

TECHNICAL SPECIFICATION

Audio archive system –
Part 2: Audio data preservation

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TECHNICAL SPECIFICATION

**Audio archive system –
Part 2: Audio data preservation**

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AUDIO ARCHIVE SYSTEM –**Part 2: Audio data preservation**

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62702-2, which is a technical specification, has been prepared by technical area 6: Storage media, storage data structures, storage systems and equipment, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
100/2461/DTS	100/2519/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

A list of all parts in the IEC 62702 series, published under the general title *Audio archive system*, can be found on the IEC website.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

Sound recordings such as music, speech, and storytelling are an important human heritage and should be preserved whenever possible. However, we were unable to record and preserve sounds until Edison achieved the first recording in 1877. Although various technologies were invented later, most of them have a limited lifespan with respect to audio archiving because storage and sound quality deteriorates when it is transferred to the next generation storage device.

The progress of LSI technology made it possible to digitize recorded sound. The digital recording is very suitable for audio archiving because the migration is performed by copying digital data.

There can be various recording materials for this purpose, they are optical disks, magnetic disks, magnetic tape and non-volatile memories such as phase change memory.

This Technical Specification specifies physical and logical aspects for a standard of audio archives of various storage types which are typically used for audio archives in markets.

The IEC 62702 series currently consists of:

Part 1 which specifies the minimum requirements on physical aspects of optical disks for digital sound recordings. Part 1-1 specifies DVD optical disk, Part 1-2 specifies BD optical disk.

Part 2 which specifies the minimum requirements for digitization of content, format of digitised content, content information and media inspection.

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AUDIO ARCHIVE SYSTEM –

Part 2: Audio data preservation

1 Scope

This part of IEC 62702, specifies the requirements for digitization of audio data for audio preservation.

2 Normative references

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

IEC 62227, *Multimedia home server systems – Digital rights permission code*

3 Terms and definitions

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

3.1

audio archive

archive that consists of audio data preservation

3.2

audio data preservation

data of audio stored in physical media for preservation

3.3

AIP

archival information package

3.4

dissemination

distribution of preserved audio content to users

3.5

objective media

media whose storage is based on impartial criteria

4 Objective media inspection

4.1 Criteria of the objective media

In order to objectively determine whether recorded audio content should be digitised and migrated to an archival media for long term preservation, the following criteria should be applied.

- Evaluate the availability of the media and its playback means in the long term with consideration to the format of the media; whether the media specification is internationally

standardized or publically accessible and available. If the availability is limited in its lifespan, i.e. less than the archive system's target term, then the media is worth preserving.

- Evaluate the degradation of the media. If the degradation of the media causes degradation of the reproduction, of sound, or if playback is difficult, then the media should be preserved.
- Evaluate the continuity of the organization that possesses the media to determine whether the media should be preserved.

4.2 Criteria of the archival media for preservation and dissemination

To determine what kind of media should be used for archival media for preservation and dissemination media, the following criteria should be applied.

- For archival media, evaluate the long term availability, durability and energy efficiency. However, it depends on the policy of the archive organization.
- For dissemination of media, evaluate the media format of availability, popularity, availability of reproduction devices or software. Copy protection or rights management systems are considered if the content is copyrighted. If rights management systems apply, see IEC 62227.

5 Digitization of audio content

5.1 Condition and environment

The objective media has its own original characteristics of reproduced sound quality. The condition and environment including digitise equipment should be determined to guarantee the original sound quality of audio content. The sound quality factors are:

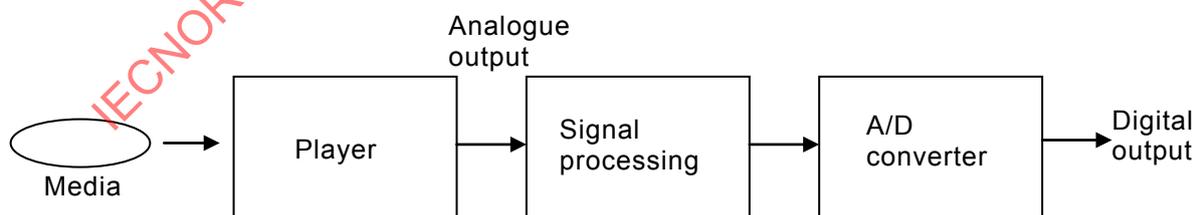
- S/N ratio;
- frequency characteristics;
- frequency deviation (jitter, wow-flutter).

