CERTIFICATE

By Authority Of
THE UNITED STATES OF AMERICA
Legally Binding Document

By the Authority Vested By Part 5 of the United States Code § 552(a) and Part 1 of the Code of Regulations § 51 the attached document has been duly INCORPORATED BY REFERENCE and shall be considered legally binding upon all citizens and residents of the United States of America. *HEED THIS NOTICE*: Criminal penalties may apply for noncompliance.

Document Name: AIMM/PIMA IT9.25: Imaging Materials--Optical Disc Media--Storage

CFR Section(s): 36 CFR 1234.14(b)(3)

Standards Body: Association for Information and Image Management

APPROVED

Official Incorporator:
THE EXECUTIVE DIRECTOR
OFFICE OF THE FEDERAL REGISTER
WASHINGTON, D.C.

ANSI/PIMA IT9.25-1998

American National Standard

for Imaging Materials – Optical Disc Media – Storage

ANSI American National Standards Institute
11 West 42nd Street
New York, New York
10036

ANSI/PIMA IT9.25-1998

American National Standard
for Imaging Materials –

Optical Disc Media – Storage

Secretariat

Photographic & Imaging Manufacturers Association, Inc.

Approved May 15, 1998

American National Standards Institute, Inc.

American National Standard

Approval of an American National Standard requires review by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgement of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made towards their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Published by

American National Standards Institute, Inc.
11 West 42nd Street, New York, NY 10036

Printed in the United States of America

Contents

Foreword (This foreword is not part of American National Standard ANSI/PIMA IT9.25-1998.)

This standard is concerned with the storage of optical discs, including read only, write-once, and re-writable.

This standard was prepared by a Joint Technical Commission of PIMA IT9-5 on Optical & Magnetic Imaging Materials and the Audio Engineering Society Standards Committee Subcommittee SC-03 on Audio Preservation and Restoration.

This standard contains three informative annexes, which are not considered part of this standard.

Suggestions for the improvement of this standard will be welcome. They should be sent to the Photographic & Imaging Manufacturers Association, Inc., 550 Mamaroneck Avenue, Suite 307, Harrison, NY 10528-1612; e-mail: natlstds@pima.net

This standard was processed and approved for submittal to ANSI by PIMA Technical Committee on Physical Properties and Permanence of Imaging Materials, IT9. Committee approval of this standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the IT9 Committee had the following members:

Peter Z. Adelstein, Chairman
Steven Puglia, Vice Chairman
A. Tulsi Ram, Secretary

Organization Represented	*Name of Representative*
Photographic & Imaging Manufacturers Association, Inc.	Edgar Draber
	Joe Helm
	Ron Hiller (Alt.)
	Kazuo Kato
	Atsushi Tomotake (Alt.)
	David F. Kopperl
	A. Tulsi Ram (Alt.)
	Charles Schallhorn (Alt.)
	Cheri L. Warner (Alt.)
	Peter Krause
	Rita Hofmann (Alt.)
	Rod Parsons (Alt.)
	Norman Newman
	Neil Anderson (Alt.)
	William Murray (Alt.)
	Peter Roth
	R. "RK" Kannabiran (Alt.)
	Robert L. Seyfert
	Yoshihiko Shibahara
	Kenneth M. Smith
Association for Engineering Graphics and Imaging Systems	Susan S. Y. Johnson
Association for Information and Image Management (Liaison)	Marilyn Wright
First Image Management Company	William E. Neale
Genealogical Society of Utah	Eric Erickson
	Nathan Nilsson (Alt.)
	Brent Reber (Alt.)
Image Permanence Institute	James M. Reilly
	Douglas Nishimura (Alt.)
International Society of Photogrammetry and Remote Sensing	Francis J. Parrish
Light Impressions Corporation	Dennis Inch
Motion Picture Studio Preservation	Rick Utley
National Geographic Society	Robin E. Siegel
National Information Standards Organization (Liaison)	Margaret Bymes
National Optical Astronomy Observatories	William E. Schoening

