International Association of Sound and Audiovisual Archives

Technical Committee

Standards, Recommended Practices and Strategies

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

Version 3, December 2005

The purpose of this document

In an increasingly digital environment, members of IASA and the archival community at large have been asking how to safeguard the audiovisual heritage. The Technical Committee of the International Association of Sound and Audiovisual Archives (IASA) has prepared these general guidelines to help meet these requests.

IASA-TC 03 aims to identify problem areas and to propose recommended practices for use by sound and AV archives in today's technical environment. These recommendations are a balance between the ideal situation and the real world that we inhabit. They are intended to help the reader to focus on the various issues relating to responsible audio archiving practice. At the same time it uses a consistent terminology and may be read by people with financial responsibility for a collection as well as by technically trained staff.

This document constitutes a revision of earlier versions of IASA-TC 03 issued in September 2001 and February 1997. The revision is a consequence of the most recent developments in digital audio archiving. The document has also taken account of IASA-TC 04, *Guidelines on the Production and Preservation of Digital Audio Objects*, published in 2004. Accordingly, TC 03 concentrates on the principles while TC 04 provides detailed explanations of the practical consequences of TC 03.

The safeguarding of the audio heritage will be the subject of further development because of changes in technology and in the market places and the resulting consequences for the archival community. The IASA Technical Committee is continuously involved in monitoring, debating, and influencing the situation. Whenever appropriate, an updated version of this document will be issued.

Version 3 was prepared by a writing group consisting of George Boston, George Brock-Nannestad, Lars Gaustad, Albrecht Häfner, Dietrich Schüller and Tommy Sjöberg, and was reviewed by the entire IASA Technical Committee

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Editor

0. Ethical considerations

This document is not a Code of Ethics for all aspects of sound archiving. It covers, however, the ethical consequences resulting from the technical aspects of recording, preserving and accessing sound documents within the framework of the technical development offered by today's market situation.

The guiding principles of this document can be summarised by the following statement:

> *Preservation enables us to provide our successors with as much of the information contained in our holdings as it is possible to achieve in our professional working environment. It is the responsibility of an archive to assess the needs of its users, both current and future, and to balance those needs against the condition of the archive and its contents.*

1. The task of sound archives

There are four basic tasks that are performed by all archives:

- acquisition
- documentation
- access
- preservation.

While the primary aim of an archive is to ensure sustained access to stored information, the indispensable prerequisite to achieve this aim, however, is to preserve the information placed in the care of the collection. For most documents this means the use of the best practices to ensure the physical and chemical integrity of the original documents. Sound archives have to ensure that, in the replay process, the recorded signals can be retrieved to the same, or better, fidelity standard than was possible when they were recorded.

Comment:
Advances in the technology of analogue recordings often enable modern replay equipment to retrieve more information from the carriers than was possible at the time of recording.

It must also be noted that, for a number of reasons, some of the holdings retained in sound archives are not the original recordings but copies. In such cases, these copies must be considered to be the original.

2. Primary and secondary information

Documents are the bearers of information:

- primary information, consisting of the sonic content, and
- ancillary or secondary information which may take manifold forms.

Both primary and secondary information form part of the Audio Heritage. The relative importance of the two will vary depending on the content, the type of carrier and the needs of users, both present and future. Secondary information, however, becomes a crucial factor in the authentication of primary information once the sonic content has been transferred from its original carrier for preservation purposes (cf paragraph 5).

Comment:
In many cases the carriers have become collectable cultural objects in their own right, eg mass produced sound discs. Furthermore, secondary information such as hand written notes etc may constitute an indispensable part of the sound document (the original carrier and associated material). It is the task of the archive to evaluate the degree to which the document needs to be preserved in order to serve future users and to then implement a suitable preservation strategy.

3. The instability and vulnerability of audio carriers

For traditional paper based documents, the long-term preservation of the original carrier is (with a few exceptions) generally feasible. In general, audio carriers (except metal matrices of mass replicated carriers) will have a shorter life-expectancy than that of good quality traditional text materials.

In addition, audio carriers are more vulnerable to damage caused by poor handling, by poorly maintained or malfunctioning equipment and by poor storage than conventional text documents. Due to the high density of information, digital carriers are generally more vulnerable to loss of information through damage than analogue carriers. If a carrier is damaged by poor storage or mishandling, the information may be lost. This applies to both digital and analogue material.