5.2 Digitization method

5.2.1 Content of analogue media

5.2.1.1 System

The digitization of analogue signals of analogue media is described in Figure 1.



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Figure 1 – Digitization of analogue signals

There are various types of signal processing methods with respect to the analogue output signal. The choice of method depends on the policy of preservation. If all signals are preserved exactly as they are, signal processing is not applied. Signal processing is used to enhance or modify audio signals. For noise reduction, or any compensation for noise of the audio signal of content, see Annex C.

5.2.1.2 Digital signal format

The player of the analogue media reproduces analogue signals. An analogue to digital converter digitises that analogue signal to digital data. The basic format of analogue to digital conversion is described in Table 1.

Table 1 – Digital signal format

Codec	Liner PCM
Sampling frequency	48 kHz or 96 kHz
Bit length	24 bit
Channels	Same as the analogue content

The sampling frequency depends on the content frequency characteristic. For instance, LP analogue records have a frequency response over 30 kHz that may be utilized for a 4 channel application, in this case 96 kHz sampling is recommended.

5.2.1.3 Audio file format

The file format for digital signals is is described in Table 2.

Table 2 – File format

File format	BWF
	RIFF/WAVE

5.2.1.4 Information of time code or address

Content of analogue media may not have a time code or address information. Mostly playing time information is provided separately by other media. Playing time, or start and end time or address of an audio track may not be provided. However, after digitization, the time code or address can be embedded in digitised content or provided separately. All information concerning time code or address of audio track of analogue media should be provided.

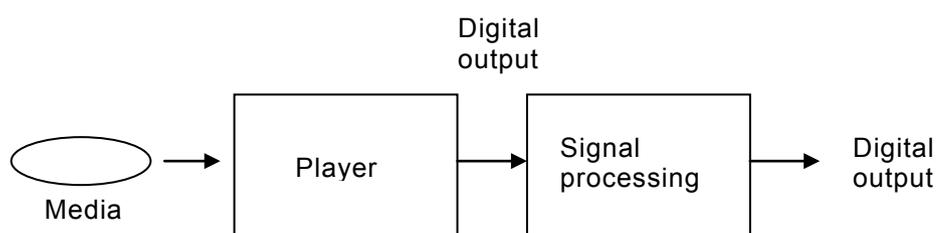
5.2.2 Content of digital media

5.2.2.1 System

The player of the digital media reproduces analogue and/or digital signals. If the available player has only an analogue signal output, a digital signal before an A/D converter in the player should be used as a reproduced signal. In case an available player has a digital audio signal output or interface, a reproduced signal is obtained from that.

If players have only an analogue signal output, the system is the same as the analogue system described in 5.2.1.1.

For players with digital signal outputs, the system is described in Figure 2.



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Figure 2 – Digital signal capturing

The signal processing of output signals is the same as described in 5.2.2.2.

Examples of digital signal capturing are provided in Annex A.

5.2.2.2 Format

The basic format of digital signals is described in Table 3.

Table 3 – Digital to digital conversion format

Format	Linear PCM
File format	RIFF/WAVE
Sampling frequency	Same as the source digital content
Bit length	Same as the source digital content
Channels	Same as the source digital content

5.2.2.3 Audio file format

Digital signals are stored in the file format as described in Table 4.

Table 4 – Audio file format

File format	RIFF/WAVE
	BWF

6 Inspection of digitised file and recorded media

Digitised content data is stored in the file format. Before recording to a media, the file should be inspected to ensure that digitization is completed without any defects or degradations.

The data format is WAVE or BWF, the digitised audio data is given in data chunks.

- The file format is verified.
- The data chunk is reproduced and it is ensured that the audio signal is completely digitised by a human hearing check or signal comparison of the reproduced audio signal and original audio signal.

When the file is recorded to a media for preservation, then the media should be inspected to ensure that the recording is completed. The disk media inspection is described in Annex B.

7 Reception of digitised content

The reception of digitised content is executed with information of the digitised content. The information format regarding audio content is defined by various standard developing organizations, these are used in each organization and there is no international standard commonly applicable. This Technical Specification defines the categories and information items for audio preservation. Basic requirements about the archival information package are described in Clause 8. Any information format standard can be used which includes these categories and information items.

8 Archival information package

8.1 Content information

Content information, that is information related to digitised audio content, is categorized as described in Table 5. Each category consists of information items. This Technical Specification specifies the categories and information items as an example of basic requirements, because this kind of information is specified by various standard developing organizations for their purposes. These types of information have been used in each country and organization for conventional archiving.

