROM, CD-Recordable, magneto-optical disks and optical tape.

This guide is a compilation of contributions from a number of people, each expert in the preservation of a different type of document. Each field of expertise has developed its own terminology and, while there are many terms shared by all the disciplines, some are not. No attempt has been made to harmonise the terms used and so you will find different terms used in different chapters but meaning the same thing eg. user copy and access copy.

You will also find places where the topic has been covered in another chapter as well. Again, efforts have not been made to avoid this. Many readers will wish to read a chapter in isolation and this repetition will ensure that they receive all the information necessary for the understanding of the chapter.

2. General Preservation Factors

Preservation Masters and Access Copies

Many data carriers, especially modern high density formats, are, by their very nature, vulnerable. Additionally, there is always the risk of accidental damage through improper handling, malfunctioning equipment or disaster.

For the long term storage of many types of documents it is increasingly becoming necessary to review the strategies for preservation. One strategy that is widely used is the creation of access copies of documents. A lower quality copy can act as an adjunct to the catalogue to aid researchers to decide what documents they wish to study. A good quality copy may be acceptable for study in place of the original. The use of copies to reduce the frequency of access to the original document will reduce the stress on the original and help to preserve it. A clear policy about the classes of researchers allowed access to original documents - particularly fragile ones - will also help documents survive. It is clearly impossible to totally prevent access to originals but many users can perform their research using good quality access copies and, thus, aid the preservation of the original document..

It is imperative, therefore, to have at least two copies of each document - one preservation master and one access copy. These should be stored in two different locations, ideally under different climatic conditions (see below). Several archives have established a policy to produce, in addition to the preservation master, an additional safety copy. Computer centres have established similar policies to safeguard the data in their care.

Archive quality microfilm, used by many institutions both as a preservation and a high quality access medium, is being supplemented by digital storage systems using optical discs and magnetic tapes as the carrier. A further advance being considered by a number of institutions is the self-controlling and self-regenerating digital mass storage system. This is currently being tested as a medium for the safeguarding of some collections of audiovisual documents. This kind of concept may also provide a solution for the major problem of the safeguarding of electronic documents. Such mass storage systems are, at the same time, an indispensable pre-requisite for the functioning of all kinds of services in the forthcoming information age, for example "digital libraries" and "video on demand".

The price of mass storage systems is relatively high at present but will soon come within the reach of average budgets. Contrary to fears expressed by some, this concept does not call exclusively for huge, centralized stores: it will also allow individually tailored solutions for smaller applications. Thus, such systems could also be a solution for the preservation of documents in countries with adverse climatic conditions.

While in hot and humid environments, conventional preservation techniques may be inappropriate due to the notorious lack of funds for the proper air-conditioning of storage areas, mass storage systems, requiring relatively small floor space, can be effectively air-conditioned at a lower cost. As an example, a cabinet available from one typical system, occupying one square metre of floor space, can hold the equivalent of over one million pages of A4 text.

Obsolescence of Hardware

With development of technology, recording systems, ie the carriers together with the necessary recording and replay equipment, have become increasingly sophisticated. Even for textual materials, the almost universal use of word processors can create unexpected difficulties. At the same time, the (commercial) lifetime of systems has become increasingly shorter. While for traditional audiovisual formats such as analogue tape the lifetime of the tape was of predominant interest, the future availability of suitable and functioning replay equipment is becoming the burning issue for several modern formats. In the computer world, the availability of dedicated drives has always been of greater concern than the stability of the respective carriers. The situation is additionally aggravated by the obsolescence of dedicated software and operating systems. Several audio archives are now systematically transferring their holdings into self-controlling and self-regenerating mass storage systems (see above) to escape the vicious circle of ever decreasing life spans of carriers and their dedicated hardware. It has become apparent that, in setting up strategies for the safeguarding of both audiovisual and electronic documents, the future migration has to be taken into account.

Maintenance of Equipment

With all machine readable documents, the performance of recording and replay equipment is a central factor in the safeguarding of data. Great efforts have to be made to keep equipment in the best possible condition. To this end, many audio-visual archives and computer centres have their own service departments employing well trained personnel. In a time of ever increasing sophistication of equipment, however, there is an increasing amount of work that has to be done by specialists from outside. When out sourcing such jobs to third parties, the essential role of machine maintenance for the safeguarding of the collection has to be kept in mind.

Climatic Conditions

To ensure a long life for the polymers carrying the information in storage, it is necessary to control the climatic conditions in the store. The basic requirement is for stable temperatures and stable humidity levels. Large variations in either parameter will accelerate the decay processes. Air conditioning plants must be kept running for 24 hours a day. To use the plant only when staff are present negates the purpose of the equipment. It is there to preserve the material in store not for the comfort of the staff. The air in the storage areas should be filtered through activated carbon filters and should be freely circulated to all storage areas six times an hour with a 10% intake of fresh air. It is extremely important that the circulation is maintained, with fans if necessary, to avoid pockets of stagnant air where fungal growth may flourish.

High temperatures will accelerate the decay processes; cooler temperatures will slow them. Similarly, high levels of humidity in the storage areas will encourage hydrolysis and, if above 65% RH, will encourage the growth of moulds and fungi. It is common knowledge that many polymers are best stored at low temperatures. It is less commonly known that humidity also must be controlled. The problem for many collections is that is relatively easy to keep the temperature in the storage areas stable but controlling the humidity level is more difficult and expensive.

As the temperature drops the air can hold less moisture and the relative humidity rises. If a store is cooled without simultaneously controlling humidity, there is a danger that moulds and fungi will be encouraged to grow. These growths will not only eat away at paper and other natural polymers but will also make machine readable carriers - magnetic tapes, optical discs etc - unplayable and possibly damage the equipment. If it is not possible to keep the relative humidity below 65% when the store is cooled, it would be better to set a higher, but stable, target

temperature that will ensure that humidity is kept stable and below 65% RH. The penalty will be a shorter life for the carriers. This is greatly preferable, however, to a life of only a year or two because of irreparable damage caused by moulds and fungi.

3. Paper and Other Traditional Materials

This group, with the greatest diversity, contains the oldest materials. They are accessible with the naked eye and the majority are made of materials which have the capacity to last for a long time if cared for correctly. It should not be forgotten, however, that these information carriers are a composite of materials with different properties. Writing supports and writing materials should always be seen in combination. They are linked together by physical and chemical forces. The treatment of the various endogenous (internal) and exogenous (external) types of damage is very complicated and should only be done by experts.

Despite this, a lot can be done by suitably trained people to extend the usable life of documents. There are many simple measures of good housekeeping which can prolong the life of traditional materials almost indefinitely; special skills are not required, merely common sense and forethought. The options for preservation include:

- The provision of appropriate stable environmental conditions.
- Boxing and packing.
- Copying to some other medium.
- Active conservation treatment.

The latter is an expensive solution and the cost can usually only be justified for a small number of items of particular importance. Each institution or organisation will have to decide on its own priorities and decide how best to protect every category of material. Basic protection, such as good housekeeping, training staff to handle items with care, or storing them on shelving rather than the floor is not expensive and should be part of every preservation programme.

However, it is unwise for the archivist, librarian or other professional staff to attempt more than such basic preservation activities. The use of modern materials, such as pressure sensitive tape to repair torn pages or the use of inappropriate adhesives to stick boards together, will make the condition of the document worse in the long run. Instead it is recommended that the item in question should be packaged in acid free boxes, tied together if necessary and protected against damage in transit by secure packing. Advice should then be sought from a trained conservator; most national archives or libraries will have information about local conservators and where they can be contacted.

3.1 Preservation Requirements

In general the requirements for ensuring the survival of these historic materials include the following:

I. Dedicated buildings for the storage of and access to archival material.
II. Appropriate and stable environmental conditions.
III. Appropriate boxing and packing to avoid damage in storage or transporting.
IV. Appropriate storage equipment such as shelving, static or mobile, and safes where necessary for items of particular value or security.
V. Security systems to prevent theft.
VI. Adequate listing and indexing to prevent speculative searches and much damaging handling of the material.
VII. The provision of facilities to make access copies (electro-static copies, microfilming, photography) for material which is at risk through fragility or heavy use.
VIII. Access to conservation facilities.

Conservation work is the most expensive solution and can only be afforded for a small number of items of particular importance. Some archives have the resources to employ conservators on the staff; in this case their advice should be sought as a matter of course in all issues to do with the physical survival of the items. In other cases a private conservator may be consulted.

If the decision is made to send work out on contract the following points need to be considered:

I. How is the material to be transported, and by whom?
II. What are the security arrangements in the conservation workshop and is extra insurance required?
III. What are the qualifications of the conservator in question?
IV. Is it possible to see examples of his/her work elsewhere and talk to those who have had work done before?
V. What type of work has been recommended and are the method and materials appropriate for the item?
VI. What is the cost?
VII. What guarantees are offered about the quality of work?
VIII. Will the owner have access to the material at all times?
IX. What timetable is proposed?

All estimates should be written, with details of work to be carried out and the proposed security and insurance arrangements.

Designated storage areas are the best solution for all archival material to ensure their security. They should be soundly constructed, secure from outside intrusion, have few, if any, windows and be equipped with adequate shelving. The floors should be solid, uncarpeted and, ideally, on one level, to aid the use of trolleys for transporting documents. All services should be isolated. If there are windows they should be fitted with blinds to avoid natural light and should be lockable or have bars fitted. Local fire precautions should be observed. The stability of the temperature and the ralative humidity is also an important factor. Rapid or large changes can be very destructive. It is not recommended that archival materials should be stored in basements or attics where the temperature and relative humidity will be difficult to control.

It is particularly important not to exceed 65% relative humidity, the point at which mould growth is triggered. If using an air conditioning system to cool a storage area, it is essential to monitor the relative humidity. If the relative humidity approaches the danger level then action must be taken to reduce its level. This can be done either by allowing the temperature to rise slightly or by using de-humidifying equipment. Air conditioning plants must be kept running for 24 hours a day. The plant is there to preserve the material in store not for the comfort of the staff. The air in the storage areas should be filtered through activated carbon filters and should be freely circulated to all storage areas six times an hour with a 10% intake of fresh air. Fans should be used to avoid the creation of pockets of stagnant air where fungal growth may flourish. In general terms, the colder a storage area is, the better the archival materials will survive.

Microfilms or facsimiles can provide both an access copy of original documents and also a safeguard against loss through decay or disaster. Ideally two copies should be made and the duplicate sets kept in different buildings as a protection against a sudden disaster. If high fidelity microfilms are made they can also be used as the source for making digital copies. Preservation initiatives of this sort support access to information. The making of photocopies should be restricted to the staff of the institution. Even for trained staff, photocopying should be controlled. The very intense light used in photocopiers can swiftly destroy many pigments.

3.2 Paper

Both Oriental and Western papers are made using cellulose (vegetable fibre or materials made from such fibres such as rags) and water, the former being beaten into a pulp, dispersed in water and then drained through a tight mesh mould. Once the water has drained away, the film of pulp remaining on the mould is transferred to felts, dried and pressed to produce a sheet of paper which may require further treatment depending on the proposed use. While the original ingredients were relatively pure the paper maintained good strength and longevity. However, the introduction of wood pulp in the nineteenth century to satisfy the increasing demand for paper led to a deterioration in quality.

Additives in the shape of alum, or alum rosin, chlorine, sulphate of soda or other chemicals designed to speed the production of the paper, or counteract the natural acidity of the wood, caused more damage by breaking down the fibres which in consequence embrittled the paper. Other types of unstable paper in the twentieth century include many copying papers, the quality of which is dependent on the standard of paper used initially, the stability of the bond created between the copying ink and the paper, and the type of ink. In many cases the quickest and cheapest method of ensuring their survival is to re-copy them using stable materials and well maintained equipment.

The reasons for the decay of nineteenth and twentieth century papers are well known but until recently few solutions have been proffered. The adoption of rigorous standards in the manufacture of paper intended for long term use is the solution for the future survival of paper documents but does nothing for those which already exist. Basic methods such as good storage, maintaining stable environmental conditions, excluding light, keeping the store rooms clean and dry and handling the material carefully will contribute to the overall preservation of these materials.

Specialist microfilming, copying or conservation work should be left to trained personnel who will be able to assess the problems of individual items. Mass methods, such as mass de-acidification of paper, are used in some archives and libraries but are not practised universally and are expensive.

Periodicals are another important part of textual archives and libraries. Most are printed on particularly poor quality, high acid paper. This, coupled with the large page size, which can make them difficult to handle with care, and the, perhaps, greater demand for access, gives a particularly poor combination of factors. The preservation of periodicals can require specific conservation treatments such as lamination or paper-splitting, in addition to more traditional methods such as binding or boxing and re-formatting.

3.3 Parchment

Parchment is made from the skin of an animal, usually sheep but calf skin is also used. It consists of collagen fibres, arranged in three dimensional bundles, which are themselves proteins composed of long chain amino acids. The skin is turned into parchment during a long process which involves the removal of the fur and flesh with the use of lime, scraping the skin, stretching on frames to dry under tension, polishing it and finally rubbing it with French chalk to provide a good writing surface. It was the most common writing medium of the Middle Ages in Europe, superseding papyrus by the third or fourth century AD, until the invention of printing in the fifteenth century increased the demand for a lighter, more flexible medium.