Comment:
The level of risk of a carrier will depend upon the vulnerability of the carrier, the quality and maintenance of replay equipment, the professional skills of the operator and the quality of the storage. The level of risk ranges from the very high for an LP frequently replayed by conventional mechanical pick-up systems to relatively low for a rarely used analogue quarter inch polyester tape replayed by well maintained equipment.

4. Obsolescence of formats

a. Analogue

Analogue formats are being phased out as systems, both because carriers and hardware are no longer manufactured in the volumes once available and because product support is steadily being withdrawn from them.

b. Digital

None of the digital recording systems developed specifically for audio has achieved a proven stability in the market place, let alone in an archive. With the exception of the audio CD, the DVD audio and the MiniDisc, all specific digital audio formats have become obsolete after a short period in the market leaving many carriers still in good condition but without the machines required to access the sounds. In recent years there has been a clear shift from specific audio formats such as R-DAT and CD-R (audio) to formats storing content as data, ie file formats in a computer environment. Although, in principle, file formats, operating systems and computer storage media will also be threatened by obsolescence, this professional environment makes the problem easier to manage than the digital audio formats driven by the consumer market.

Comment:
R-DAT and CD-R (audio) were the first digital recording systems with considerable market acceptance in the field of audio to have been employed as digital target formats for archiving purposes. Neither of these systems, however, has a proven record of archival stability. R-DAT, as a format, is obsolete and holdings are threatened by future unavailability of replay equipment and spare parts. CD-R is still widely used, although, at present, the use of recordable CDs and DVDs must be seen as potentially dangerous to the survival of the sounds (cf IASA-TC 04, 6.6). The Technical Committee, therefore, strongly recommends the use of true file formats in a computer storage environment and reliance on the data integrity provisions associated therewith (cf paragraphs 10, 12, and 13, and IASA-TC 04, 6.1).

5. Safeguarding the information

a. By preservation of the carrier

Although the life of most audio carriers cannot be extended indefinitely, efforts must be made to preserve carriers in useable condition for as long as is feasible.

Preservation requires storage in an environment suited to the purpose, separating primary and secondary information sources where necessary and possible, and performing routine maintenance and cleaning as needed. Maintenance also includes the regular checking of test tones, if available, on analogue carriers and of the data integrity of digital carriers. In addition, the equipment used for handling and replay must meet the physical requirements of the carriers. Preservation includes minimising the use of originals/archival copies by making access copies available.

b. By subsequent copying of the information

Because the life expectancy of carriers and the availability of hardware is limited, the preservation of the document in the long term can only be achieved by copying the contents to new carriers/systems when it becomes necessary.

In the analogue domain, the primary information suffers an increase in degradation each time it is copied. Only the digital domain offers the possibility of lossless copying when refreshing or migrating recordings (cf paragraph 12). For the long-term preservation of the primary information contained on an analogue carrier it is necessary, therefore, to first transfer it to the digital domain.

Removing the primary information from the original carrier raises the question of future authentication of the sound. Future users, for the reasons given in this document, may only have access to the primary information of a sound document in the form of a copy on a new carrier/system. Once carrier decay or system obsolescence makes access to the primary information of a sound document only possible by use of a copy of the original carrier, the importance of adequate secondary information increases. Archives need, therefore, to record in a systematic manner the relevant secondary information contained in the original document and to make this information accessible together with the copy of the primary information. By this means, future users can be sure of the authenticity of the primary data.

6. Selection of best copy and carrier restoration

If several copies of a sound document are available, the best must be selected for the further preservation of its content. Additionally, cautious and appropriate cleaning and restoration procedures must be performed to optimise signal retrieval.

Comment:
With mass replicated carriers - specifically mechanical and optical carriers - the replay quality of different copies may vary considerably because of the way that they have previously been handled and stored. It may, therefore, be advantageous to extend the search for the best copies to other collections on a national,or even international scale.

