

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Audio archive system –  
Part 1-2: BD disk and data migration for long-term audio data storage**

**Système d'archivage audio –  
Partie 1-2: Disque BD et migration de données pour le stockage à long terme des  
données audio**

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## AUDIO ARCHIVE SYSTEM –

## Part 1-2: BD disk and data migration for long-term audio data storage

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IEC 62702-1-2 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. It is an International Standard.

This second edition cancels and replaces the first edition published in 2017. This edition constitutes a technical revision.

In order to reflect the updates to ISO/IEC 29121:2021, this edition includes the following significant technical changes with respect to the previous edition:

- a) ISO/IEC 16963 has been identified as the referee test method for the estimation of lifetime;
- b) the ambient conditions for the measurement of maximum data error have been added;
- c) the requirements for test drives have been changed considering the use condition of users;
- d) the requirements for the estimated lifetime have been defined more clearly;
- e) the requirements for the periodic performance test have been defined more clearly.

The text of this International Standard is based on the following documents:

Draft	Report on voting
100/3671/CDV	100/3743/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

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 document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

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- replaced by a revised edition, or
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## INTRODUCTION

Sound recordings such as music, speech, and storytelling are an important human heritage and should be preserved for as long as possible. However, we were not able to record sounds in order to preserve them in the past. The first recording system, the phonautograph, was invented by Édouard-Léon Scott de Martinville in 1860 and, after that, Thomas Alva Edison invented the recording and playback system known as the phonograph in 1877.

Although various technologies were invented later, most of them have limitations for audio archives because storage lifetime is limited, and the sound quality deteriorates when it is transferred to the next generation of storage device.

The progress of LSI (Large-Scale Integrated Circuit) technology made digital recording of recorded sound possible. Digital recording is very suitable for audio archiving because the migration is performed by copying digital data.

For this purpose, various recording materials exist, such as optical disks, magnetic disks, magnetic tape, and non-volatile memory (such as phase-change memory).

This International Standard specifies physical and logical aspects for standards of audio archives of various storage types which are typically used for audio archives on the market.

The IEC 62702 series currently consists of:

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

NOTE DVD optical disks include DVD-R disk, DVD-RW disk, DVD-RAM disk and +R format disk, +RW format disk. BD optical disks include BD recordable disk and BD rewritable disk.

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



## AUDIO ARCHIVE SYSTEM –

### Part 1-2: BD disk and data migration for long-term audio data storage

#### 1 Scope

This part of IEC 62702 specifies a method of data-quality assurance for writable BD disks (hereafter referred to as "disks") which are specified for long-term data storage, and a data migration method which can sustain the recorded data on disks for long-term audio data preservation. The writable disks include BD recordable disk and BD rewritable disk.

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 16963:2017, *Information technology – Digitally recorded media for information interchange and storage – Test method for the estimation of lifetime of optical disks for long-term data storage*

ISO/IEC 29121:2021, *Information technology – Digitally recorded media for information interchange and storage – Data migration method for optical disks for long-term data storage*

IEC 62702-1-2:2022

#### 3 Terms and definitions

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

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

##### 3.1

##### **$B_{\text{mig}}$ life**

*lifetime* (3.10) for use of *data migration* (3.6) and identical to  $B_{0,000\ 1}$  life which is 0,000 001 quantile of the lifetime distribution (i.e. 0,000 1 % failure time) or 99,999 9 % survival lifetime

[SOURCE: ISO/IEC 29121:2021, 3.1]

##### 3.2

##### **$B_5$ life**

5 percentile of the *lifetime* (3.10) distribution (i.e. 5 % failure time) or 95 % survival lifetime

[SOURCE: ISO/IEC 16963:2017, 3.4]

##### 3.3

##### **$(B_5 \text{ life})_L$**

95 % lower confidence bound of  $B_5 \text{ life}$  (3.2)

[SOURCE: ISO/IEC 16963:2017, 3.5]

### 3.4

#### **B<sub>50</sub> life**

50 percentile of the *lifetime* (3.10) distribution (i.e. 50 % failure time) or 50 % survival lifetime

[SOURCE: ISO/IEC 16963:2017, 3.6]

### 3.5

#### **controlled storage condition**

well-controlled storage conditions with full-time air conditioning (25 °C and 50 % relative humidity) in which the *lifetime* (3.10) of data stored on optical disks