Organization Represented	*Name of Representative*
Professional Photographers of America, Inc.	Robert M. Opfer
Smithsonian Institution	Mark McCormack-Goodhart
	James H. Wallace, Jr. (Alt.)
Society of Imaging Science and Technology	Peter Z. Adelstein
Sony Corporation	Huy Sam
U.S. Library of Congress	Gerald Gibson
U.S. National Archives and Records Administration	Steven Puglia
	Alan R. Calmes (Alt.)
	Sarah Wagner (Alt.)
Wilhelm Imaging Research	Henry Wilhelm

Individual Experts

Eugene Ostroff
Scott A. Williams

The Joint Technical Committee which developed this standard, had the following members:

Peter Z. Adelstein, Chairman
Gerald D. Gibson, Co-Chairman

Michael Alexander
George Boston
Peter Brothers
Kevin Bradley
James Burke
Alan R. Calmes
Katherine Cochrane
Jean-Marc Fontaine
Lars Gustad
Albrecht Hafner
Ken J. Hallam
Takashi Hirakawa
Barbara Iwanicka
Fredrick Kolb, Jr.
Drago Kunej
William Murray
David Peele
Fernando Podio
Daniel Queen
Elango Ramanathan
Dietrich Schuller
Ted Sheldon
Michael Stamp
Susan Stinson
William Storm
Carl Talkington
John Van Bogart
Robert Waelbroeck
Johanna Welheiser
James Wheeler
David Wickstrom
Joseph Wrobel
Edward Zwaneveld

Introduction

Use of optical disc material is becoming widespread in audio, video, and computer applications. Preservation of this information is becoming of increasing concern to society, particularly as the recorded information becomes older and frequently of greater value to libraries, archives, museums, government agencies, and commercial organizations.

The stability of optical discs is dependent upon that of the complete system. This includes the stability of the material itself, the equipment on which it is run, and, in systems, upon the necessary software. ANSI/NAPM IT9.21-1996, *Life Expectancy of Compact Discs (CD-ROM) – Method for Estimating, Based on Effects of Temperature and Relative Humidity*, specifies a methodology for estimating the life expectancy of the CD-ROM. Other optical discs will be addressed in future standards. These standards consider only the effects of temperature and humidity and do not include other factors such as light, corrosive gases, and particulates. Standards are not available on the life expectancy of hardware and the problems associated with hardware wearing out or becoming obsolete. Optical disc users should store the discs under conditions that will extend their life and handle the material so that it will not be subjected to stress and undergo physical breakdown during use. This standard addresses the concerns of storage.

A major component of a large number of optical discs is the polycarbonate substrate. Polycarbonate is a very durable material, but it does absorb moisture and there is always an equilibrium between the ambient humidity and the moisture content of the disc. Polycarbonate is susceptible to decomposition under certain conditions and given a suitable catalyst.

The second component of most optical discs is the reflective layer. This layer is usually some highly reflective metal such as aluminum, silver, or gold. Each of these materials is subject to reaction with various chemicals that may be found in the environment. Aluminum, for example, combines readily with oxygen to form aluminum oxide. Silver combines with sulfur to tarnish and form silver sulfides. Gold is known to react with chlorine to form gold chlorides.

A third component of these discs is some type of seal coat. This is typically a UV cured polymer whose purpose is to protect the reflective layer and any other material layers in the disc.

A fourth component, in the case of some recordable optical discs, is the dye layer. For magneto-optic or phase change discs, additional layers are also included.

Regardless of the inherent stability of the various disc layers, it is known that good storage conditions will extend the life of all optical discs. While a good storage environment cannot reverse any degradation that has already occurred, it can slow down additional deterioration. A single storage condition is described in this document. This condition is intended for discs that contain recorded information of long term value. Various manufacturers' studies indicate that the life expectancy of well manufactured optical discs is in excess of 50 years under typical room ambient conditions [2], [3][1)]

[1)] The number in the bracket refers to the reference in clause 2.