Archival holdings in a narrower sense, ie non-replicated recordings, may often be available in two or more versions. For example, an original carrier (tape, cassette, instantaneous disk) and an archival master which is a copy of the original. While archival masters, or younger carriers in general, may often be in a better state of physical preservation, they may be of inferior audio quality due to poorer earlier transfer technology and the inescapable losses in the analogue copying process. Consequently, the retrievable quality of the various available copies must be checked against each other. It is a common experience that signal retrieval from well preserved early original tapes yields better results than that from their analogue archival master tape copies.

When choosing cleaning and restoration procedures, utmost care must be taken to balance improvement of signal retrieval against possible further deterioration, even the entire loss of the carrier. Therefore, in the transfer of any historical and/or endangered carrier, the use of the originals must be kept to the minimum at all times. Heavily deteriorated carriers may even be lost completely in the attempt to replay them. In such critical cases it is necessary to safeguard the sonic content by making a straight copy of the first replay which may, in the case of successful restoration, be changed for a later transfer. In addition, the straight copy should be used for the experimental calibration of parameters.

7. Optimal signal retrieval from original carriers

Optimal retrieval of the signal on analogue recordings can only be achieved by modern, well maintained replay equipment, ideally of the latest generation, in order to keep replay distortions to the absolute minimum. When replaying historical formats, replay parameters (speed, playback equalisation, track format etc) must be chosen objectively and be based upon knowledge of the given historical format. The replay equipment has to be optimally adjusted to the correct parameters and any experimentation with settings must be done using a straight copy of the original recording. In order to keep possible damage to the original carriers to minimum, replay equipment must be regularly maintained to professional standards. To aid in this and to diagnose emerging problems, calibration media suitable for the replay equipment must be used whenever obtainable.

For digital originals, the same principles apply. It must be noted, however, that despite nominal format compatibility, minor - or even major - differences may occur between different players when retrieving signals from the same carriers. In order to detect such problems, error monitoring during replay is imperative.

In addition, it must be noted that format incompatibilities may be discovered in some digital formats when trying to retrieve the various kinds of sub-code information.

Comment:
It is not an easy task to assess the correct replay parameters for a given analogue sound document if objective information on the recording format parameters is missing. As in other fields of historical research, the use of cautiously chosen approximations is permissible when necessary. As a matter of principle, however, irreversible steps must be avoided. Subjective treatments must only be applied to access copies.

The systematic retrieval of sub-code information of digital originals, especially that contained in original R-DAT recordings, is still a widely neglected chapter in the safeguarding of useful secondary information. The reasons are due mainly to incompatibilities of sub-codes as not all players and interfaces support all sub-codes. As yet, no routines have been developed for the further safeguarding of this information in other than the original format. Compatibility problems often also occur in the replay of recordable or rewritable optical disks.

It should also be noted that several recent digitisation projects have suffered from inadequate signal retrieval from original documents because of the lack of professional knowledge and the appropriate equipment.

8. Unmodified transfer to a new target format

It is mandatory that transfers made from old to new archive formats be carried out without subjective alterations or "improvements" such as de-noising, etc. It is essential that the full dynamic range and frequency response of the original is transferred.

It is important to understand that the intended signal is only part of a given sound document. The unintended and undesirable artefacts (noise, distortions) are also part of the sound document, either caused by limited historical recording technology, or subsequently added to the original signal by mishandling (eg clicks) or by poor storage. Both have to be preserved with utmost accuracy, which has consequences for the choice of digital resolution (cf paragraph 10).

It must be noted, however, that some inaccuracies of original recordings, such as those caused by misaligned recording heads in analogue and digital magnetic tape recordings, can only be corrected successfully in the replay process of the original tape. "Azimuth Error" is common in analogue magnetic tape recordings, particularly if recording equipment was not regularly maintained by professional technicians. Minute inaccuracies in the tape path adjustment of original recordings, eg R-DAT tapes, may cause a considerable and avoidable rise in errors.

Print-through, a storage related artefact with analogue magnetic tape, can also only be reduced on the original tape before the transfer.

The careful documentation of all parameters and procedures employed in the transfer process is essential.

9. Improvements in transfer technologies

Transfer technologies from originals may improve in the future. In particular, there may be improvements in the retrieval of signals from the original carrier. Original analogue carriers may contain secondary information which falls outside the frequency range of the primary information and which may assist in correcting inaccuracies in the original recording. Most current transfer technologies result in an irretrievable loss of this information.