[SOURCE: ISO/IEC 16963:2017, 3.7]

### 3.6

#### **data migration**

process to copy data from one storage device or medium to another

[SOURCE: ISO/IEC 29121:2021, 3.5]

### 3.7

#### **error correction code**

#### **ECC**

mathematical computation yielding check bytes used for the detection and correction of errors in data

Note 1 to entry: For BD recordable disk and BD rewritable disks, the long-distance code (LDC) + burst-indicating subcode (BIS) defined in ISO/IEC 30190, ISO/IEC 30191, ISO/IEC 30192, and ISO/IEC 30193 is applied.

Note 2 to entry: This note applies to the French language only.

[SOURCE: ISO/IEC 29121:2021, 3.6 modified— Note 1 to entry has been shortened to apply only to BD disks.]

### 3.8

#### **error rate**

rate of errors or error count measured on the signal at the input of error-correction decoder, which represents raw-error rate of data recorded on a disk

[SOURCE: ISO/IEC 29121:2021, 3.7]

### 3.9

#### **initial performance test**

first test of the *error rate* (3.8) of data recorded on a disk before storing

[SOURCE: ISO/IEC 29121:2021, 3.8]

### 3.10

#### **lifetime**

time that information is retrievable in a *system* (3.16)

[SOURCE: ISO/IEC 29121:2021, 3.9]

### 3.11

#### **maximum data error**

greatest level of *error rate* (3.8) anywhere in one of the relevant areas on the disk

[SOURCE: ISO/IEC 16963:2017, 3.13, modified — Note 1 to entry has been deleted.]

### 3.12

#### **RSE<sub>R</sub><sub>max</sub>**

greatest level of random symbol error rate measured on the signal in one of the relevant areas on a disk at the input of error-correction decoder, which excludes burst errors of length greater than or equal to 40 bytes

Note 1 to entry: See ISO/IEC 30190, ISO/IEC 30191, ISO/IEC 30192, ISO/IEC 30193 and ISO/IEC 16963.

Note 2 to entry: This note applies to the French language only.

### 3.13

#### **periodic performance test**

periodic test of the *error rate* (3.8) of data recorded on a disk during the storage

[SOURCE: ISO/IEC 29121:2021, 3.15]

### 3.14

#### **retrievability**

ability to recover physical information as recorded

[SOURCE: ISO/IEC 16963:2017, 3.14]

### 3.15

#### **substrate**

layer, which can be transparent or not, provided for the mechanical support of a recording layer

[SOURCE: ISO/IEC 30193:2021, 3.43]

### 3.16

#### **system**

combination of hardware, software, storage medium and documentation used to record, retrieve and reproduce information

[SOURCE: ISO/IEC 16963:2017, 3.20]

### 3.17

#### **uncorrectable error**

error in the read-out data that cannot be corrected by the error correction decoders

[SOURCE: ISO/IEC 29121:2021, 3.18]

### 3.18

#### **X<sub>mig</sub> interval**

migration interval (year) which is determined by user

[SOURCE: ISO/IEC 29121:2021, 3.19, modified — Note 1 to entry has been deleted.]

## **4 Disk and lifetime for long-term audio data storage**

### **4.1 Disk for long-term audio data storage**

A disk with a specified lifetime should be used for long-term audio data storage. A disk with an unspecified lifetime should not be used.

## 4.2 Lifetime estimation

For the purposes of this document, the lifetime of a disk shall be derived from the measurements specified in ISO/IEC 16963. The Eyring method is used for lifetime estimation under controlled storage conditions (25 °C and 50 % relative humidity).

In ISO/IEC 16963, the estimated lifetime can be defined variously as  $B_{50}$  life,  $B_5$  life and the 95 % lower confidence bound of  $B_5$  life [equals  $(B_5 \text{ life})_L$ ] and is described as follows.

$$B_{50 \text{ life}} = \exp(\ln \hat{B}_{50}) = \exp(\hat{\beta}_0 + \hat{\beta}_1 x_{10} + \hat{\beta}_2 x_{20})$$

$$B_{5 \text{ life}} = \exp(\ln \hat{B}_5) = \exp(\hat{\beta}_0 + \hat{\beta}_1 x_{10} + \hat{\beta}_2 x_{20} - 1,64 \hat{\sigma})$$

where

$B_{50 \text{ life}}$  is the variable for  $B_{50}$  life;

$B_5 \text{ life}$  is the variable for  $B_5$  life;

$x_{10}$  and  $x_{20}$  are the temperature-dependent factor and the relative-humidity-dependent factor at the controlled storage conditions (25 °C/50 % relative humidity) respectively.