It is a very tough and versatile material which, due to its nature, is hygroscopic. It reacts to temperature and humidity which must, therefore, be kept as stable as possible. Excess relative humidity endangers parchment from both mould growth and deterioration but, by contrast, if the parchment is too dry, the ink is likely to flake off. The ink is also susceptible to being abraded by rough handling or tensions induced by unstable environmental conditions. In practical terms the range of conditions for parchment, which is nearly always stored alongside paper and other archival materials, are similar to those required for paper.

3.4 Palm Leaves and Birch Bark

These materials are cellulose based, being vegetable fibre. As natural materials, without the processing involved in paper making, they are quite hard wearing but are susceptible to cracking. The inks used are frequently carbon based and may be endangered by incorrect storage, environmental conditions or handling. The storage standards for these are similar to those for paper or parchment.

3.5 Seals

Applied and pendant seals are frequently found on official documents as a means of authentication. Their fragility is evident and some are likely to be in two or more fragments. Pendant seals are usually found on parchment documents, attached by a silk thread (frequently plaited) or a tongue of parchment. The materials from which the seals were made were traditionally either wax or shellac; in the seventeenth century improvements were made to enhance the bond between the writing medium and the seal by inserting a piece of dampened paper between the wax and the seal matrix to form a papered seal. The addition of resin, known as Venice turpentine, gave the seal a good finish being added as a plasticiser. The red or green colour of the wax was obtained by mixing vermilion or verdigris with the molten wax when it was being initially prepared with turpentine, the colour being a significant indication of the importance or purpose of the seal. Lead was used for Papal seals.

Pendant seals were frequently given additional protection from damage by bags, pouches or skippets - the boxes specifically designed to house seals. Where these survive and offer adequate protection they should be kept with the seal so far as is possible. Wax and shellac pendant seals without original, or adequate housing, should be stored in archivally sound boxes with holes cut in the side to accommodate the tag by which the document and seal are joined. Additional protection can be achieved by lining the boxes with an inert foam, Plaztazote, hollowed out to fit the shape of the seal. When in storage both document and seal should be supported and under no circumstances should the seal be allowed to hang free.

Applied seals should be protected by placing a small pad of cellulose wadding over the seal and onto the document, thereby cushioning the seal.

Lead seals should be placed in polyester bags or plastic boxes and stored on metal, not wooden, shelving. The organic acids in the wood react with the lead and cause the seals to deteriorate.

If the seals are fragmentary and require expert conservation, specialist advice must be sought. The individual fragments should be carefully wrapped, and placed together in a box to await advice.

3.6 Leather and Book Bindings

Many archives have been bound into book format, or created as books. In consequence it is necessary to consider them as a separate category, although they may be made of some of the materials discussed above. Collections of archival material which have been bound may combine more than one material within one case, making preservation particularly difficult. Cases in point include parchment and paper from the period when both were in frequent use, or more recently photographic prints stuck into albums. Textile sample books present major problems for the archivist and conservator as they were frequently outsize and the paper backing was very poor quality.

Leather used for bindings is an organic material, coming from the same source as parchment. The most prestigious skin was that of a calf, followed by goat; pig skin was used for the larger and heavier volumes which required a stronger covering and sheep skin was used where durability was not an issue. Most leather was vegetable tanned (using gall boiled in water) until the nineteenth century; this was a slow process which left protective salts in the skin. The skin was then dyed to the required colour. Demand for a greater number of skins and a quicker process however, resulted in the introduction of alternative, stronger acids for tanning which ultimately contributed to the decay of the leather. This, combined with the natural acidity in the skin and the absorption of sulphuric acid from increasing air pollution, led to the condition known as 'red rot' where the binding crumbles away. No cure for this condition has been found.

From the point of view of the protection of the contents, the binding will probably provide some protection and should not be removed other than by a conservator or specially trained bookbinder. Evidence of interesting binding techniques have too often been lost as a result of such action. If the sewing of the volume has failed, or the boards have become detached from the text block the whole item should be placed in a slipcase or box of appropriate size and tied round, to ensure that nothing is lost and further damage is not being caused. The environmental conditions should be similar to those for paper and parchment and particular care should be taken in handling any volumes where the mechanical structure appears to be at risk.

3.7 Writing Materials

3.7.1 Inks

In general, an ink is a fluid or viscous material of various colours but most frequently black, brown-black or blue-black. It is composed of a pigment or dye in a suitable vehicle and used for printing and writing. The earliest inks were essentially suspensions of lamp black or soot (carbon) in a gum and are harmless to all writing supports. They are, however, sensitive to water. This type of ink was in common use until the 11th century, when iron-gall inks began to come into prominence. Examination of parchment manuscripts from the 9th to the 15th centuries indicate that all were written with iron-gall inks in which no trace of carbon could be found.

An iron-gall ink is produced by the reaction of tannic acid with an iron salt, such as ferrous sulfate ($FeSO_4$). The reaction produces no immediate change in the colour of the solution, but, when the ink is applied to paper and is thus exposed to air, it darkens by oxidation, forming ferric tannate.

Iron-gall inks were the predominant inks until about 1860, when the introduction of aniline dyes brought about radical changes in ink manufacture . Since then the manufacture of ink has become extremely complicated. Iron-gall ink does have one serious disadvantage. Free acids are often present. These attack parchment and, more vigorously, paper. In extreme cases, the written letter and/or area will become very brittle and the manuscript becomes too weak to be safely used.

To prevent additional damage ensure that the paper is well supported and packed. Specialist advice should be sought and the document should not be used until conservation work has been completed. To preserve the information, the document may be copied onto another information carrier (microfilm or digitization), but only by careful, expert staff. Research is currently being conducted on the best method of combatting the damage so caused but the variety of recipes used to prepare the ink makes progress slow.

3.7.2 Pigments and Dyes

Pigments are natural or synthetic, organic or inorganic substances used in the manufacture of paint, printing inks etc. to impart colour. Although most pigments and dies are more or less stable and do not affect the parchment and paper, there are many manuscripts which have been damaged by the action of copper-green, caused by the acid used to prepare the green colour. Similarly the use of basic lead carbonate, used as a white pigment since ancient times, has a darkening reaction which eventually leads to a black discolouration. Expert advice should always be sought to rectify such problems.

3.8 Photocopies and Computer Printed Outputs

These are relatively new media but, like the writing supports described above, their deterioration and preservation principles depend upon the paper used and the applied printing technology. As with other new documents, it is advisable that only papers which meet the standards for Archival Paper should be used.

The question of which printing technology (dot matrix, ink jet, laser, etc) will have the best life expectancy is very complex and not easy to answer. Recent research works prefer the ink-jet-printer, since the ink particles adhere to the cellulose fibres with little reactive bonding agent. Laser printed papers tend to "block" if stored under unsuitable conditions or if kept between certain types of plastic sheet. On the other hand, ink-jet printed papers are water-sensitive while laser prints are water-resistant. Under normal conditions this is of minor importance, but will considerably more important after a disaster involving water.

As some of these methods of duplicating texts use very intense lights, particularly laser photocopiers and scanners, they should be used sparingly. The intense light can destroy some pigments and dyes if used frequently. Only trained staff should be permitted to make copies of material in the collection and each occasion that a document is copied should be recorded. If a particular document is found to be copied frequently, consideration should be given to making a high quality sub-master for use as the source of future copies.

Recommended Climatic Storage Conditions

Material	Temperature range	Relative humidity range
Paper	13-20°C	45%-55%
Parchment	13-20°C	45%-55%
Leather	13-20°C	45%-55%
Palm Leaves, Birch Bark, Seals etc.	13-20°C	45%-55%

Standards

Many of the standards issued by individual countries, or the International Standards Organisation, cover a range of materials and include details of the best storage conditions. They are less numerous than the more technical standards in the sections which follow as they are traditional materials which have survived over a long time because of their inherent qualities and are not dependent on technical standards.

ISO NP 11799	Storage requirements for archive and library materials
ISO WD 11108	Archival material - requirements for permanence and durability
ISO/TC46 SC10	Storage requirements for library and archival materials
ISO DIS 11800	Information and documentation - requirements for binding materials and methods used in the manufacture of books
ISO CD 14416	Information and documentation - requirements for binding of books, periodicals, serials and other paper documents for archive and library use-methods and materials
BS 5454	Recommendations for storage and exhibition of archival documents (1989)
BS 4971	Recommendations for repair and allied processes for the conservation of documents; part I

Reference Literature

Edward Adcock, Marie-Thérèse Varlamoff and Virginie Kremp
Principles on the Care and Handling of Library Materials
IFLA-PAC and the Commission for Preservation and Access 1998

Dureau , JM and Clements, DNG
Principles for the Preservation and Conservation of Library Materials
IFLA Professional Report no 9 1986

Preservation of Historical Records
Committee on Preservation of Historical Records of the National Research Council of the National Academy of Sciences.
National Academy Press, 1985

Ellis, J
Keeping Archives
Thorpe and Australian Society of Archivists, 1993

Favier, J, Neirink D
La Pratique archivistique Francaise, Paris
Archives Nationales, 1993

Pickford, C, Rhys-Lewis, J and Weber, J
Best Practice Guideline 4
Preservation and Conservation, Society of Archivists, 1997

Ritzenthaler, M L
Archives and Manuscripts
Society of American Archivists, 1993

UNESCO RAMP studies in general. Available in Arabic, Chinese, English, French, Russian and Spanish

Also see the publications of the Commission on Preservation and Access (Washington CD, USA) and the European Commission on Preservation and Access (The Hague, Netherlands)

4. Photographic Materials

Deterioration of Photographic Materials

Photography can be defined as any method producing a visible image by the inter-action of light with a layer of chemicals. Since the birth of still photography in 1839, photographs have been manufactured employing many different methods. About 40 of these methods have been used commercially and examples of the resulting images can now be found in great numbers and varieties in archives and library collections.

The development of a commercially successful system for recording and viewing moving images was the result of work by many people in the latter part of the 19th century. The first successful public demonstrations were given by Lumière in Paris in 1895. Since then many advances have been made including the introduction of sound and of colour. Many different frame rates and sizes of film were devised before the industry stabilised on to a few "standard" formats. A film collection still has to be able to handle films on many formats.

Microfilm was developed to secure original print and image material with special historical, commercial or scientific value. The use of microfilms can also improve the access to the information carried by the original documents. The use of microfilm for access will, as with other forms of access copy, help preserve the original by protecting it from wear and tear and from theft.

The most recent developments are as a result of the computer revolution. New techniques have been developed using equipment such as ink-jet and thermal sublimation printers to produce copies of digitised images. These should be considered as printing techniques and not as photographic materials although they can provide a good representation of the original photographic image. Because of the short life expectancy and the sensitivity to light and heat, these printing techniques cannot be considered a substitute for photographic materials.

The best practice for photographic materials is to have several sets of images:

The **Original Image** kept in ideal conditions and disturbed as infrequently as possible.
A **Safety Master** used as a reserve copy. It should be stored in a separate place to the original in case of the loss of the original in a fire or some other disaster and also kept in good storage conditions.
A **User Copy Master** made from the original or the safety master and used to make User Copies.
User Copies for routine access to the images.

Though photographic images have been made in a great number of different sizes - from microfilms to large posters - the deterioration and preservation principles are dependent upon the chemical process used to make the image and not the size or purpose of the image. As the production of photographs has included many different chemical processes in the capture of the image, photographs also have a wide variety of ageing properties. Some materials were made of extremely self-destructive components, others were very sensitive to physical contact and almost every photographic material is sensitive to the environment, not only temperature, relative humidity and air pollution but also oxidising substances found in emissions from some building materials, wall paints and wooden furnishing. The card-board and paper in boxes and envelopes used for protecting the items from physical damage may also contain harmful substances.

Deterioration Factors

Deterioration factors can be categorised in two ways - internal and external.

1. Internal Deterioration

Internal deterioration factors are dependent on the components of a photographic item and the residual chemicals from developing- and post treatment processes. The speed of the decay processes is related to relative humidity, temperature and oxidising substances.

The most commonly known example of a photographic material deteriorating from internal processes is cellulose nitrate film, which during deterioration emits substances that both accelerate the deterioration process as well as attacking materials in the vicinity.

Another materials group exposed to self destruction is that of acetate film - the first safety film. Until recently, acetate film was considered as very stable but today the problem of the Vinegar Syndrome - the popular name for the deterioration of acetate film with the emission of acetic acid (vinegar) vapour as a by-product that acts to accelerate the rate of decay - is widely known. Still another example, although involving an old process, is the yellowing of albumen prints, where the egg white in the emulsion bleaches the silver image.

Colour photographs - negatives, prints and transparencies - generally have bad ageing properties as the colour-components are unstable unless kept below 0°C. Photographic colour materials are not only subject to light fading - fading of the colours and image in the presence of light - but also to dark fading - fading in the absence of light. Transparencies are commonly considered to have better colour stability than colour negatives and prints but ageing properties may differ greatly due to different chemical properties.