Because of the potential for improvements in primary and secondary information retrieval and the availability of ever increasing digital resolutions, all transfers should be considered preliminary. Hence the original carriers and suitable play-back equipment must be preserved whenever possible. However, although the possibility of a re-transfer in the future must be considered, all transfers must be carried out to the highest standards possible at the time of transfer. They may, in the future, become the last transfer from the originals.

Comment:
A recent improvement in transfer technology is the laser replay of some mechanical carriers which provides contact-less, optical replay. Information about speed fluctuations (wow and flutter) of analogue magnetic tapes may be found in the variations of the reproduced bias frequency. Processes that can use this information to correct the primary information are now available and may become part of future transfer routines.

10. Digital target formats and resolution

Digital coding schemes (formats) as well as digital resolution are the subject of further development. Notwithstanding these developments, it must be stressed that coding schemes used for preservation purposes must be openly defined and not proprietary to a limited number of manufacturers. Data (file) formats are superior to digital audio streams (R-DAT, CD-Audio) in terms of data security and their monitoring.

Digital formats have a limited resolution set by the defined and finite sampling frequency and digital word length. While for digitally originated signals the original resolution should comply with the digital preservation format, the choice for analogue originals will always be a compromise. In principle, high digital resolutions are desirable for the adequate representation of all the minute subtleties of original analogue signals.

Comment:
In recent years, storing audio in form of file formats has become the dominant practice and the .wav *or* BWF *format has become a de-facto standard. This format is officially recommended by the Technical Committee (cf IASA-TC 04, 6.1.1.1 and 6.6.2.2).*

Currently, A/D converters providing 192 kHz sampling rate and 24 bit amplitude resolution are standard. For analogue originals IASA recommends a minimum digital resolution of 48 kHz sampling rate at 24 bit word length. In heritage/memory institutions a resolution of 96 kHz / 24 bit has become widely adopted. Better transfers of the unintended parts of a sound document (cf paragraph 8) make the future removal of these artefacts by digital signal processing easier when making access copies. Speech recordings, because of the transient character of consonants, must be treated like music recordings.

11. Data reduction

As a rule, it is generally accepted that, when selecting a digital target format for original analogue or linear digital recordings, formats employing data reduction (frequently mistakenly called data "compression") based on perceptual coding (“lossy codecs”) must not be used. Transfers employing such data reduction result in the irretrievable loss of parts of the primary information. The results of such “lossy” data reduction may sound identical or very similar to the unreduced (linear) signal, but the further use of the data reduced signal will be severely restricted. These archival principles should also be applied, whenever possible, to the creation of original recordings made with the intention of being archived. If, however, contents come to an archive having been recorded on data reduced, non-linear format, such contents must be preserved faithfully. There is no objection, however, to the use of lossless, ie fully reversible compression.

Comment:
Data reduction is a powerful tool in the dissemination of audio signals. Its use is, however, counter to the ethical principle of preserving as much of the primary information as possible. Data reduction does not permit the restoration of the signal to its original acoustic condition and will, in addition, limit the further use of the recording because of the artefacts generated when cascading perceptually coded material - for example, in the making of a new programme incorporating the original sounds.

In the case of recordings originated in data reduced formats, a major problem with obsolescence of equipment may arise when the format of origination is of a proprietary character such as the MiniDisc and similar future systems (cf IASA-TC 04, 5.5.12.1).

12. Digital archiving principles

Digital archiving has to observe the following core principles:

- Each digital copy produced for archival purposes must be checked against the imported file ("verification"), be free of uncorrectable errors, and have the lowest possible number of correctable errors. An error status report has to be produced and kept for future monitoring. Digital recordings entering the archive from outside sources may, however, contain uncorrectable errors; again, an error status report including the position of such errors must be retained.

- Each carrier containing digital recordings must be checked at regular intervals for data integrity.

- Digital content must be copied to a new carrier whenever the number of errors increases significantly - at any rate before uncorrectable errors occur ("refreshment").

- Digital content must be copied before the old carriers, formats, and/or hardware become obsolete ("migration").

- It is essential to keep at least two digital preservation copies and to use additional copies for access as appropriate. The preservation copies should be kept in different locations whenever possible.