American National Standard
for Imaging Materials –

Optical Disc Media – Storage

1 Scope

This standard is for extended-term storage conditions for optical discs as defined in clause 3 and provides recommendations concerning the storage conditions, storage facilities, enclosures, and inspection for optical discs. It applies to discs made for audio, video, instrumentation, and computer use.

Recommendations are general in nature and manufacturer's cautions for specific material should be considered. Relaxation from these recommendations, whether before or after recording, will generally result in shortened life expectancy.

2 Normative references

The following references contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards and publications are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards and publications listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ANSI X3.212-1992 (R1997), *Information systems – 130-mm rewritable optical disc cartridge for information interchange*

ANSI/NAPM IT9.21-1996, *Life expectancy of compact discs (CD-ROM) – Method for estimating, based on effects of temperature and relative humidity*

ANSI/PIMA IT9.23-1998, *Imaging materials – Polyester base magnetic tape – Storage*

ANSI/NFPA 75-1995, *Electronic computer/Data processing equipment*

ANSI/NFPA 90A-1996, *Installation of air conditioning and ventilating systems*

ANSI/NFPA 232-1995, *Protection of records*

ANSI/UL 72-1990, *Tests for fire resistance of record protection equipment*

IEC 908 (1987), *Compact disc digital audio system*[2)]

ISO/IEC 10149-1995, *Information technology – Data interchange on read-only 120-mm optical discs (CD-ROM)*[2)]

[2)] Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

[1] Morgan, John, *Conservation of Plastics,* Plastics Historical Society, the Conservation Unit, Museums and Galleries Commission, London, UK: 21, 29-30, 32; 1991

[2] Murray, W.P., *Accelerated Service Life Predictions of Compact Discs*, ASTM STP 1202: 263-271; 1994

[3] Stinson, Douglas, et al., *Lifetime of Kodak Writable CD and Photo CD Media*, Sigcat Discourse, vol. 9 issue 1. January/February 1995

3 Definitions

For the purpose of this standard, the following definitions apply:

3.1 CD: Compact Disc, as described in IEC 908.

3.2 CD-ROM: Compact Disc – Read Only Medium, as described in ISO/IEC 10149.

3.3 CD-WO: Compact Disc – Write Once, a record once version of the CD described above. This type of media can be recorded one time and read many times.

3.4 CD-R: Compact Disc – Recordable, same as CD-WO (see 3.3.)

3.5 CD-RW: Compact Disc – Re-writable, a re-recordable version of the CD described in 3.4. This type of media can be recorded many times and read many times.

3.6 dew point: a) The surface temperature at which moisture begins to condense on a surface. The more humid the air, the higher the dew point temperature; b) The temperature corresponding to saturation for a given absolute humidity. See also *relative humidity.*

3.7 extended-term storage conditions: Storage conditions suitable for the preservation of recorded information having permanent value.

3.8 fire-protective storage: Facilities designed to protect records against excessive temperatures, water and other fire-fighting agents, and steam developed by insulation of safes or caused by the extinguishing of fires and collapsing structures.

3.9 isoperm lines: Lines of constant life plotted as a function of temperature versus relative humidity.

3.10 life expectancy (LE): The length of time that information is predicted to be retrievable in a system under extended-term storage conditions.

3.11 magnetic field intensity: The level of the magnetic field at a point in space.

3.12 medium: The material on which the information is recorded (plural: media.)

3.13 relative humidity (RH): The ratio, defined as a percentage, of the existing partial vapor pressure of water to the vapor pressure at saturation. (It is usually, but not always, equal to the percentage of the amount of moisture in the air to that at saturation.)

3.14 storage environment: The conditions for storing materials, i.e., temperature, relative humidity, cleanliness of facilities, and atmospheric pollutants.

3.15 storage housing: A physical structure supporting materials and their enclosures. It may consist of drawers, racks, shelves, or cabinets.

3.16 system: The material, hardware, software, and documentation necessary for recording and/or retrieving information.

3.17 WORM disc: An optical disc in which the data in specified areas can be written only once and read multiple times by an optical beam.