A Few Examples

Collodion, one of the earliest photographic emulsion materials, was used in several similar photographic techniques during the mid-18th century, e.g. ambrotypes, collodion wet plates, pannotypes, ferrotypes and celloidin paper. The collodion emulsion contains cellulose nitrate (also used for the first "plastic-type" film base) and emits nitrous gases, though far less than cellulose nitrate film. These gases may attack other objects in the vicinity and, due to the loss of gas which leads to shrinkage of the emulsion, the emulsion may eventually crack.

Supports that are subject to self-deterioration include cellulose nitrate film, acetate film and some of the modern resin coated or so called plastic paper. The main ingredient of nitrate film is cellulose nitrate which emits nitrous gases. The gases are not only oxidative but also toxic and explosive. In a self-accelerating deterioration process, the support - the film base - and the emulsion are eventually completely destroyed. What is left is a sticky substance. Cellulose nitrate film is flammable at fairly low temperatures and rolls of film, like motion picture films, might even self ignite at a room temperature as low as 41°C when kept for an extended period of time in a badly ventilated environment, for example in the traditional metal film can[1]. Cellulose nitrate film sheets do not self ignite in the same way because the mass per volume

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[1] Laboratory tests performed in 1949 in the USA established that nitrate film stored in an insulated container could self-ignite at an external temperature of 41°C (106°F) ie. at a temperature not far removed from those reached in midsummer in many countries. Other sources suggest that self-ignition can take place at temperatures as low as 37°C (99°F).

is much less and normally the emitted gases slowly evaporate away from the negatives when they are kept in envelopes and open boxes.

Acetate film was introduced in the 1920s as a substitute for the flammable cellulose nitrate film. It was labelled "safety film" as it was less flammable than its predecessor. The early acetate film lacked dimensional stability which made it shrink and loosen the emulsion from the support. The acetate base was improved and was considered more or less stable until the vinegar syndrome was discovered during last decade.

PE or Resin Coated papers are made from paper fibres covered with polyethylene with the gelatine emulsion outside the polyethylene layer. Until about the mid 1980s this photographic print paper had bad ageing characteristics. The paper base contained optical whiteners which absorbed light energy. An oxidising substance was formed which attacked the resin coating resulting in cracking. The oxidant also attacked the silver image and bleached it. During the last decade an anti-oxidant has been introduced and thus the resin coated papers now have improved longevity.

Microfilms have been and are produced using a variety of processes but the silver-gelatine developing-out film is considered to have the best long-term stability. Diazo- and vesicular processes are commonly used for making access copies but they do not have long-term stability and are not recommended for preservation copies.

2. External Deterioration Factors

External deterioration factors are harmful substances in the preservation environment. Among the many contaminants, a few should be particularly mentioned. Lignin, alum rosin sizing and oxidative residual chemicals in paper and cardboard used for envelopes, boxes and mounting boards as well as plasticisers in PVC-folders and similar storage media are the most common together with air pollutants. Furbishing in repositories should not consist of materials emitting oxidising gases. Oxidising gases react with photographic materials in a similar way as common air pollutants. High temperature and relative humidity accelerates these processes.

Synergetic Effects of Internal and External Deterioration Factors

The external deterioration factors may co-operate with the internal factors to increase the reaction speed of the internal deterioration factors.

Materials with good initial ageing properties - i.e. with few internal deterioration factors - may last longer in a bad environment than an object with bad ageing properties - i.e. with many internal deterioration factors - kept in a good preservation environment.

Good storage conditions will counteract deterioration of materials with bad ageing properties to a certain point, while bad storage conditions will always accelerate deterioration processes.

Recommended Measures for Improving Preservation Conditions

The best way to preserve photographic materials is to emphasise measures on preventive care. The necessity of proper storage materials - envelopes, boxes, archive and library furbishing etc. - and storage climate cannot be over estimated.

If possible a photographic collection should be divided and stored as two sets; an active and a passive. The active set is for frequently used material - mainly copies of originals - and the passive set is for long term keeping of the originals. The passive set should have a stable climate with low temperature and relative humidity. A number of recommendations exist but they do not differ significantly from the requirements listed in the following table. These are weighted for a good cost/effectiveness ratio. The requirements can be difficult to achieve but must always remain the target. The target temperature and humidity readings can be relaxed provided that the conditions are kept stable and with the proviso that the humidity level is kept above 25% and below about 65% - the level above which moulds are encouraged to grow. The penalty in most cases is, however, a shorter life expectancy for the carriers.

Preservation Climate Requirements for Photographic Materials

	Temp	±/24h	±/Year	RH	±/24h	±/Year
STILL IMAGES						
Negatives	<18°C	±1°C	±2°C	30%-40%	±5%	±5%
b/w Prints	<18°C	±1°C	±2°C	30%-40%	±5%	±5%
Cellulose Nitrate Film	<11°C	±1°C	±2°C	30%-40%	±5%	±5%
Colour Negatives	<2°C	±1°C	±2°C	30%-40%	±5%	±5%
Colour Slides	<2°C	±1°C	±2°C	30%-40%	±5%	±5%
Colour Prints	<2°C	±1°C	±2°C	30%-40%	±5%	±5%
MOVING IMAGES						
Colour Films	-5°C	±1°C	±2°C	30%	±2%	±5%
b/w Safety Films	<16°C	±1°C	±2°C	35%	±2%	±5%
b/w Nitrate Films	4°C	±1°C	±2°C	50%	±2%	±5%
b/w MICROFILM						
Silver-gelatine	<18°C	±1°C	±2°C	30%-40%	±5%	±5%

A range of humidity levels are quoted for still images and microfilm. The humidity must not move outside this range. Any variation must not exceed the change of RH figure for 24 hours. For moving images, a target humidity level and figures for the maximum movement from this figure over periods of 24 hours and one year are quoted.

Basements and attics are usually not suitable for storing photographic materials. Basements are usually very humid and often accommodate plumbing which, if it starts to leak, may cause irreversible damages. Attics, if not properly insulated, will have an uncontrolled climate affected by the out-door conditions.

High temperature and high relative humidity (RH) accelerates most deterioration processes. The cooler the temperature the slower the deterioration rate. The control of relative humidity is even more important in an archive or library with photographic materials.

These types of damage may occur when the RH is **TOO HIGH**:

- Mould and fungi start to grow when RH rises above 65%.
- The emulsion swells and get sticky.
- Residual chemicals will accelerate deterioration processes.
- Glass plates might start to deteriorate and the glass may turn foggy.
- Deterioration processes caused by air pollutants, paints etc. may accelerate.
- Photographs on metal support, Ferrotypes, may start to corrode.

The following damages may occur when RH is **TOO LOW**:

- The emulsion dries out and might flake.
- Dry emulsion may fall off the support.
- Film support may lose its flexibility

It may be difficult to keep the air in an archive or library clean since most major collections are usually situated in the centre of major cities. But it is nevertheless of the utmost importance to keep the areas free from air pollutants as possible. They are very reactive with substances in both b/ w and colour photographs. Listed in the following table are the requirements for clean air in photographic collections.

Other harmful substances exist in the air but good chemical filters customised for the substances listed in the table will control these as well.

Air Quality Requirements in Archives and Libraries for Photographic Materials

Gas	Active Set	Passive Set
SO_2	1 $\mu g/m^3$	1 $\mu g/m^3$
NO_x	5 $\mu g/m^3$	1 $\mu g/m^3$
O_3	25 $\mu g/m^3$	2 $\mu g/m^3$
CO_2	45 g/m^3	45 g/m^3
Fine Particles	75 $\mu g/m^3$	75 $\mu g/m^3$

If the collection includes any nitrate moving films, seek advice from the local fire authorities about the storage requirements, the maximum quantity of film that can be kept in one storage area and any other restrictions that they may require. This action is not merely good advice - it is essential. Nitrate movie film is considered to be an explosive by the fire authorities in many countries.

Conclusion

Photographic objects belong to a very delicate category of our cultural heritage which need special attention by trained personnel. Materials are susceptible to air pollutants, both fuel generated and emitted from furbishing and protective materials in repositories, as well as high humidity and temperature. It is important, therefore, to be in control of the preservation environment. It is also important to be able to identify the photographic methods represented in a collection and thus be aware of specific preservation problems.

Specifications, methods and measures for improving the preservation environment for photographic materials can be found in special literature and standards. Some of these are listed below.

Standards

ISO 417	Photography - Determination of residual thiosulfate and other related chemicals in processed photographic materials - Methods using iodine-amylose, methylene blue and silver sulfide.
ISO 543	Cinematography- Motion picture safety film - Definition, testing and marking
ISO 3897	Photography - Processed photographic plates - Storage practices.
ISO 4331	Photography - Processed photographic black-and-white film for archival records - Silver-gelatin type on cellulose ester base - Specifications
ISO 4332	Photography - Processed photographic black-and-white film for archival records - Silver-gelatin type on poly(ethylene terephthalate) base -Specifications
ISO 5466	Photography - Processed safety photographic films - Storage practices
ISO 6051	Photography - Processed reflection prints - Storage practices.
ISO 6200	Micrographics - First generation silver-gelatine microforms of source documents - Density specifications
ISO 8126	Micrographics - Diazo and vesicular films - Visual density - Specifications
ISO 9718	Photography - Processed versicular photographic film - Specifications for density
ISO 10214	Photography - Processed photo graphic materials - Filing enclosure for storage.
ISO 10602	Photography - Processed silver-gelatine type black-and-white film - Specifications for stability.
ISO 5-1	Photography Density measurements Part 1: Terms, symbols and notations
ISO 5-2	Photography - Density measurements - Part 2: Geometric conditions for transmission density
ISO 5-3	Photography Density measurements - Part 3: Special conditions
ISO 5-4	Photography - Density measurements - Part 4: Geometric conditions for reflection density

Reference Literature

Garry Thomson
The Museum Environment
Butterworth-Heinemann, Oxford 1986
ISBN 07506 2041 2

Preservation of Microfilming - does it have a future?
Proceedings of the First National Conference of the National Preservation Office, at the State Library of South Australia, 4-6 May 1994, Canberra 1995
ISBN 0 642 10639 8

Guidelines for Preservation Microfilming in Canadian Libraries
National Library of Canada for The Canadian Cooperative Preservation Project (In English and French)
ISBN 0 660 57970 7

Henry Wilhelm & Carol Brower
The Permanence and Care of Colour Photographs: Traditional and Digital Colour Prints, Colour Negatives, Slides, and Motion Pictures.
Grinnell, Iowa, 1993, ISBN 0-911515-00-3 (hardcover)
ISBN 0 911515 01 1 (paperback)

Imaging Processes and Materials
Ed. by John M. Sturge, Vivian Walworth & Allan Shepp, New York 1989
ISBN 0 442 28042 6

James M. Reilly
Care and Identification of 19th-Century Photographic Prints
KODAK Publication No. C-25, CAT 160 7787
ISBN 0 87985 365A
Schrock, Nancy Carlson

Preservation and Storage
In Picture Librarianship ed. By Helen P Harrison, Library Association, London 1985

The Conservation of Photographs
Eastman Kodak, Rochester, New York, 1985

Brown, Harold Godard
Basic Film Handling
FIAF Preservation Commission, Brussels

Brown, Harold Godard
Problems of Storing Film for Archive Purposes
British Kinematography No. 20, 1952

The Book of Film Care. Publication F-30
Eastman Kodak Ltd, Rochester, New York, 1983

Handling, Preservation and Storage of Nitrate Film
FIAF, Brussels, 1987

5. Mechanical Carriers

Within the group of documents commonly labelled audiovisual (photographic still and moving images, audio and video recordings) are sound recordings on cylinders and discs. The common factor with this group of documents is the method of recording the information. This is by means of a groove cut into the surface by a cutting stylus and which is modulated by the sounds, either directly in the case of acoustic recordings or by electronic amplifiers.

There are no official standards for the preservation of these materials but there are, however, a number of standard reference publications available. These are listed in the Bibliography that follows. In addition, the Proceedings of the series of Technical Symposia organised by the international archive federations (FIAF, FIAT, IASA and ICA) on the preservation of sounds and moving images contain many papers of interest.

Phonograph Cylinders

Cylinders, originally developed for use as dictating devices, have been used since around 1889 for original recordings in the academic world and later also as mass produced recordings for the entertainment industry in competition with early gramophone (shellac) discs. While industrial production ceased in the late twenties, they continued to be used for field recording until the 1950s (!). Most cylinders are made of wax; some of the mass replicated cylinders are made from celluloid. There are about 300,000 cylinders in the custody of recorded sound collections world-wide. They are extremely brittle and fragile and if they have been stored under conditions which are too humid, they suffer from mould. Fortunately, most of these holdings have already been transferred onto modern media and thus their contents, which are frequently of unique historical value, are already safeguarded .

Shellac Discs

Coarse groove gramophone discs, commonly called shellacs or 78s, were the main mass produced audio format of the first half of our century. It is estimated that the world-wide stocks of this format amount to 10 million discs. They were produced from 1898 until the mid-fifties. The discs consist of various mineral substances bound together by organic substances like shellac or similar binding materials. Although breakable if dropped, these gramophone records are fairly stable and there are no reports of a systemic instability problem.