Also, the 95 % lower confidence bound of  $B_5$  life becomes

$$B_{(5 \text{ life})L} = \exp\left[(\ln \hat{B}_5)_L\right] = \exp\left[\ln \hat{B}_5 - 1,64 \sqrt{\text{var}(\ln \hat{B}_5)}\right]$$

where

$B_{(5 \text{ life})L}$  is the variable for  $(B_5 \text{ life})_L$ ;

$\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2$  and estimated variance of residual errors  $\hat{\sigma}$  are obtained using regression analysis of time-to-failure data.

## 4.3 $B_{\text{mig}}$ life for long-term audio data storage

The estimated lifetime of  $B_5$  life means 5 % of the products reach failure. It is widely used in other contexts. However, from the viewpoint of the reliability of long-term audio storage to retain the integrity of the original data, it is not appropriate to use  $B_5$  life as the estimated lifetime when determining a test interval and deciding on data migration.

In the case of audio data migration, it is necessary to have a sufficiently low failure probability. The time at which one millionth of the products reach the failure shall define, in this document, the estimated lifetime to determine test intervals and migration interval.  $B_{0,000\ 1}$  life is 0,000 001 quantile of the lifetime distribution (i.e. 0,000 1% failure time) and expressed as  $B_{\text{mig}}$  life in this document.  $B_{\text{mig}}$  life can be calculated using  $B_{50}$  life and  $B_5$  life as follows (see also ISO/IEC 29121:2021, Annex E).

$$B_{0,000\ 1\ life} = \exp(\ln \hat{B}_{0,000\ 1}) = \exp(\ln \hat{B}_{50} - 4,75\hat{\sigma}) = \exp\left(\ln \hat{B}_{50} - 4,75 \frac{\ln \hat{B}_{50} - \ln \hat{B}_5}{1,64}\right) =$$

$$\exp(2,9\ln \hat{B}_5 - 1,9\ln \hat{B}_{50})$$

where

$B_{0,000\ 1\ life}$  is the variable for  $B_{0,000\ 1\ life}$ .

Thus

$$B_{mig\ life} \times 24 \times 365 = B_{0,000\ 1\ life} = \exp(2,9\ln \hat{B}_5 - 1,9\ln \hat{B}_{50})$$

where

$B_{mig\ life}$  is the variable for  $B_{mig\ life}$ .

In actual storage conditions, the temperature and relative humidity can deviate from the controlled storage condition of 25 °C and 50 % relative humidity, which changes the estimated lifetime. In this case, the estimated lifetime should be adjusted according to the estimated lifetime at the actual storage conditions, as specified in ISO/IEC 29121:2021, Annex D.

#### 4.4 Estimated-lifetime rank and display colour

##### 4.4.1 Estimated-lifetime rank and display colour identification

For audio data migration, rank of  $B_{mig}$  life and its identifying display colour are defined as follows.

$B_{mig}$  life is over 30 years, the display colour is red.

$B_{mig}$  life is over 60 years, the display colour is green.

$B_{mig}$  life is over 100 years, the display colour is gold.

Guidelines for use of the ranks of  $B_{mig}$  life and their display colours are shown in Annex A.

##### 4.4.2 $B_{mig}$ life and display colour indication on disks and packages

The rank of  $B_{mig}$  life, its display colour and the reference-controlled storage condition shall be indicated on both the disk and the packaging, excluding a two-sided disk. Indication examples for ranks and their colours are shown in Annex A.

## 5 Test condition, test methods and disks for audio data

### 5.1 Ambient conditions of maximum data error measurement

The ambient condition is the surrounding condition in a room where a test drive is located. The ambient conditions for the  $R_{SER_{max}}$  measurements are as follows:

Temperature: 15 °C to 30 °C

Relative humidity: 20 % to 75 %