4 Environmental conditions

4.1 Humidity and temperature limits

The average relative humidity of an extended-term storage environment shall be maintained between 20% and 50% RH. Ideally, the maximum temperature for extended periods should not exceed 25°C, and a temperature below 23°C is preferable. The peak temperature shall not exceed 32°C. Generally, protection will be increased by storing discs at low temperature and low relative humidity since chemical degradation is reduced at these conditions (see annex A).

Storage of discs below -10° C and 5% RH is not recommended because of the possibility of damaging the mechanical integrity. Any cycling of relative humidity shall not be greater than ± 10% over a 24-hour period. Specific manufacturer's recommendations, when available, should take precedence over the above general recommendations.

4.1.1 Extended-term storage environment

For any facility, it is impossible to specify what the best relative humidity and storage temperature should be, since it depends upon the value of the material, the past storage history, the length of time the disc is to be kept, the size of the vault, the cost of various options, and the climate conditions where the facility is located.

Lower temperatures with the specified relative humidity range may be difficult to achieve with normal humidity air-conditioning equipment and will require a specialized installation. Automatic control systems are recommended, and they shall be checked frequently enough to determine that the specified temperature and humidity limits are not being exceeded. A reliable hygrometer can be used for this purpose.

Where air conditioning is not practical, high humidities may be lowered by electrical refrigeration-type dehumidifiers controlled with a hygrostat. Inert desiccants, such as chemically pure silica gel, may be used, provided the dehumidifier is equipped with filters capable of removing dust particles down to 0.3 micrometers in size and is controlled to maintain the relative humidity within the specified range. Dehumidification may be required in storage areas such as basements and caves that have inherently low temperatures, but frequently exceed the upper humidity limit.

The recommended humidity and temperature conditions can be maintained either within individual storage housings or within storage rooms containing such housings.

4.2 Gaseous impurities

Best available technologies shall be used to ensure minimization of gaseous impurities such as ammonia, chlorine, sulfides, peroxides, ozone, oxides of nitrogen, smoke, and acidic gases.

4.3 Magnetic fields

Magnetic fields are a concern only for magneto-optical discs. The optical disc cartridge standard (ANSI X3.212) for magneto-optical discs, for example, specifies a maximum field strength at the recording layer of 600 oersteads (48KA/meter) as a storage condition. The fields specified for magneto-optic discs are higher than for magnetic tape (ANSI/PIMA IT9.23) because the optical material must be heated above the Curie temperature by the laser in the presence of this field for recording to occur.

External magnetic fields are most frequently observed near motors and transformers (i.e., commercial building elevator installations). Such installations are usually localized and the field intensity falls off rapidly with separation. A few meters separation from the source will usually provide sufficient protection.

External fields of a more unanticipated nature may be produced by some headphones and microphones or by cabinet latches.

5 Materials

The materials used for storage housings and enclosures shall be chemically stable and non-debris producing. They shall be free from warpage and distortion.

6 Enclosures

6.1 Containers

Containers shall be resistant to impact, moisture and dust intrusion. Containers made of paper or cardboard shall not be used. Containers shall be designed in such a way that neither the disc data or label surface is in contact with the container when the container is stored in its proper vertical position. Containers shall not be able to be deformed, or mechanically compromised, in the defined storage conditions. The container lid shall be capable of being latched, attached, or locked to prevent accidental opening.

Plastics such as polystyrene, polypropylene, and polycarbonate are suitable for storage housing applications. Prolonged exposure to strong light, including fluorescent and incandescent lighting, causes yellowing of polystyrene plastics, sometimes accompanied by crazing. Polystyrene and polypropylene break down in sunlight or ultraviolet (UV) [1]. Foam rubber and plastics such as cellulosics, polyvinyl chloride (PVC), and highly plasticized materials shall be avoided.

6.2 Labeling

Containers shall provide a means for labeling that allows identification of the recorded information contained within. The labeling shall be non-acid, non-debris, and non-oxidant producing and shall be attached or affixed in such a manner that it will remain for the life expectancy of the discs. Multiple labels on the container shall be avoided, and the number of labels shall be kept to a minimum to avoid the possibility of adhesive migration.