Instantaneous Discs

Prior to the introduction of magnetic tape, which occurred in the late 1940s and early 1950s, the "instantaneous discs" - so called because they can be played immediately after recording the sounds without the need for the lengthy processes required for mass produced discs - were the only medium for audio recordings that could be played back immediately. The total number in existence amounts to about three million. Practically all of these discs are irreplaceable originals, many of them of great cultural, historical and scholarly importance.

Unfortunately, the largest group of these instantaneous discs, the "acetate discs", are at the greatest risk. These discs are laminates consisting of a core plate, usually of aluminium but plates of glass, steel and card are also known, with a lacquer coating of nitrate or acetate cellulose which is soft enough to be cut by a recording machine, but hard enough to withstand several replays. With age, the coating shrinks and becomes brittle by a hydrolytic process: the stresses between the shrinking lacquer and the stable core increase until, suddenly, the lacquer breaks apart, and flakes off. By this means a considerable portion of the holdings world-wide have already been lost. Even if

programmes to transfer the sounds were hastily established, further losses of irreplaceable information cannot be prevented. Every day, apparently intact records are being affected by this phenomenon.

Microgroove Discs

From the late 1940s onward microgroove discs (vinyl or LP records) replaced shellac discs and only relatively recently (since about 1990) has this format been replaced by the compact disc (CD). The total number of microgroove discs in sound archives world-wide is estimated to be more than 30 million. They are made mainly of polyvinyl chloride. No systematic stability problems on a great scale have arisen so far, but their stability in the long term, thinking in centuries, is unknown.

The Stability of Mechanical Carriers

The main factors related to instability of mechanical carriers and retrievability of information can be summarized as:

- Humidity and temperature
- Mechanical deformation
- Dust and dirt of all kinds.

Humidity, as with all other data carriers, is a most dangerous factor. While shellac and vinyl discs are less prone to hydrolytic instability, most kinds of instantaneous discs are extremely endangered by hydrolysis. Additionally, all mechanical carriers may be affected by fungus growth which occurs at humidity levels above 65% RH.

Elevated **temperatures** beyond 60°C are dangerous, especially for vinyl discs and wax cylinders. Otherwise, as with other carriers, the temperature determines the speed of chemical reactions like hydrolysis and should, therefore, be kept reasonably low and, most importantly, stable to avoid unnecessary dimensional changes.

Mechanical integrity is of the greatest importance for mechanical carriers. It is imperative that scratches and other deformation caused by careless operation of replay equipment are avoided. The groove that carries the recorded information must be kept in an undistorted condition. Only specialist personnel should, therefore, be allowed to handle and replay mechanical carriers.

While shellac discs are very fragile, instantaneous and vinyl discs are more likely to be bent by improper storage. Generally, all mechanical discs should be shelved vertically. The only exceptions are some soft variants of instantaneous discs.

Dust and dirt of all kind will deviate the pick-up stylus from its proper path causing audible cracks and clicks. Fingerprints are an ideal adhesive for foreign matter. A dust-free environment and cleanliness is, therefore, essential.

Obsolescence of hardware is not yet a major issue for mechanical carriers. Replay equipment for microgroove and 78rpm discs is still available and several sound archives have constructed cylinder replay machines which offer excellent performance for cylinders of all formats. With the exception of instantaneous discs and cylinders, mechanical carriers are not generally at risk. Because the discs wear when played, migration to a modern digital format will be necessary for items in frequent demand.

Because of the extreme risk to the future survival of instantaneous discs, all existing holdings must be transferred with highest priority.

Recommended Climatic Storage Parameters

	Temp	±/24h	±/year	RH	±/24h	±/year
Preservation Storage	between 5°C and 10°C	±1°C	±3°C	30%	±5%	±5%
Access Storage	about 20°C	±1°C	±3°C	40%	±5%	±5%

Operation areas (studios) should have the same climatic conditions as access storage areas.

It is of utmost importance to control both temperature and humidity simultaneously. Archivists and librarians are explicitly warned to not to cool the storage environment without dehumidification because such action will normally lead to an unacceptable rise of relative humidity and may encourage the growth of moulds and fungi.

Standards and Recommended Practices

IASA TC-03	The Safeguarding of the Audio Heritage: Ethics, Principles and Preservation Strategy. 1997

Reference Literature

Burt, LS
Chemical Technology in the Edison Recording Industry.
In: Journal of the Audio Engineering Society 10-11/1977

Calas, Marie-France, et Fontaine, Jean-Marc
La conservation des documents sonores.
CNRS-Editions, Paras 1996

Khanna, SK
Vinyl Compound for the Phonographic Industry.
In: Journal of the Audio Engineering Society 10-11/1977

Pickett, AG and Lemcoe, MM
Preservation and Storage of Sound Recordings.
Washington 1959. Reprint by ARSC, 1991

Schüller, Dietrich
Behandlung, Lagerung und Konservierung von Audio- und Videoträgern.
In: Das Audiovisuelle Archiv, Das Audiovisuelle Archiv 31/32, 1992
(1993)

Schüller, Dietrich
Preservation of Audio and Video Materials in Tropical Countries.
In: IASA Journal 7/1996

St.Laurent, Gilles
The Care of Cylinders and Discs.
Technical Coordination Committee (Ed), Milton Keynes 1997
(available in English, French, German and Spanish)

6. Magnetic Materials

Magnetic media are essential to modern life. They are used in the form of tape to record sounds and images and to record digital data. In the form of hard and floppy discs they are used to store computer data. When applied in the form of a magnetic strip to a card, magnetic media control our access to money from cash dispensers, entry to doors and to many other things.

The basic principles for recording signals on a magnetic medium were set out in a paper by Oberlin Smith in the 1880's. The idea was not taken any further until Valdemar Poulsen developed his wire recording system in 1898. Magnetic tape was developed in Germany in the mid 1930's to record and store sounds. The use of tape for sound recording did not become widespread, however, until the 1950's. The BBC, for example, was still using disc recorders until around 1965.

The recording of images on magnetic tape came later. As with sound recording, there were several systems before tape recording came into common use. The first known recordings of images by a non-photographic method were made by John Logie-Baird in 1924. The images were recorded on to 78 rpm discs which are now in the National Sound Archive in London. The first practical recordings of television programmes were made using special film cameras filming video screens. The first video recording machine using tape was made by the BBC in 1955. It used a half inch tape running at 120 inches per second - just over 3 metres per second. This was swiftly superseded by the introduction of the Ampex Corporation's 2 inch video tape system. The arrival of new formats for recording video pictures has steadily increased since then. It has been calculated that, taking the different broadcast standards and electricity supplies into account, images have been recorded on over 100 different formats in the 40 years since video-tape recording started.

Although some dictating machines using a disc coated with a magnetic pigment were in use from the 1950's, disc based media did not develop until computers became widespread. The steady increase in the storage capacity and decrease in physical size of both hard and floppy disks has paralleled the developments in the tapes used for sound and image recording.

Magnetic Tapes

Magnetic media in the form of tapes on open reel or housed in cassettes and cartridges are the most widespread carriers for audio and video data and are widely used for the storage of large quantities of computer data. They are a reliable, low-risk and economical storage medium. Archivists and librarians can rely on a long period of experience in the care and handling of magnetic tapes in archives. If free from production faults, they can be preserved for many years. The oldest audio tapes are now over 50 years old and still perfectly readable.

Types of Magnetic Tape Construction

Early audio tapes used cellulose acetate as the support film material, which is also used for safety film. Cellulose acetate has a tendency to become brittle through hydrolysis caused by the moisture contained in the atmosphere. This brittleness generally causes serious problems when playing old audio tapes. Tapes with severe cases of hydrolysis can suffer from the so-called "Vinegar Syndrome", an auto-catalytic process whereby acetic acid is set free in ever increasing quantities and thus creates an accelerating effect on the decay process. This has been particularly experienced in film archives, especially in hot and humid climatic areas. Affected films become soft and limp, ending up as powder or slime. While, in theory, this may also happen to acetate audio tapes, no disastrous losses similar to those in the film world have been reported. Still, acetate tapes, which were produced until the mid 1960s, are at risk and transfer onto other carriers must be envisaged.

Another group of historical audio tapes used polyvinyl chloride (PVC) as the base film material. As with vinyl discs, these tapes have not exhibited any systematic instability; the long term prospects are, however, unknown.

Polyester is the base film material which is used for all modern audio and all video and computer tapes. It has the greatest resistance of all base materials to mechanical stress and the influence of humidity. No systematic stability problems have occurred so far but, again, its stability over very long periods (centuries) is unknown.

Many varieties of magnetic materials have been used for the pigment layer, for example the various oxides of iron used from the very first tapes until today and chromium dioxide. Only metal powder, as used in more recent high density tape formats, has given cause for serious concern. Early tapes metal powder tapes suffered from corrosion but this problem now seems to be under control. There is, again, no precise answer to the question of how long metal particle tapes will keep their information undistorted and readable. It must be emphasized, however, that, contrary to layman's expectations, the magnetic information on properly stored and handled tape does not fade away.

The greatest problem related to magnetic tape is the stability of the pigment binder - the glue that holds the magnetic particles together and to the base film. A considerable number of audio and video tapes, especially amongst those produced during the seventies and eighties, are suffering from pigment binder hydrolysis. The atmospheric moisture is absorbed by the pigment binder causing the polymer to hydrolyse and lose its binding property. Tapes of this kind deposit a smear of magnetic particles onto the replay heads. This clogs the heads and swiftly makes the tape unreadable. In extreme cases, the oxide layer the completely delaminates from base in large segments when the tape is played. Processes to render such tapes playable again are available, but the restoration process is cumbersome, time consuming and cannot restore the most severely affected tapes. This problem has been found especially in hot and humid areas where many tapes do not last longer than a few years.

Types of Magnetic Tape Housing

There are three basic methods for the immediate storage of tape: open spool, cassette and cartridge. The tape on an open spool has to be threaded on to the machine and the free end secured on a second spool by hand - a time consuming task and easily performed incorrectly. Tape in a cassette is enclosed in a shell and the two ends of the tape are securely fixed to captive spools. A cartridge is also fully enclosed but the tape is in the form of a continuous loop. Cassettes and cartridges are easier to load on to a machine than open spool tapes and are also suitable for use in robotic storage systems. Cassettes are common for modern video and computers but relatively few are used for professional audio. Cartridges are most commonly encountered with data but some are used for audio - particularly for short items such as station idents and commercials.

Open Spool Tapes

Open spools were until recently the main form of tape used for professional audio recordings. Continental European tradition generally uses professional tape on flangeless hubs only, a practice that requires additional care when handling the tapes. Some expensive professional digital audio formats like DASH and PD (ProDigi) use reel-to-reel tape and stationary head technology. Early video and many data tape formats also used tape in open spool form.

Cassette Tapes

Cassettes are used for many purposes. They range from the Compact Audio Cassette or Musicassette through the many types of video cassette to the latest Digital Audio Tapes with rotary heads (R-DAT). They are probably the most widely used form of tape used in modern systems.

The Compact Audio Cassette was originally designed for use with dictating machines. Its convenient size led to it becoming used for the issue of commercial music recordings and for home recording. Except as an access tape, it was not normally used for professional work. In addition to the Compact Cassette, there have been several other cassette tape formats used for dictating machines.

Many types of cassette have been used for analogue video recordings both professionally and in the home. The commonest is the ubiquitous VHS cassette. Other formats include the ¾ inch U-Matic - a semi-professional format - and the ½ inch BetaCam used by many broadcasters around the world. All video tape formats, analogue and digital, use rotary head technology. Some of these digital video formats were also adapted for the storage of general computer data.

Rotary head technology is used for the digital audio format R-DAT, while stationary head technology is employed for the DCC (Digital Compact Cassette), a data-reduced digital consumer audio format designed to replace the Compact Audio Cassette.

A variety of cassette formats are used in the computer world as back-up tapes for the information held on hard discs - the so-called streamer tape formats. These include the QIC- 80, Exabyte and a derivate of the R-DAT audio format.

The R-DAT format potentially makes an ideal data backup media. However, there is little experience of their long-term storage qualities. Opinions are divided. Some experts say that a five year re-copying term is appropriate, others claim that DAT are not suitable for long-term storage. For safety reasons, a two year recopying term is advisable until more is known of the long-term performance of these formats.

Tape Cartridges

The primary use for cartridges is for storing computer data but a variant was extensively used to record short sound sequences for commercials, station identifications and the like. These audio cartridges were either monophonic or stereophonic (two tracks). The cartridges used for computer data, however, use 24 tracks which permits a storage capacity of 12700 bpi. Due to the sequential recording, the average access-time is relatively long.

Magnetic Disks

There are two types of magnetic disk - the hard disks and the floppy disks. While reading and writing, the disk is rotating around its centre. The data are recorded in circular tracks, sector by sector. Because of the sectorial access to the data, the average access- time is relatively short .