Whenever digital archiving is carried out, the core principles mentioned above must be observed. It is preferable that the checks should be performed automatically, as is possible with computer controlled equipment and automated equipment such as DMSSs (paragraph 13). If this is not possible, then manual checks will need to be undertaken on a statistically significant basis.

Comment:
In their essence, these principles are identical with those recommended for the analogue world. A fundamental difference, however, is the qualitative dimension of the digital world, which permits objective validation of the integrity of recordings. Regular data integrity monitoring is amongst the core obligations of digital preservation routines. Digital carriers and systems may fail, without any warning, at any time. It is imperative, therefore, to have at least one duplicate (backup copy) of each digital archival copy, ideally in a separate place. Also, strategies for minimising risks to digital archives are greatly supported by digital technologies, specifically by networking between the primary collection, the user and backup archives.

13. Digital mass storage systems

After extensive pilot projects, digital mass storage systems (DMSS) have been installed in major archives for the storage of large audio collections. Such systems permit the automatic performance of tasks including checking of data integrity, refreshment, and, finally, migration with a minimum use of man power (cf IASA-TC 04, 6.2).

Comment:
Several sound archive groups (mainly radio archives) have successfully pioneered digital mass storage installations. The driving force was the potential of DMSSs for "eternal" preservation as well as the new dimension of remote access to holdings stored in them. Presently, some national archives and research archives are also about to introduce such systems. Because of the considerable investment costs of today's DMSSs, smaller collections are not able to afford such systems at the moment. However, small and scalable systems are becoming affordable as hardware prices continue to fall. It is anticipated that software prices will also begin to drop thus making automated digital archiving affordable for a large number of archives and collections, and even individuals.

14. Solutions before DMSSs become affordable: Small scale manual approaches to digital storage

In order to avoid the risk of losing audio content on original carriers that are in immediate danger of terminal decay, many sound archives cannot wait for a DMSS to be installed before copying such holdings to digital carriers.

To date, the following digital target systems/formats have been used in such cases: R-DAT, CD-R (audio format, as well as data format) and computer data recording systems such as DLT or LTO.

Comment:
R-DAT, originally widely used as digital target format for the transfer of analogue audio, has lost ground dramatically because of format obsolescence. Also, in view of the availability of higher digital resolutions, the format has become less attractive. Although the same is true for the CD-R (audio) format, this medium is still widely used, particularly by smaller institutions, because of its financial feasibility. Due to a lack of standards and compatibility problems, however, CD-Rs and DVD-Rs can only be considered reliable after thorough testing. This is time consuming and implies significant investment in soft- and hardware for testing. IASA, therefore, does not recommend the use of either recordable CDs and DVDs as the sole digital target format for archives that cannot afford such test procedures (cf IASA-TC 04, 6.6).

Using a computer based system which incorporates tape formats such as DLT or LTO for nearline or offline access incurs greater expense, mainly because of the cost of the tape drives. For smaller amounts of storage, the use of hard disk drives (HDD) has become affordable. It must be noted, however, that in manual approaches, as opposed to automated storage systems such as DMSSs, the lower costs of hard- and software have to be offset against a considerably increased requirement for labour with all its implications in terms of risk to the carriers and personnel costs (cf IASA-TC 04, 6.5).

15. Preservation metadata

In addition to descriptive, administrative and structural metadata, a set of preservation metadata is mandatory to evaluate the technical parameters of a recording and to draw appropriate conclusions for the management of preservation.

Preservation metadata should contain full details about:

- the original carrier, its format and state of preservation.
- replay equipment for the original carrier and its parameters.
- the digital resolution, file format information, and all equipment used.
- the operators involved in the process.
- checksum – the digital signature that permits authentication of the file.
- details of the secondary information sources.

Comment:
Metadata, often described as "data about data", is, in the digital environment, a detailed and specific extension of cataloguing practice. However, when associated with digital collections, it is a necessary part of their use and control. A Preservation Metadata Set is a statement of the information that is expected to be required to manage preservation of digital collections and will supplement and incorporate the descriptive, administrative and structural metadata sets assembled for the digital collection. Preservation metadata will be a key component in the preservation and management of any digital collection and must be designed to support future preservation strategies. Metadata can be stored within the resource it describes (eg file formats that support descriptive headers), separate from the resource (eg an external catalogue) or separate but linked to the resource (eg a file linked with the digital object in a repository structure). Each strategy has particular benefits and disadvantages. It is possible, and probably desirable, to use these strategies in parallel.