"Stick-on" labels shall not be applied to the disc for long-term storage. These labels may cause mechanical imbalance of the disc and mechanical deformation. When "stick-on" labels are misapplied, any effort to remove or reposition the label may damage the disc. Furthermore, it is possible that chemical reactions may occur between the label adhesives and the disc surface.

Other marking systems have their own unique problems. The disc manufacturer should be consulted when selecting marker pens. Some solvents in the ink may damage the disc. Thermal printing techniques have been known to damage the information on the disc if the applied thermal energy is too great. The disc manufacturer should be consulted prior to the use of thermal printing on any specific disc surface.

7 Preparation

All preparation of media for storage shall be done in areas that comply with the requirements set forth in clause 4.

7.1 Acclimatization

In order to minimize stress in the material and reduce the chance of moisture condensation, materials shall be acclimatized for at least 24 hours at ambient room conditions when being transferred from outside the storage facility, or when being removed from a storage area to an access or production area. A maximum rate of change of 10°C in any one hour and 10% RH in any one hour is recommended. The rate of change shall be slow enough to avoid condensation.

Materials shall be kept in non-airtight storage containers during acclimatization to minimize the temperature and humidity gradients that occur. When materials are stored at low temperatures, they shall be allowed to warm up to a temperature above the dew point prior to removal from the container in order to avoid moisture condensation. If possible, when transferring optical discs to a lower temperature environment, the humidity should be acclimatized first, then the temperature. When transferring optical discs to a higher temperature environment, the temperature should be acclimatized first, then the humidity (see annex B).

8 Storage housing

Drawers, racks, and shelves shall be designed in such a way that the discs in their containers can be placed in their appropriate vertical position. They shall be designed and utilized so that containers do not support other containers.

Shelving shall be strong enough to support the shape and weights of the containers without deformation of the container or the shelving itself. Shelves should allow for adequate air flow so that the conditioned environment can be maintained throughout the storage area. To avoid catastrophic damage, shelves should not be placed too close to heat sources, water pipes, or sprinkler heads. The shelves should possess a lip to minimize dripping of melted plastic and burning plastic onto lower shelves in case of fire.

9 Storage rooms

Storage rooms shall be designed to be able to bear the load of the fully loaded shelving. They shall be clean areas, satisfying at least ANSI class 100,000 cleanroom requirements (see ANSI/NFPA 90A) and be under constant environmental control in accordance with the specifications of clause 4. Air pressure in the storage area shall be maintained at a positive pressure relative to adjacent hallways and rooms.

Dust and/or debris-generating devices or materials shall not be allowed in the storage room (e.g., carpet, draperies, unsealed insulation, fibrous wall coverings and furnishings, etc.). Storage rooms shall not be used to acclimatize or pack incoming/outgoing materials (see ANSI/NFPA 75).

In order to minimize UV damage to labeling, packaging materials, and possibly to the materials themselves, rooms shall not be lit other than when being actively accessed. All dye-based discs are particularly susceptible to damage from exposure to UV light. If this is not feasible, install UV filter sleeves over the fluorescent light tubes.

Walls and enclosures of environmentally controlled spaces shall be designed to prevent condensation of moisture on interior surfaces. Provisions shall be made to prevent damage from water, i.e., floods, leaks, sprinklers, etc. Floors shall be provided with drains, incorporating reverse flow devices to inhibit insects and wastewater back flow, or some other means of water removal. Storage rooms should be located above basement levels where possible.

Storage rooms should be periodically cleaned. A goal shall be the removal of dust without blowing fine particles around and the removal of dirt without the use of acids or oxidants. Dust removal shall be done by a vacuum system that has an exhaust pipe that carries the dust completely out of the storage room. An alternative method is to use a cleanroom vacuum cleaner with special multistage filters, including a final 99.97% HEPA exhaust filter, capable of removing particles of 0.3 micrometers (microns) or larger.