Floppy disks are thin, flexible plastic plates covered with a magnetic oxide layer and protected by a firmly fastened square plastic jacket. At present, the common format is the 3·5 inch-disk. The older 3·0, 5·25 and 8·0 inch disks are no longer in use and it is difficult to find drives for them. The storage capacity of a 3·5 inch disk is 1·4 MB. 3·5 inch disks with a capacity of 2·88 MB have been developed but are not very common yet.

Data interchange on floppy disks usually causes no media problems provided that a drive for the physical format of the disk is available. Disks are not suitable for long-term storage. They can deform because of the instability of the plastic material and damage the drive. They should, therefore, only be used for a limited period of time.

Hard disks are usually found installed permanently in computer systems and used for very fast access, short term storage. Removable hard disks exist but they are not common. Although hard disks are reliable, it is advisable to make back-up copies of data stored on them. Storage capacities in excess of 2 GB are now common and, when hard disks are used in an array (RAIDs), very large storage capacities can be achieved - albeit at great cost compared with other storage formats. Hard disks in RAIDs will be in continuous use and have a life expectancy of several years

Data Density versus Data Security

The history of magnetic storage media is the history of ever increasing data density. This has been achieved by the steady decrease in size of the elementary magnetic structure - from iron oxide via chromium dioxide to "pure metal" as used in metal particle tape and hard disks. In parallel with this, has come the development of ever smaller gaps in the reading heads, very thin base films (some R-DAT tapes are only 9µm "thick") and very narrow tracks widths (13µm on R-DAT). By use of these developments, ever increasing quantities of information can be recorded on ever decreasing sizes of carriers.

The danger is, however, that the recorded information becomes increasingly vulnerable. It is generally true to state that, because of their increased data density, modern formats are less reliable than older formats with their lesser storage capacities. Correct recording and reading of information onto or from modern magnetic formats is highly dependent on the physical and chemical condition of the recording medium being in pristine condition, the replay equipment functioning perfectly and an environment free from disturbing factors such as smoke, dust, and other pollutants.

The Stability of Magnetic Carriers

The main factors that affect the stability of carriers and the retrieval of information can be summarised as:

- Humidity and temperature.
- Mechanical deformation.
- Dust and dirt of all kinds.
- Magnetic stray fields.

Humidity is the most dangerous environmental factor. Water is the agent of the main chemical deterioration process of polymers: hydrolysis. Additionally, high humidity values (above 65% RH) encourage fungus growth, which literally eats up the pigment layer of magnetic tapes and floppy disks and also disturbs, if not prevents, proper reading of information.

Temperature is responsible for dimensional changes of carriers, which is a particular problem for high density tape formats. Temperature also determines the speed of chemical processes: the higher the temperature, the faster a chemical reaction (eg hydrolysis) takes place; the lower the temperature, the slower the chemical reaction.

Mechanical integrity is a much underrated factor in the retrievability of data recorded on magnetic media: even slight deformations may cause severe deficiencies in the play back process. Most careful handling has, therefore, to be exercised, along with regular professional maintenance of replay equipment, which, if it malfunctions, can destroy delicate carriers such as R-DAT very quickly. With all tape formats, it is most important to obtain an absolutely flat surface of the tape wind to prevent damage to the tape edges which serve as mechanical references in the replay of many high density formats. All forms of tape - open reel, cassettes and cartridges - and floppy disks should be stored upright.

Dust and dirt prevents the intimate contact of replay heads to media which is essential for the retrieval of information, especially with high density carriers. The higher the data density, the more cleanliness has to be observed. Even particles of cigarette smoke are big enough to hide information on modern magnetic formats. Dust may also be responsible for "head crashes" of computer hard disks and of rotary head formats, which inevitably leads to irretrievable loss of data. It goes without saying that in addition to the mechanical problems caused by dust, fingerprints and smoke, chemical pollution caused by industrial smog can accelerate chemical deterioration. The effective prevention of dust and other kinds of dirt and pollution is, therefore, an indispensable measure for the proper preservation of magnetic media.

Stray magnetic fields, finally, are the natural enemy of magnetically recorded information. Sources of dangerous fields are dynamic microphones, loudspeakers and head sets. Also magnets used for magnetic notice boards etc, possess magnetic fields of dangerous magnitudes. By their nature, analogue audio recordings, including audio tracks on video tapes, are the most sensitive to magnetic stray fields. Analogue video and all digital recordings are less sensitive. For the safeguarding of analogue audio recordings is necessary to keep to the following maximum magnetic stray fields:

- AC fields: 5 Oe (Oersted) = 400 A/m (Ampere per metre)
- DC fields 25 Oe = 2000 A/m.

It should be noted that normally a distance of 10-15cm is enough to diminish the field strength of even strong magnets to acceptably low values.

Recommended Climatic Storage Conditions

	Temp	±/24h	±/year	R H	±/24h	±/year
Preservation Storage	between 5°C and 10°C	±1°C	±2°C	30%	±5%	±5%
Access Storage	around 20°C	±1°C	±2°C	40%	±5%	±5%

Fluctuations of target temperature and humidity values should be kept to a minimum. Operational areas (studios) should, therefore, have the same climatic condition as the access storage areas.Tapes must be allowed to slowly acclimatise to the change in conditions when brought out of or returned to the preservation storage.

It is of utmost importance that both temperature and humidity are controlled simultaneously. Damage to tapes can occur if attempts are made to cool the storage environment without dehumidification. Such action will normally lead to an excessive rise in relative humidity.

Summary

Although magnetic media are generally quite stable and analogue magnetic tape has been in existence for over 60 years, none of the magnetic media are designed with longevity in mind. Even if all recommended standards and practices for the preservation of original magnetic carriers are carefully observed, it not possible to preserve them for long periods. Sooner or later copies will have to be made. Because of the increasing deterioration of audiovisual information when copying in the analogue domain, a preservation policy based on copying can only be successful in the digital domain. For digital documents, audiovisual as well as computer data, the problems related to the preservation of the carriers are increasingly overshadowed by the problems of the obsolescence of hardware and associated software. The management of future migration is, therefore, becoming the central issue of audiovisual as well as of general data preservation. Self-checking and self-regenerating digital mass storage systems are likely to become a powerful tool in future preservation policy.

The digitization of analogue carriers and the migration of information already in the digital domain are gigantic tasks. Because these will take time to complete, digitization/migration projects must be arranged in a hierarchical order. Priority must be given to those documents which are in frequent demand and to those which are at immediate risk. Meanwhile, those documents which are in good condition can wait. They must, however, be stored with all possible care in order to keep them in the best possible physical condition until their turn for digitization or migration comes.

Standards

There are few relevant international standards at present. The American National Standards Institute (ANSI) and the British Standards Institute (BS) have issued some useful national standards. The Audio Engineering Society (AES) and ANSI are jointly working on a series of new standards dealing specifically with the storage of magnetic materials.

International

AES22-xxxx	Draft AES Recommended Practice for Audio Preservation and Restoration - Storage of Polyester-base Magnetic Tape
AES/EBU	Recommended practice for digital audio engineering - serial transmission format for linearly represented digital audio data
IASA TC-03:	The Safeguarding of the Audio Heritage: Ethics, Principles and Preservation Strategy. 1997
SMPTE RP 190-1996	Recommended Practice: Care and Preservation of Audio Magnetic Tape

National

ANSI X3.14-1983	American national standard for information systems: recorded magnetic tape for information exchange
BS 4783:1972	Recommendations for the care and transportation of magnetic tape
BS 4783:1988	Recommendations for storage, transportation and maintenance of magnetic media for use in data processing and information storage. Part 2: Recommendations for magnetic tape on open spools
BS 4783:1988	Recommendations for storage, transportation and maintenance of magnetic media for use in data processing and information storage. Part 3: Recommendations for flexible disk cartridges
BS 4783:1988	Recommendations for storage, transportation and maintenance of magnetic media for use in data processing and information storage. Part 4: Recommendations for magnetic tape cartridges and cassettes

Reference Literature

Allen, Norman et.al.
Factors Influencing the Degradation of Polyester Based Cinematographic Film and Audio-Visual Tapes.
In: Boston, George (Ed.), Archiving the Audio-visual Heritage. Proceedings of the Third Joint Technical Syposium, Ottawa 1990. 1992

Bertram, HN, and Cuddihy, EF
Kinetics of the Humic Aging of Magnetic Recording Tape.
In: IEEE Transactions on Magnetics 27:4388-43955, 1982

Bradley, Kevin
Restoration of Tapes with a Polyester Urethane Binder.
In: Phonographic Bulletin 61/1992

Calas, Marie-France, et Fontaine, Jean-Marc
La conservation des documents sonores. C
NRS-Editions, Paris 1996

Dumont, J, , Johansen, J, and Kihlander, G
Handling and Storage of Recorded Video-tape.
European Broadcasting Union, Technical Centre, Lausanne 1989

Edge, Michelle
The Deterioration of Polymers in Audio-visual Materials.
In: Boston, George (Ed.), Archiving the Audio-visual Heritage. Proceedings of the Third Joint Technical Symposium, Ottawa 1990. 1992

Gibson, Gerald D.
Magnetic Tape Deterioration: Recognition, Recovery and Prevention.
In: IASA Journal 8/1996

Gilmour, Ian, and Fumic, Victor
Recent Developments in Decomposition and Preservation of Magnetic Tape.
In: Phonographic Bulletin 61/1992

Häfner, Albrecht
The Introduction of Digital Mass Storage Systems in Radio Broadcasting: A Report on the Progress within the ARD.
In: IASA Journal 3/1994

Hayama, F. et al.
Study of Corrosion Stability on DAT Metal Tape.
AES Preprint 3237

Heitmann, J
Zukünftige Archivierungssysteme.
In: Fernseh- und Kinotechnik 50,7/1996

Jenkinsen, Brian
Long-term Storage of Video-Tape.
BKSTS Journal, March 1982

Knight, GA
Factors Relating to Long Term Storage of Magnetic Tape.
In: Phonographic Bulletin 18/1977

Mathur, MCA, Hudson, GF, and Hackett, LD
A Detailled Study of the Environmental Stability of Metal Particle Tapes.
In: IEEE Transactions on Magnetics 28:2362-2364, 1992

Pickett, AG and Lemcoe, MM
Preservation and Storage of Sound Recordings.
Washington 1959. Reprinted by ARSC, 1991

Rothenberg, Jeff
Ensuring the Longevity of Digital Documents.
In: Scientific American 272 (January)/1995

Schüller, Dietrich
Auf dem Weg zum "ewigen", vollautomatischen Schallarchiv.
In: 17.Tonmeistertagung Karlsruhe 1992, Bericht. München, etc. 1993

Schüller, Dietrich
Behandlung, Lagerung und Konservierung von Audio- und Videoträgern.
In: Das audiovisuelle Archiv 31/32, 1992 (1993)

Schüller, Dietrich
Preservation of Audio and Video Materials in Tropical Countries.
In: IASA Journal 7/1996

Schüller, Dietrich
Safeguarding Audio and Video Materials in the Long-term.
In: Stephen Foster (Ed), Proceedings of the 1st International Memory of the World Conference, Oslo, 3-5 June 1996. UNESCO (Paris) 1996

Smith, LE
Factors Governing the Long Term Stability of Polyester-Based Recording Media.
National Institute of Standards and Technology (NIST), Washington 1989

Van Bogart, John
Magnetic Tape Storage and Handling. A Guide for Libraries and Archives.
Commission on Preservation and Access, Washington DC, 1995

Welz, G.
On the Problem of Storing Videotapes.
In: Orbanz, Eva (Ed), Archiving the Audio-visual Heritage. Proceedings of the (Second) Joint Technical Symposium, Berlin 1987. Berlin 1988

7. Optical Media

Optical media are used for storing digital sounds, images and data. There are three main families:

- The commercially issued, mass produced, CD family including the digital audio CD- both 12cm and the "single" 8cm disc - CD-ROM, CD-I and CD-V and the analogue Video Disc.
- Optical disks and tapes that can be recorded on once.
- Re-recordable disks.

Jukeboxes are available for most types of disc allowing automated access to a number of discs.

Mass Produced Discs

The mass-produced discs of the CD family have the digital information in the form of microscopic pits pressed into a polycarbonate base which is coated with a light reflective layer. This reflective layer is usually of aluminium, but gold and silver are also used. A transparent lacquer is then placed over the reflective surface to protect it. This surface also carries any label information. As the data on members of the are impressed, they cannot be altered or rewritten.

Because of the high costs to setup the production of a pressed disc, the discs are only used when large numbers of copies are required (over about 100), for example, encyclopaedia or sound recordings. The higher the number of discs issued, the lower is the unit price. The storage capacity of a 12cm CD is about 650 MB or one hour of audio. The average access time is about 300 ms with a double speed player, 250 ms with quadruple speed and 130 ms with sextuple speed.

The first disc in the family to be developed was the 30cm analogue LV (Laser Vision) Disc for video. This usually consisted of two discs stuck back-to-back to form a double sided disc with one hour of video per side. A sub-format was developed which could store up to 54000 still video images per side. The LV disc was the most successful of several attempts to generate market acceptance but is expected to be superseded by the DVD (Digital Versatile Disc or Digital Video Disc) that is being launched in 1997.