Table 5 – Content information

Category	Information item	Description
Information of original content	Title information	Content identification in original media, such as what part of what series
	Attribute	Title, composer, player, etc.
	Object information	Content identification
	Location information	Content location identification
Information of media of original content	Media information	Content media format identification
	Player information	Information for playback of the digitised file
Information of digitization equipment and systems	Equipment information	Used equipment and system
	Signal processing	Pre-process, post-process
	Digitiser information	Codec, sampling frequency, digitization bit length
	Integrity ID	Integrity of digitised content
Copyright information and copyright control information	Copyright information	Copyright and DRPC information
	Copyright control information	DRM information and SCMS, CGMS information

Some information items exist as non digital information such as paper documents. For digital data preservation, these non digital data should be digitised and all information is managed as metadata in digital form.

8.2 Package format for AIP

All digitized audio files, other content information and all related metadata should be packed together in a package format. MPEG-A professional archival application format (PA-AF) should be used for the package format for AIP.

If lossless compression is needed to compress the size of audio files, MPEG-4 audio lossless coding should be used along with MPEG-A PA-AF.

9 Preservation

Digitised content with information is preserved with the media. What kind of media should be used depends on the importance of its content.

IEC 62702-1-1¹ specifies the physically required specification of DVD for audio data preservation. In this standard, the disc rank is specified that indicates the guarantee period of disc durability.

The rank specifies its guaranteed preservation years as 30 years, 60 years and over 100 years. 30 years represents a social or business period, 60 years represents an active human life period, and over 100 years is the utmost disc for any period.

Which ranked disc should be used depends on the policy of the audio archive system. For instance, factors that decide on the disc rank are:

- budget, any cost to maintain the archive;
- maintenance or renewable period of the archive.

10 Access

To enable easy and efficient access to audio archives, the following criteria are applied.

- The description of content including metadata should have a hierarchical structure. A table of content should be provided for the user's better understanding and convenience.
- Depending on the viewpoint of AAL (ambient assisted living), an audio archive should be usable for the user with visual impairments.

NOTE ANSI/NISO Z39.98 (DAISY) is one solution for users with difficulty in seeing. This is also applicable to audio archive content. Dealing with audio preservation content such as read out text, all DAISY properties are available.

11 Dissemination

11.1 Format

To disseminate preserved content, the format of preserved content may not be appropriate because the size of the file is large and may not be suitable for dissemination purposes.

Dissemination methods are streaming, file distribution and broadcasting. A format depends on each method, factors of the format are described in Table 6.

Table 6 – Dissemination format

	Streaming	File	Broadcasting
Format	Not specified	Not specified	Not specified
File format	Not specified	Not specified	Not specified
Sampling frequency	Same as original	Same as original	Same as original
Bit length	Same as digitised or less	Same as digitised or less	Same as digitised or less
Channels	Same as original	Same as original	Same as original

¹ Under consideration.

11.2 Copyright management

The preserved content has copyright and related information, this information should be bound to the content. The information system is specified in IEC 62227 as digital rights permission code. In case the content needs to be encrypted, any DRM (Digital Rights Management) method may be applied.

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Annex A (informative)

Digital signal capturing

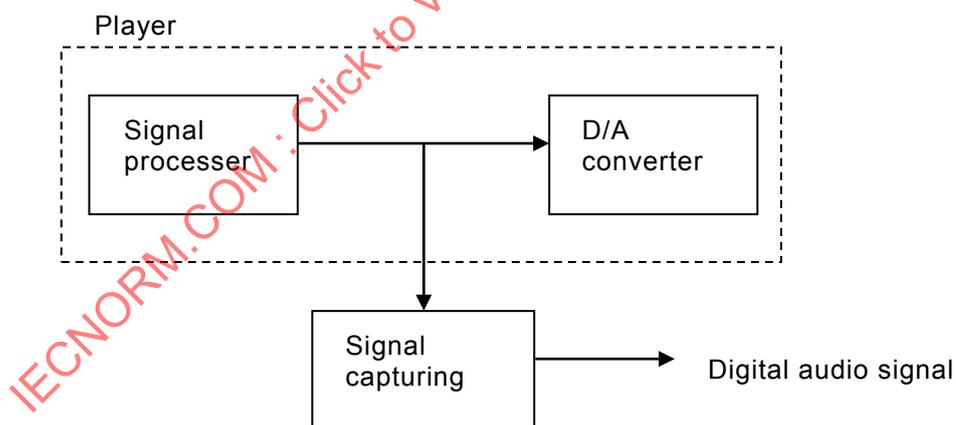
This annex explains digital signal capturing for the purpose of audio preservation. Copy control issues of digital audio content may need to be solved between content owner and archive owner.