Non-chemically-treated, clean, and static-free wipes shall be used to remove dirt and dust from shelves and from the outside surfaces of containers. Chemical cleaning solutions shall not be used to clean floors or any other surfaces within the storage facility; this includes all common household cleaners. A minimum amount of water shall be used with a clean mop to clean floors. All traces of water shall be removed immediately by a clean dry-mop.

10 Fire protection storage

During heating in the package that is to be stored for 4 hours at 150°C, enclosure materials for fire-resistant storage shall not ignite or release more reactive fumes than the optical discs themselves.

For protection against fire and associated hazards, the disc package shall be placed in either fire-resistive vaults or insulated record containers. If fire-resistive vaults are used, they shall be constructed in accordance with recommendations contained in appropriate standards and regulations (see ANSI/NFPA 232) with particular care for protection from steam. Masonry or concrete walls may release steam from internally bonded water when heated in a fire. A vapor barrier is recommended for such vaults, or else sealed containers shall be used.

Insulated record containers conforming to appropriate national standards and regulations may be used (such as class 150 record containers in ANSI/UL 72). They shall not exceed an interior temperature of 65°C and an interior relative humidity of 85% when given a fire exposure test from 1 hour to 4 hours depending on the classification of the record container.

For the best protection of the information from fires, duplicate copies of disc records shall be placed in other storage areas, preferably in different buildings located some distance removed from each other.

11 Identification, inspection, and cleaning

11.1 Identification

Records containing the proper date, control-number information, location, title, and other required information shall be maintained.

11.2 Inspection

Representative samples of discs shall be inspected at five-year intervals. If deviations from the recommended temperature and relative humidity ranges have occurred, inspection shall be made at more frequent intervals. A sampling plan established in advance shall be used, and a different lot shall be inspected each time. Deterioration of either discs or enclosures shall be noted. Discs shall be examined for playback performance, physical distortion, debris, and container and label deterioration.

Optical discs shall only be handled or touched using gloves. Dye-free gloves that do not shed, most commonly found as thin, clean, white lint-free cotton (or equivalent lint-free material) gloves shall be used.

If the material has been stored at a temperature below the dew point of the atmosphere where the inspection is to take place, the discs in their enclosures shall first be allowed to warm up to a temperature within a few degrees of that of the inspection room. The time required for warm-up increases with the volume of the material and the temperature difference.

11.3 Cleaning

If during inspection there is any evidence of dirt or debris on the media, it shall be cleaned prior to putting it back into storage. Manufacturer's specific recommendations should be followed when cleaning the media.

As a general guide, only wiping with a soft clean lint free cloth is recommended. The disc should be wiped in a radial direction to minimize the possibility of circumferential scratches. An alternative method of cleaning is to dust the disc with clean purified compressed air or nitrogen regulated to less than 40 psi. Scraping, burnishing procedures, and solvent cleaning should not generally be used.

Annex A
(informative)

Temperature-relative humidity relationship

Degradation of optical material is caused by chemical reactions whose rates are generally lowered with decreasing temperature and decreasing relative humidity. Consequently, the useful life of optical discs can usually be increased by lowering the storage temperature and/or storage humidity.

A lower storage temperature can compensate for a higher humidity to obtain the same life expectancy. This relationship permits several temperature-relative humidity combinations to be acceptable for storage conditions as shown in figure A.1. The "isoperm lines" apply specifically to a Tellurium Selenium (TeSe) ablative type of WORM optical medium, but should provide a general guideline for any similar type of optical material.

The term "median life" in figure A.1 refers to the ability to read back data originally recorded on the disc based on the Narrow Band Signal to Noise Ratio (NBSNR). This relationship provides the storage vault designer some information to evaluate trade-offs when selecting a reasonable design point.