The DVD is the same diameter as the CD (12cm) but, by using a laser with a shorter wave length, the storage capacity of one layer is increased by a factor of seven to 4·7 GB. Additionally, a dual layer structure will be possible, read by two different laser wave lengths, thus doubling the capacity to 9 GB. In principle, by glueing two such double layer disks together like the LV video disks, a total capacity of 18 GB can be achieved. The disk is intended for the storage of data-reduced video-films or, like CD-ROMs, texts and multimedia data with, however, considerably higher storage capacities.

Write-Once Recordable Media

There are several types of write-once recordable disks. The format that is becoming the most widely used is the recordable CD (CD-R or CD-WO) which has been available since 1993. Having the same format and storage capacity as the audio CD and the CD-ROM, the CD-R can be played on the appropriate standard CD drives. The polycarbonate body of the disk has a dye layer placed on it which is then coated with a metallic reflective layer. The dye layer carries the data in place of the pits of pressed discs. When recording, high-intensity laser pulses change the dye from opaque to transparent. The low-intensity read laser reads the changes in reflected light as a digital bit stream. Once written, the data cannot be altered. CD writing drives are already available on different speed levels. The CD-R is a well established and standardized format.

Different standardized software protocols are available for recording Audio CDS and CD-ROMs. The Photo-CD is a CD-R with a proprietary software protocol to record photographs as electronic still images.

A recordable version of the DVD in not yet available, but may be expected in the near future.

CD-Rs are but the latest and most prominent examples of so-called WORM (Write Once, Read Many) disks which have been in use as computer storage media for quite some time. The biggest problem with WORMs is the great variety of systems and formats. A number of producers offer WORMs with a continuous helical recording format similar to a sound LP disk; others offer disks with ring-shaped tracks as on computer floppy and hard disks. Some can use both formats. The proprietary software of WORMs poses a problem, too. Not even the physical dimensions are standardized.

One writing method used by a number of manufacturers including LMS, Toshiba and Sony burns pits in the metallic surface of the disc with a laser beam. Another system supported by ATG and Optimen creates bubbles by the heat of the laser beam. In both cases the reflectance of the metallic layer is changed and the data can be read by a low power laser beam.

Optical Tape

Optical tape is made by ICI and packaged in a cassette for use as a WORM format data storage tape. The tape drives are made by EMASS in the USA and supplied in Europe by GRAU Storage Systems. Kodak are about to launch a competing system.

The tape contains a dye layer which changes its state when a high power laser beam is applied and can be read by a lower power laser - the same basic method as for CD-Rs. Because the tape is a sequential carrier, the access time can be quite long. In compensation, the storage capacity of one tape is considerably greater than a disc (up to 100GB).

Rewritable Optical Media

In contrast to the preceding optical media, data on rewritable optical disks ("Erasable"), Magneto-Optical (M/O) and Phase-change, can be altered or deleted many times. There are rewritable optical disks in the 5·25 inch format and, more recently, in the 3·5 inch format. The most common still are the magneto-optical discs, where a laser beam in the write mode heats the inner layer of the optical disk and thus changes the polarity of a magnetic coating. The resulting microscopic magnetic marks of different polarity can be read as a bit stream by a low-energy laser beam in the read mode. A more recent recording technology is the Phase-change where the carrier layer is coated with a thin semi-metal film, which can be both in an amorphous and in a crystalline state. A laser beam in the write mode can change single spots to either an amorphous or a crystalline state so that, again, a digital bit stream is created. The Phase-change may replace M/O in the future.

Rewritable optical disks have a short access-time (600 milliseconds). The storage capacity has steadily increased up to the current 2·6 GB.

The Stability of Optical Carriers

The main factors that affect the stability of carriers and the retrieval of information can be summarised as:

- Humidity and temperature.
- Mechanical deformation.
- Dust and dirt of all kinds.

For some carriers there are additional factors:

- Light
- Stray magnetic fields.

Humidity is, as with other data carriers, a most dangerous factor. In the case of optical media it has a hydrolytic action on components such as the protection layer of CDs and a corrosive influence on all metal components including metallic reflective layers. As a secondary effect, high humidity levels (above 65% RH) encourages the growth of moulds and fungi which can obstruct the reading of optical information.

Temperature, as with all other data carriers, determines the speed of (deteriorating) chemical reactions. More importantly, it is responsible for dimensional changes which may be of concern, especially in the case of multi-layer media.

Mechanical integrity is of utmost, and underrated, importance. Even microscopic scratches can hinder the reading laser beam, as do fingerprints and other foreign matter. Mechanical bending of discs cause microscopic cracks which again divert the laser. While the WORM and MO-disks developed as computer storage media are housed in cartridges which only open when inserted into the respective players, the representatives of the CD-family must be handled with utmost care, keeping mechanical integrity in mind.

Dust and dirt prevents the proper reading of the recorded information. Cigarette smoke will accumulate on the disk surfaces and may hide information. The CD-family is again more exposed to this danger than those disks that are protected by cartridges.

Light may affect the dye layers used in recordable and erasable disks.

Stray magnetic fields must be kept away from magneto-optical disks.

Recommended Climatic Storage Parameters

	Temp	±/24 h	±/Year	RH	±/24 h	±/Year
Optical Media	about 20°C	±1°C	±3°C	40%	±5%	±5%

Fluctuations of chosen parameters should be kept to a minimum. Operation areas (studios) should, therefore, have the same climatic conditions as storage areas. As with magnetic carriers, tighter parameters would be favourable for long term preservation. Such suggestions have, however, to be offset against the availability of hard- and software, which seems to be of greater concern than the stability of the carriers themselves.

Standards

AES28-xxxx	Draft AES Standard for Audio Preservation and Restoration - Method for Estimating Life Expectancy of Compact Discs (CD-ROM), Based on Effects of Temperature and Relative Humidity.
AESxy-xxxx	Draft AES Standard for Audio Preservation and Restoration - Method for Estimating Life Expectancy of Magneto-optical Disks, Based on Effects of Temperature and Relative Humidity.
ISO/DIS 9171-1.2. ISO/IEC 9171-1:1989	Information Processing - Information Interchange on 130 mm Optical Disk Cartridge - Write Once (**5·25 inch-WORM**, 297-327 MB on each Side), Teil 1: Unrecorded Optical Disk Cartridge (Technical concept, conditions for handling and storing, measures, mechanical and physical properties, optical properties or information, physical interchangeability between systems)
IASA TC-03	The Safeguarding of the Audio Heritage: Ethics, Principles and Preservation Strategy. 1997
ISO DP 10090- Draft Proposal	Standards for Information Interchange on 86 mm Optical Disk Cartridges (3·5 inch Rewritable M/O, 120 MB on each Side) are still under preparation

Reference Literature

Calas, Marie-France, et Fontaine, Jean-Marc
La conservation des documents sonores.
CNRS-Editions, Paris 1996

Fontaine, Jean-Marc
The Preservation of Compact Discs - Principles of Analysis.
In: Boston, George (Ed.), Archiving the Audio-visual Heritage. Proceedings of the Third Joint Technical Syposium, Ottawa 1990. 1992

Herla, Siegbert, und Muecke, Herbert
CD-R(ecordable) - Sprengsatz in unseren Schallarchiven.
In: 19. Tonmeistertagung Karlsruhe 1996, Bericht. Muenchen 1997

Nugent, WR
Issues in Optical Disc Longevity.
In: Boston, George (Ed.), Archiving the Audio-visual Heritage. Proceedings of the Third Joint Technical Syposium, Ottawa 1990. 1992

Pohlmann, Ken
The Compact Disc - A Handbook of Theory and Use. 1989

Williams, EW
The CD-ROM and Optical Disc Recording System.
Oxford Science Publications. 1996

8. Electronic Publications, Electronic Documents and Virtual Information

This chapter reviews the special problems created by these new methods of creating and supplying information. Many of the documents rely on storage provided by physical media that have been discussed in the preceding chapters.

Electronic Publications

Electronic publications cover the rapidly increasing area of publications that require a computer to be used to access the information that they contain. They can be documents distributed free of charge or obtained by purchase. They are supplied in two forms - Off-line publications and On-line publications. Some electronic publications are not supplied on physical carriers and need to be copied into the libraries' access system and be stored on hard disc stacks, tape streamers or other data storage systems; others are supplied on physical carriers and can be stored on shelves. This chapter will, therefore, be looking not at the physical carriers - they have been covered in the preceding chapters - but at the specific problems of acquiring, selecting, storing and accessing this group of documents.

Definition and Typology of Electronic Publications

Off-line Publications

An off-line publication is an electronic document which is bibliographically identifiable, which is stored in machine readable form on an electronic storage medium. CD-ROM, diskettes or floppy discs and magnetic tapes are examples.

- Off-line monograph eg a CD-ROM encyclopaedia.
- Off-line serial eg a CD-ROM journal.

On-line Publications

An on-line publication (or resource) is an electronic document which is bibliographically identifiable, which is stored in machine readable form on an electronic storage medium and which is available on-line. For example - an electronic journal, a World Wide Web page or an on-line database.

- On-line monograph eg. a dictionary on the Web.
- On-line serial eg. an electronic journal on the Web
- On-line resource eg. an organisation's home page.

Electronic publications can be original electronic publications, but they can also be the digitised version of a written or printed document. For many collections, most of the electronic publications will be the digitised version of a written or printed document in their possession. Examples include the CD-ROM of the National Library in Prague which contains several manuscripts and other documents, the Saint Sophia Project from Bulgaria, the Radziwill Chronicle, the Sana'a Manuscripts and the Memoria de Iberoamerica.

The producers and publishers of electronic publications can be traditional publishers who expand into new areas of publishing. It can also be newly established content providers, especially in case of the new publications on the World Wide Web, who only offer on-line electronic publishing.

In addition, some companies specialize in CD-ROM publishing.

Nowadays, most publications are written, edited and formatted using word processors and desk-top-publishing software. The printed version of the journal or the monograph is derived from the electronic form.

Distinction Between Audiovisual Material and an Electronic Publication

Multimedia publications are now produced which contain a mixture of material e.g. a biography, a bibliography, stills (photos), animation, video and sound. It sometimes becomes difficult to distinguish between an audiovisual document and an electronic publication related to text. For example, a movie with subtitling is audiovisual - a CD of Michael Jackson with a video clip consisting of moving images is considered to be an audio CD. A CD-ROM which contains a biography, a bibliography, texts of the songs, some sound, video and photos is considered to be a multimedia CD-ROM publication.

In short, an electronic publication must contain a considerable amount of text before a library will take it on deposit. Some libraries also take audiovisual publications into deposit. e.g. Die Deutsche Bibliothek in Frankfurt am Main in Germany.

Electronic Documents or Virtual Information

The term Electronic Documents or, as they are sometimes called, Virtual Information refers to the modern methods of transmitting documents between individuals, primarily text-based documents - the equivalents of letters and memoranda - by electronic means ie. without the use of paper. Many of the actual and potential problems created by electronic documents are similar to those created by electronic publications.

The documents, while stored on a physical carrier somewhere and easily accessible to a small group of people including the author, are, nethertheless, difficult for an archivist to obtain access to and preserve. The documents include E-Mail messages and computer files held on personal computers. When electronic documents are stored, it is on physical carriers used by other types of documents. The main factor that differentiates electronic documents from other documents is the method of transmission.

The first, and major, problem in the preservation of electronic documents is to gain access to them and discover what exists. This can only be done with the active support of the institution and its staff. If the institution has a PC network, the problem of access can be eased.

Since many of the E-Mail messages between staff are likely to be trivial and, perhaps, somewhat embarrassing if read by others than the author and the intended recipients, it is essential to ensure that everyone is aware that the archive will be periodically reviewing both formal files and messages held in the central file server to select material that is worth preserving.

Once access is gained, the material can be subject to standard selection criteria and the chosen information copied into the archive's data storage system. The long term preservation of the information can then be part of the archive's strategy for documents in general.

What is Involved in Acquiring Electronic Documents and Publications?

Selection

Research is being carried out by many archives and libraries into the best methods to give access to electronic materials in the very long term. Because of the sheer quantity of material being produced, particularly for access via the World Wide Web, selection is essential. Many archives and libraries use the existing selection criteria for printed materials for electronic materials as well. The contents of the document are the relevant factors for selection and not the medium. This means that the physical carrier, the hardware and the software used are not relevant for the selection process. Local policy defines the criteria for selection e.g. in Germany audiovisual material is included in the national bibliography, in some other countries it is not.

Acquisition and Registration

Off-line publications can often come to the library as printed publications. Obviously, when the library starts collecting off-line publications, the publishers have to be notified. In the Netherlands, where deposit is done on voluntary basis, it is important that the publishers are kept informed about the new selection criteria. In France, the law defines what publications are to be submitted.

On-line publications require a new form of co-operation. The publication has to be transmitted from the host system to the library via the network. Selected documents are either ordered, transferred automatically by the publisher or harvested by the library with a harvester application. For on-line documents, acquisition means the physical migration (via the network) of the document from the host-system to the depository system. The publisher/producer or administrator (for archives) needs to be involved in this process.