In case the player has a digital audio interface, a digital audio signal is output through a digital audio interface and captured, if the player has no digital audio output then the signal before a D/A converter is captured.

IEC 60958-3 is a digital audio interface standard, which is commonly used by consumer audio/video players. Professional audio/video player uses IEC 60958-4 or AES3. These standards specify the method to carry Linear PCM format data. In case of compressed audio data, the IEC 61937 series or SMPTE ST 337 and other specifications are used. Also, some players are equipped with other digital interfaces. The receiver equipment can receive digital audio interface data, output D/A converted analogue signals for reproduction, but it cannot capture digital data of this receiver equipment.

To capture digital audio data, there are two methods. One method is to capture the data before the D/A converter of the receiver equipment. This resembles the case when the player has no digital output. The other method is to process digital audio interface output signals to capture Linear PCM audio data. However, this method requires dedicated equipment.

Figure A.1 shows the capturing of digital audio signals from the D/A converter input. The capture of a D/A converter input signal is bypassed, instead it is processed to the appropriate digital audio signal format such as WAVE.



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Figure A.1 – Signal capturing from the D/A converter signal

Figure A.2 shows the capturing of digital audio signals from the digital audio interface. The digital audio signal is captured from the interface output. It is processed to obtain an appropriate digital audio signal format such as WAVE.

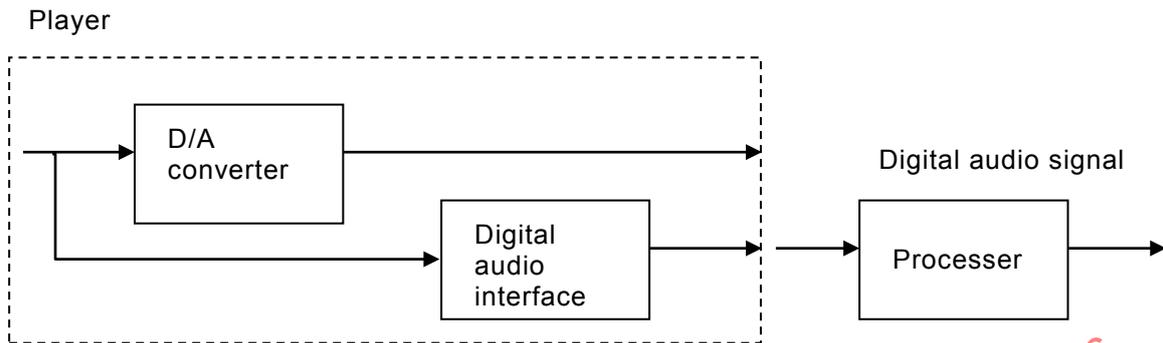


Figure A.2 – Signal capturing from the digital audio interface

Digital audio data of digital media such as CD, DAT can be captured, but digital media such as DVD, BD employs copy control, these media allow only the digital audio signal output without copy protection when audio quality is equal or under 48 kHz sampling and 16 bit length. This copy restriction is applied in order to prevent unauthorized copying. If the content owner agrees to capture high quality digital audio signals for audio preservation, copy control is deactivated with cooperation between the content owner and stake holders.

A PC can playback a CD with a CD drive, the data of a CD can be captured with the PC. CD file systems are specified in ISO 9660. A PC can capture a complete CD file system as a disc image, and can also capture only audio data to the WAVE file. Therefore, the audio data of a CD is directly captured to the disc image or the WAVE file. The disc image also contains other information than audio data such as time code, subcode.

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Annex B (informative)

Digitised content inspection in disk media

Disk media has its own nature of recording and playback characteristics. Recorded digital data should be inspected for playback to avoid any defects or artefacts, and ensured playability. The items to be inspected are described as follows.

- Visual inspection; executed by human eyes
 - Recorded layer, whether there is visual noise, defects or degrading.
- Machinery inspection; executed by the dedicated playback equipment
 - Playback
 - Noise, defects or degrading of reproduced audio signal except those from original content.

To determine whether the disc should be remade depends on the criteria that the archive system employs.

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