16. Strategy

Sooner or later, all audio contents destined for long-term preservation will have to be transferred to digital storage repositories. As the transfer process is time consuming and cost intensive, it should follow a strategy based on the individual situation of the collection and the specific policy of an archive.

Generally, priority should be given to those documents, which are:

- at immediate risk, and/or
- part of a commercially unsupported system, and/or
- in regular demand.

The following analogue carriers can be considered to be inherently unstable and should, therefore, be copied:

- cylinders
- instantaneous discs of all types and especially "lacquer" discs
- acetate tapes
- all long/double/triple play open reel tape and all cassette tapes of any type
- any carrier that shows obvious signs of decay either by inherent instability (eg "sticky shed syndrome") or by deterioration caused by improper handling or storage (eg mechanical deformation, mould, etc).

Digital carriers must also be regarded as possibly endangered by decay, especially if they have never been checked for their data integrity. Several formats already show obvious signs of chemical decomposition with the consequent implications for the integrity of the data they contain.

Apart from carrier degradation, recent development suggests that obsolescence and the associated unavailability of replay equipment may become an equal, if not greater threat for the future retrievability of information. Practically all analogue and most dedicated digital audio formats, apart from optical disks, are obsolete. Maintaining the availability of replay equipment will become an ever increasing problem. Sound archives are strongly advised to check their equipment against the size of their holdings and take immediate action to ensure the future availability of sufficient modern (cf paragraph 7) equipment to enable the optimal replay of the entire holdings.

Access copies are to be made whenever possible. In contrast to archival transfers, however, such access or distribution copies may, based on the requirements of clients, be modified by speed corrections, filterings, etc. Data reduction may also be employed when compatible with user requirements. Again, as with transfers to archival masters, careful documentation of all parameters and procedures employed is essential.

Comment:
It must be noted that - with one exception - the above list of carriers does not imply an order of priority. The order of priority of transfer has to be decided for each collection after the carriers have been examined. It will depend on the individual rates of decay of the carriers, the availability of suitable play-back equipment, and, to a lesser extent, the existence of duplicate copies of the material.

The exception is that priority must be given to “lacquer” or “acetate” discs. Even when these discs are playable they are at grave risk of suddenly cracking or crazing without warning. This is because of the steadily increasing stress between the lacquer coating and the supporting base plate. This stress is generated by shrinkage of the lacquer coating. Lacquer discs should, therefore, be given the highest priority in the copying programme.

Format obsolescence is associated with a vanishing market of test equipment including test (calibration) tapes and discs and ancillary accessories such as empty reels, splicing and leader tapes, etc. It is highly recommended to take immediate action to ensure an environment for the optimal transfer of the entire collection.

17. Co-operation

The exchange of information between archives performing preservation work is strongly encouraged, as is the dissemination of information to small collections that do not merit the maintenance of obsolescent hardware and are not able to transfer their holdings to digital, let alone undertake the permanent future maintenance of such digital corpora. The information should cover all aspects of preservation work.

Comment:
The greater part of the world's heritage of audiovisual documents reflecting the linguistic and cultural diversity of mankind is kept in comparatively small institutions. Because of their endemic lack of financial resources, these institutions cannot be seen as archives in the narrower sense. Moreover, considerable quantities of materials of international importance are still kept by the scholars and other private individuals who collected them. These smaller collections will be able to prioritise their work when they learn about problematic carriers and the actions undertaken by larger archives. In several instances, larger archives may be able to perform certain preservation activities for smaller institutions. National and international co-operation in this respect is imperative. National Archives with a DMSS should consider hosting smaller sound file collections until digital preservation becomes widely affordable.

18. Maintaining the knowledge base of archives

A sound archive relies heavily on the equipment and processes necessary to preserve the documents in its care and to provide access to the files. It is a requirement, therefore, that the archive works to equip itself with the necessary skills and knowledge and to maintain these at a high level.

The archive must, as a result, keep itself and its employees updated with the latest scientific and technical information from the field of AV archiving. This will include information concerning the extraction of both primary and secondary information from carriers and improvements in preservation and restoration practices.

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