It is necessary to register documents when they are received by the library. This requires the exchange of bibliographic information (pre-publishing information) between the depository library and publisher (for archives this will be between the governmental institution and the archive), preferably before acquisition. The registration of incoming documents should be activated on arrival.

Installation

It is necessary to install the electronic publication so it can be viewed and described by the librarian. For on-line documents, a connection to the host-system is required; off-line documents have to be physically installed on a workstation.

Description of the Document

Cataloguing systems for electronic documents are still the subject of much debate. Various groups are discussing how to describe an electronic document. The existing book-based systems such as MARC and its variants do not fully describe these new formats. For example, to be able to view an electronic publication it is also necessary to describe the technical features - which computer and operating system was the publication made for? which formats are used? etc. Many fields for the technical description will be made in coded form.

Metadata

Electronic publications offer an opportunity to automate part of the production of a catalogue. Bibliographic data can be retrieved from the electronic publication itself, e.g. from the table of contents (TOC). A research project of the European Commission, BIBLINK, is studying how data can be exchanged between publisher and library in an automated way. The Dublin Core defines the fields that are necessary to support adequate bibliographic description of a Web page. The Dublin Core has received significant support, particularly from North America and including some publishers. A threat that may ultimately make it unacceptable, is that the Dublin Core contains too many features requiring definition at the national level or that require a large maintenance overhead.

Unique Identification

In the international book trade, the unique identification numbers ISBN (International Standard Book Number) and ISSN (International Standard Serial Number) are widely used to uniquely identify a certain version of a monograph or serial publication. ISBN and ISSN are also used for CD-ROMs and on-line publications like electronic journals. However, these numbers are not designed for electronic publications and a proposal was, therefore, made for a Digital Object Identifier (DOI). The DOI is designed by Association of American Publishers and the Corporation for National Research Initiatives.

Authenticity and Integrity

Some electronic publications can easily be changed. What guarantee is there that the bibliographic description defines exactly the version which is stored? And will it still do so after the lapse of several hundred years and the migration to other carriers and formats. This is still a very tricky area. Several methods are being considered, e.g. time stamps, encryptions and watermarks. But it must be said that the final solution for this issue has yet to be found.

De-installation

After the bibliographical and technical description the electronic publication must be removed from the hard disk on the computer and an on-line session must be closed. This activity has generated new information which should be included to the descriptive record.

Migration, Storage, Conversion and Emulation

Other factors that have to be considered when collecting electronic documents include the following:

Migration - Migration of the electronic content from the original carrier to the physical storage of the depository system, including migration quality control and duplication for backup (preferably on another medium).

Storage - The physical storage system will probably use different types of media with different access speeds, e.g. hard disc (very fast), magneto-optical (fast), tape (slow). This requires sophisticated software to monitor the use of documents and to shift documents from tape to discs and vice versa.

Pathfinder - This is a storage records the physical locations of all the files in a document and makes the file map available to the search engine.

Conversion and Emulation - Do you have to convert the format of the document to a new format, or do you have to design a system in which the document is stored in the original format? Emulation software enables the document stored in the original format to be viewed using the new hardware and software.

These techniques are concerned with preservation and final solutions have not yet been found. Increasing speed of technological innovation, new publishing techniques, InterNet and the present lack of standards are a few examples of the uncertainties in which the manager of a depository system must work. There is no proven solution for these systems, large vendors have build systems for data-warehousing and data-mining, although they still lack structured indexing and large scale preservation solutions needed by libraries and archives

Long Term Availability and Access for End Users: Remote or On Site

Indexing - Descriptive information is indexed for use within the search engine of the depository system. This engine can be part of the pathfinder software or can be a separate existing library system's OPAC module, to be defined locally. To find the right compromise between (the user's) indexing requirements and the technical possibilities is very complicated.

Access - Access to electronic publications by end users must be clearly defined. At present, most access is "on-site" but, when agreements are made with the owners of the information, remote access may be possible.

As with the deposit for printed publications, electronic deposit collections should be used as "collections of last resort". Libraries can, however, give access when agreements are reached with publishers and authors.

Copyright Issues, Authors and Publishers

It is obvious that it is very important that the digital archives and libraries discuss restrictions on access and availability with publishers and authors when this is appropriate.

Usage of Standards

There are many relevant standards for electronic publications. The European Commission has launched an initiative, OII (Open Information Interchange), as part of the IMPACT2 programme. The aim of the OII initiative is to promote the awareness and use of standards for the exchange of information in electronic form. The target audience are developers and providers of information products and services, as well as end-users. Standards can be purchased from international standard offices and many countries have an organisation which translates and distributes the standards. For more information visit the Commission's Web site where copies of publications on standards can be found (http://www.echo.lu/oii/activity.html).

For the preservation of electronic publications a variety of standards are relevant. These include standards on hardware, operating systems (Windows, MS-DOS, UNIX), physical carriers (CD-ROM, WORM, DAT, diskettes, magnetic tapes), application programs like wordprocessors, databases, spread sheets and formats like MARC, SGML, HTML etcetera.

Availability of Electronic Publications on the Market

Printed publications like monographs and serials are no longer available on the market permanently. After a relatively short time, a specific edition of a monograph can be difficult to find in a book shop. It may be possible to order from a large distributor or even the publisher. With off-line electronic publications it is exactly the same. The publishers are no longer interested in keeping publications available when there is no commercial interest in the products. This may be understandable from the market point of view but is still unfortunate. In addition, publishers often do not have a full archive of their own publications. It is very important, therefore, that as soon as possible after the publication date a document should be selected, described and made available (at least for review on site) by a public body like a national archive or a national library.

Reference Literature

Also see the Chapters on Magnetic and Optical Carriers

Ackerman, M. S., and R. T. Fielding (1995)
Collection Maintenance in the Digital Library
(In Proceedings of Digital Libraries, June 95, pp. 39-48, Austin, Texas)
Also available at [URL:http://csdl.tamu.edu/DL95].

Bearman, David, and Margaret Hedstrom (1993)
Reinventing Archives for Electronic Records: Alternative Service Delivery Options.
In Margaret Hedstrom, ed. Electronic Records

Commission on Preservationand Access (Ed)
Preserving Digital Information: Report of the Task Force on Archiving of Digital Information
Commission on Preservationand Access, Washington D.C.

Conway, Paul (1994)
Digitizing Preservation: Paper and Microfilm Go Electronic.
Library Journal 119 (February 1): 42-45.

Conway, Paul (1996)
Selecting Microfilm for Digital Preservation: A Case Study from Project Open Book.
Library Resources and Technical Services 40(1): 67-77.

Conway, Paul and Shari Weaver (1994)
The Setup Phase of Project Open Book.
Washington, D.C.: Commission on Preservation and Access.

Davis, Stephen P. (1995)
Digital Image Collections: Cataloging Data Model and Network Access.
In: Patricia A. McClung, ed. RLG Digital Image Access Project: Proceedings From an RLG Symposium Held March 31 and April 1, 1995, Palo Alto, California.
Palo Alto, CA: Research Libraries Group,. pp. 45-59.
Also available at [URL:http://www.columbia.edu/cu/libraries/inside/projects/diap/paper.html].

A Study of Issues Faced by National Libraries in the Field of Deposit Collections of Electronic Publications.
Report of the Workshop held in Luxembourg, December 18, 1995.
Luxembourg: European Commission, Directorate General XIII-E/4, February.

Graham, Peter S. (1994)
Intellectual Preservation: Electronic Preservation of the Third Kind.
Washington, D.C.: Commission on Preservation and Access.

Graham, Peter S. (1995a)
Requirements for the Digital Research Library.
College and Research Libraries, July, 56(4): 331-339.

Hedstrom, Margaret and Alan Kowlowitz (1988)
Meeting the Challenge of Machine Readable Records: A State Archives Perspective.
Reference Studies Review 16(1-2): 31-40.

Hedstrom, Margaret (1991)
Understanding Electronic Incunabula: A Framework for Research on Electronic Records.
American Archivist 54 (3): 334-354.

Hedstrom, Margaret (1995)
Electronic Archives: Integrity and Access in the Network Environment.
In Stephanie Kenna and Seamus Ross, eds. Networking in the Humanities: Proceedings of the Second Conference on Scholarship and Technology in the Humanities, held at Elvetham Hall, Hampshire, UK, 13-16 April, 1994. London:Bowker-Saur, pp. 77-95.

Herbst, Axel and Bernhard Malle (1995)
Electronic Archiving in the Light of Product Liability.
In Proceedings of Know Right 95. Vienna: Oldenbourg Verlag, pp. 455-460.

International Council on Archives: Committee on Electronic Records
Guide for Managing Electronic records from an Archival Perspective
(http://www.archives.ca/ica

Lesk, Michael (1992)
Preservation of New Technology: A Report of the Technology Assessment Advisory Committee to the Commission on Preservation and Access.
Washington, D.C.: Commission on Preservation and Access.

Levy, David M. and Catherine C. Marshall (1995)
Going Digital: A Look at Assumptions Underlying Digital Libraries.
Communications of the ACM 38(4): 77-83.

Lyall, Jan 1996
Draft Statement of Principles for the Preservation of and Long Term Access to Australian Digital Objects.
Canberra: National Library of Australia.

Lynch, Clifford (1994a)
The Integrity of Digital Information: Mechanics and Definitional Issues.
Journal of the American Society for Information Science 45(10): 737-744.

Lynch, Clifford (1994b)
Uniform Resource Naming: From Standards to Operational Systems.
Serials Review 20 (4): 9-14.

Lynch, Clifford (1996)
Integrity Issues in Electronic Publishing.
In Robin P. Peek and Gregory B. Newby, eds., Scholarly Publishing: The Electronic Frontier, Cambridge: The MIT Press, pp. 133-145.

Mallinson, John C. (1986)
Preserving Machine-Readable Archival Records for the Millennia.
Archivaria 22(Summer): 147-52.

Mohlhenrich, Janice, ed. (1993)
Preservation of Electronic Formats: Electronic Formats for Preservation.
Fort Atkinson, Wis.: Highsmith.

Study on the Long-Term Retention of Selected Scientific and Technical Records of the Federal Government: Working Papers.
National Research Council (1995b) Washington, D.C.: National Academy Press.

O'Toole, James M. (1989)
On the Idea of Permanence.
American Archivist 52(1): 10-25.

Owen, J. S. MacKenzie and J. van de Walle (1995)
ELDEP Project: A study of issues faced by national libraries in the field of deposit collections of electronic publications.
Background Document for the ELDEP Workshop, Luxembourg, December 18, 1995. The Hague: NBBI.

Rothenberg, Jeff (1995)
Ensuring the Longevity of Digital Documents.
Scientific American, 272 (January): 42-47.

Levels of Access and Use of Computers: 1984, 1989, 1993. Current Population Survey Reports.
United States Census Bureau (1993) Population Division, Education and Social Stratification Branch:
[URL:http://www.census.gov/ftp/pub/population/socdemo/computer/compusea.txt]

Research Issues in Electronic Records.
United States National Historical Publications and Research Commission (1991)
St. Paul: Minnesota Historical Society.

Waters, Donald J. (1994)
Transforming Libraries Through Digital Preservation.
In Nancy E. Elkington, ed. Digital Imaging Technology for Preservation: Proceedings from an RLG Symposium held March 17 & 18, 1994. Mountain View, CA: Research Libraries Group, pp. 115-127

Waters, Donald J. (1996a)
Realizing Benefits from Inter-Institutional Agreements: The Implications of the Draft Report of the Task Force on Archiving of Digital Information.
The Commission on Preservation and Access, Washington, D.C
Also available at: [URL:http://arl.cni.org/arl/proceedings/127/waters.html].

Waters, Donald J. (1996b)
Archiving Digital Information.
A presentation to the OCLC Research Library Directors Conference, Dublin, Ohio, March 12, 1996.

Weibel, Stuart (1995)
Metadata: The Foundations of Resource Description.
D-Lib Magazine (July).
Also available at: [URL:http://www.dlib.org/dlib/july95].

Wiederhold, Gio (1995)
Digital Libraries, Value and Productivity.
Communications of the ACM 38(4): 85-96.

For further citations, please refer to the ICA World Wide Web site (http://www.archives.ca/ica)

For detailed information about Digital Object Identifiers (DOI), refer to the World Wide Web (http://www.doi.org/newscon.html).

For more information about the Dublin Core refer to the World Wide Web (http://www.oclc.org:5046/oclc/research/conferences/metadata/dublin_core_report.html)

9. Glossary

Because of the range of materials covered by this guide, it may be useful to define some of the terms used in the texts accompanying the lists of standards. Further information can be found in the following glossaries:

A glossary of InterNet terms by InterNet Literacy Consultants (TM):
http://WWW.matisse.net/files/glossary.htm

A glossary of computer oriented abbreviations and acronyms called BABEL by Irving Kind:
http://WWW.access.digex.net/ikind/babel96b.html.

A glossary for NCSA Mosaic and the WWW World Wide Web users:
http:// WWW.ncsa.uiuc.edu/SDG/Software/Mosaic/Glossary/GlossaryDL.html.

A multi-lingual glossary for sound and moving image terms is under preparation by IASA for UNESCO and will be published shortly.

Acid free paper
Paper which is pH neutral or slightly alkaline (pH7 or above) at the time of production but not necessarily having an alkaline buffer or reserve.

AES
Audio Engineering Society

Amino-acid
Organic acid derived from ammonia; part of the constituent of protein

ANSI
American National Standards Institute

ASCII
American Standard Code for Information Interchange. A seven-bit standard code used to facilitate the interchange of data among various types of data processing and data communication equipment.

Authentication
a process for verifying the correctness of a piece of data.

Base
the support for a carrier. Examples include the clear film that holds a film or magnetic tape emulsion, the aluminium plate that is coated with lacquer to make an instantaneous disc.

Bibliographic description
a set of formalised data elements describing a publication.

Bibliographic record
a discrete bibliographic description stored either manually or electronically.

Bitstream
a sequence of bits transmitted across an electronic link. The software controlling the link is unaware of any structure inherent in the bitstream data.

BSI
British Standards Institute

Carrier
the physical package (ie the disc, film, paper etc) in or on which information is fixed or recorded. Examples include: a magnetic tape; a telephone cable; a sheet of paper.

CD-ROM
Compact Disc Read Only Memory.

Cellulose
The main structural material of plants, the fibres of which are used for textiles, paper and synthetic resins.
CIP
Cataloguing-In-Publication records, created using information supplied pre-publication by the publisher.
Collagen
Proteineous substance yielding gelatine
Confidentiality
the quality of protection against unauthorised accessed to private or secret information.
Conservation
active intervention by specialists to inhibit further deterioration of an object and to stabilise it in its present condition.
CPA
Commission on Preservation and Access (US based Commission - see also ECPA)
Corruption
a change in data such that the data content received is not what was originally sent.
Database (DB)
a computer Program for entering, storing and retrieving items of information in a structured fashion.
Dataflowa
transfer of data between a sender and a recipient.
Deposit of publications
a system in operation in many countries, usually legally enforced, whereby publishers must deposit one or more copies of every publication with nominated libraries. Often referred to as Legal Deposit.
Dial-in service
a method of obtaining access to the services provided by a computer by establishing a connection over the telephone system.
Document
1. The combination of a medium and the information recorded on or in it which may be used as evidence or for consultation
2. A single record or item. Examples include: a sheet of paper with writing; an E-Mail message; a film with images; a magnetic tape with a sound recording.
DTD
Document Type Definition.
Dublin Core
a metadata format being discussed internationally to define a minimal information resource description for use in a WWW environment. The term "Dublin" is used as Dublin, Ohio is the location of OCLC's headquarters.
ECPA
European Commission on Preservation and Access (see also CPA)
EDI
Electronic Data Interchange. The exchange of structured data messages to enable automated transactions between application systems.
EDIFACT
EDI For Administrations, Commerce and Transport. The international EDI standard messaging syntax under the responsibility of the UN, for trading transactions in all industries. Also known as UN-EDIFACT.
ejournal
see electronic journal.

Electronic journal
similar to a traditional journal but published only in electronic form - on a CD-ROM or the World Wide Web.
Electronic mail
a means for an originator of information to distribute information to an unlimited number of recipients via a value added network service which mimics the functions of the paper postal services.
Electronic publisher
see publisher.
Electronic publication
document, file, journal, etc. made available in electronic form.
email
see Electronic mail.
E-serial
similar to a traditional serial but published only in electronic form - on a CD-ROM or the World Wide Web.
FIAF
Fédération Internationale des Archives du Film
FIAT
Fédération International des Archives de Télévision
File transfer
a means of providing access to files on a remote IT system without requiring detailed knowledge of the structure and characteristics of the remote system.
Floppy disk
a type of computer storage medium, capable of storing up to 2 MB of data. Most commonly available in 3.5 inch size.
Format
1. in its widest sense, a particular physical presentation of an item. Examples include: a standard layout of memorandum in an office; the arrangement of data in a computer application; the general pattern of a television recording (VHS, BetaCam etc); the aspect ratio of a moving image production.
2. in the context of bibliographic control, the formalised structure in which the specific elements of bibliographic description are accommodated.
Frame relay
a data service similar to X.25, but providing higher speeds and LAN interconnection.
FTAM
File transfer, Access and Manipulation. An alternative file transfer protocol to FTP.
FTP
File Transfer Protocol, an Internet standard means of transferring electronic files between computers.
High level technical options
transmission options which operate at a higher level than low level technical options, e.g. EDIFACT, Warwick Framework, PICS, RDM, Web Crawler, Search and Retrieve. The high level technical options use one of the low level technical options as the underlying transmission medium.
Home page
a World Wide Web page set up as an introductory page by an organisation or individual.
HTML
Hypertext Mark-up Language. The standard language used for creating Web documents.
HTTP
HyperText Transfer Protocol. The protocol used for communication between Web clients and servers.

Hydrolysis
a chemical reaction activated by humidity
IAFA
Internet Anonymous FTP Archive.
IASA
International Association of Sound and Audiovisual Archives
ICA
International Council on Archives
IEEE
Institute of Electrical and Electronics Engineers.
IETF
Internet Engineering Taskforce.
IFLA
International Federation of Library Associations and Institutions.
ILL
Inter-Library Loan.
indexing service
a secondary service providing access to primary sources through the use of keywords appearing in metadata and/or full text.
Information
recorded data. Examples include: writing on a sheet of paper; the dyes on a photographic still; the sound in the grooves of a disc; the binary digits forming an E-Mail message.
Integrity Consultants
the preservation of programs and data for their intended purpose.
Internet
the world wide network of computer systems connected to each other.
Internet Publisher
an organisation or person who publishes documents on the Internet. These will be on-line documents.
ISBD
International Standard Bibliographic Description. There are seven specific ISBDs as well as the general ISBD -(G): monographs -(M), serial publications -(S), cartographic material -(CM), non-book material -(NBM), printed music -(PM), antiquarian publications -(A), computer files -(CF).
ISDN
Integrated Services Digital Network. A data service which can transmit both voice and data over a single line.
ISSN
International Standard Serial Number.
IT
Information technology.
Label
a PICS label, generated by a labelling service, contains a rating of Internet material.
Labelling service within the PICS environment, a labelling service generates ratings of Internet material. These ratings are contained in PICS labels.
Legal Deposit
see Deposit of Publications.
Low Level Technical Options
generalised IT techniques for the transmission of data, e.g. e-mail, file transfer, opto-magnetic media and World Wide Web.

MARC
MAchine Readable Cataloguing. A family of formats based on ISO 2709 for the exchange of bibliographic and other related information in machine readable form. For example, USMARC and UNIMARC.
Medium (media)
A material or base on which information is stored or transmitted. It may be a physical medium such as a gramophone record or a piece of paper or be virtual (for example, a radio carrier signal).
Metadata
information about a publication as opposed to the content of the publication; includes not only bibliographic description but also other relevant information such as its subject, price, conditions of use, etc.
MIME
multimedia mail enhancements to the Internet mail standard.
Monograph
a publication either complete in one part or complete, or intended to be completed, in a finite number of separate parts. A non-serial publication.
Multimedia
a publication in which images, sound and text are integrated.
National Bibliography
a listing of all national publications. May include all publications produced in that country, or in the language of that country, or sometimes about that country.
national character set
all of the numbers, letters and symbols associated with a given language.
NBA
National Bibliographic Agency.
Non-repudiation
a security service which prevents the receiver of a message from denying that the message had been received .
on-line publication
see On-line resource.
On-line resource
an on-line resource is an electronic document which is bibliographically identifiable, which is stored in machine readable form on an electronic storage medium and which is available on-line. For example - a Web page.
Off-line publication
an off-line publication is an electronic document which is bibliographically identifiable, which is stored in machine readable form on an electronic storage medium. For example, a CD-ROM.
Opto-magnetic media
various media used for the physical exchange of electronic information between IT systems, using postal or courier services.
Oxidation
traditionally defined as a chemical reaction in which oxygen combines with another element to form an oxide. Today it is defined as a chemical reaction in which one or more free electron are released.
Packaging level option
a high level technical option which structures the data according to content.
Permanent paper
Paper manufactured to high standard for long-term survival good condition under reasonable storage conditions. It must have good resistance to internal and external chemical reactions, good mechanical strength and be composed of only virgin, or un-recycled fibres containing no lignin.

PICS
Platform for Internet Content Selection, an infrastructure for associating labels with Internet content.
Photography
any method of producing an image by using the action of light to change a chemical layer.
Plain text file
a human-readable file of data. The data may be structured in some pre-defined format.
Preservation
the overall package of administrative and/or practical measures, such as boxing, good housekeeping, careful handling and environmental control, which ensure the survival of documents without specialist intervention. Conservation and restoration procedures are part of a preservation policy.
Print
a positive image on an opaque support. The image may be a photographic still or produced from an engraved plate or similar master.
Private data networks
data networks owned by an organisation. The lines are rented from carriers but switching equipment belongs to the organisation.
ps
postscript, a standard format for exchange of printable files.
Publications
documents containing either text or sound or images, or combinations of these, packaged for wider distribution, whether off-line (e.g. printed book, CD-ROM) or on-line (e.g. Web, database for information retrieval).
Publisher
a person or organisation that produces documents and makes them available. Newly emerging publishers may produce and distribute documents electronically - for instance, on the Web.
Pull Model
when applied to a transfer of metadata between a Publisher and an NBA, the pull model describes the scenario whereby the NBA initiates the transfer by requesting or "pulling" data to the NBA.
Push Model
when applied to a transfer of metadata between a Publisher and an NBA, the push model describes the scenario whereby the Publisher initiates the transfer by providing or "pushing" data to the NBA.
RAMP studies
Studies published by the Records and Archives Management Programme of the General Information Programme of UNESCO.
RD
Resource Description. Consists of a URL and a number of value-attribute pairs.
RDM
Resource Description Messages. A technique for encoding and transmitting metadata relating to an Internet resource accessible via a URL.
RDM agent
generates Resource Descriptions (RD) based on the content of Internet material.
RDM server
stores a collection of RDMs, to be accessed across the WWW.
Receiver authentication
a security service which guarantees that the recipient of a message is the person to whom the message was addressed.
Record
see bibliographic record.

Record creation
the generation of bibliographic records by, for example, a bibliographic agency.
Record supply
the transmission of previously generated bibliographic records.
Restoration
the process of restoring an object to a condition as close as possible to that when it was first made.
RFC
Request For Comments, a method by which standards (sic) are proposed and agreed, usually with reference to the Internet.
Search Service
an Internet service providing the means to search for electronic resources by means of keywords.
Sender authentication
a security service which guarantees to a recipient of data that the sender of the data is who he claims to be.
Serial
a publication in any medium issued in successive parts bearing numeric or chronological designations and intended to be continued indefinitely. Serials include periodicals; newspapers; annuals (reports, yearbooks, etc.); the journals, memoirs, proceedings, transactions, etc. of societies; and numbered monographic series.
Serial Contents Database
a database of the contents of journals, issue by issue.
SGML (ISO 8879)
Standard Generalised Mark-up Language. ISO standard for document description, separating contents and structure.
SMPTE
Society of Motion Picture and Television Engineers
SMTP
Simple Message Transfer Protocol. Internet e-mail standard.
SR
Search and Retrieve.
SSSH
Simplified SGML for Serials Headers.
Standard
1. a set of guidelines, usually drafted by experts in a particular field of technology, that are issued for general use by national and international standards organisations.
2. the format used to distribute a television signal. Examples include NTSC, PAL, SECAM
Subject Gateway
an Internet service listing (usually) on-line resources for a particular subject area. The resources included will have been reviewed by subject specialists before inclusion.
Subscription Agent
a supplier of journals to libraries and other information agencies.
TCP/IP
Transmission Control Protocol/Internet Protocol. The Internet transport-level protocols, often used to refer to the entire collection of Internet protocols.
Trade bibliographic agency
an agency providing bibliographic information to, and based on input from, the book trade.
Transparency
a positive image on a transparent support.
Transport level technical option
see low level technical option.

URL
Uniform Resource Locator. The standard way to give the address of a source of information on the WWW. It contains four different parts: the protocol type, the machine name, the directory path and the file name. For example: http://WWW2.echo.lu/libraries/en/libraries.html
VANS
Value added network services.
Voluntary Deposit
see Deposit of Publications.
Web crawler
a system which trawls the WWW, generating all-encompassing Web indexes.
Web robot
see Web crawler.
Web site
used to refer to a single location on the World Wide Web, usually on the same piece of hardware. Part of the Internet that stores and gives access to documents using HTTP.
World Wide Web
the global set of Internet Web sites offering world wide access to information using HTTP.
WWW
see World Wide Web.
X.25
a data service using packet switching techniques. The X.25 standard is internationally recognised.
X.400
electronic mail standard developed by the public service providers and the IT industry. An alternative to SMTP.
Z39.50
a network protocol which allows searching of (usually remote) heterogeneous databases and retrieval of data, most often used for retrieving bibliographic records.