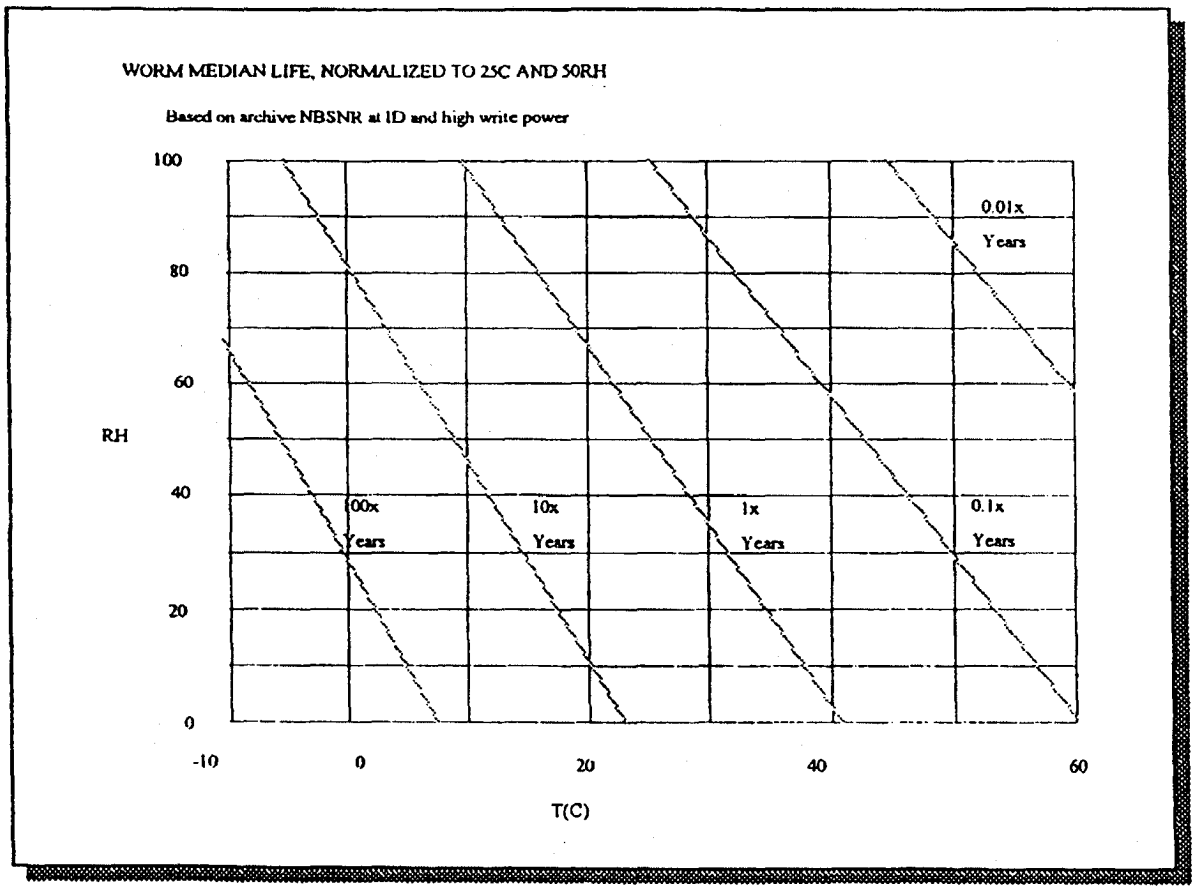

Figure A.1 – Worm median life, normalized to 25°C and 50% RH

Annex B
(informative)

Temperature and humidity acclimatization

Material that is removed from storage conditions may not be immediately ready for playback. Acclimatization to the environment of the recording/playback facility may be necessary to ensure that the disc will play with an acceptably low error rate.

Dimensional changes will occur in optical discs as a result of changes in both temperature and humidity. This can result in higher error rates during playback. Since polycarbonate, which is the substrate of many optical discs, is hygroscopic, moisture will be absorbed until an equilibrium is reached with the ambient humidity. When the ambient humidity is changed, some time must be allowed for equilibration.

A general "rule of thumb" that should be adequate for most situations is to allow the material to acclimatize overnight prior to use. For information on determining the specific amount of time required as a function of the change in humidity for polycarbonate, refer to "Ramp Profiles for Optical Disc Incubation" in annex C.

Annex C
(informative)

Bibliography

ECMA 130, *Data interchange on read-only 120 mm optical data disks (CD-ROM*[3]*.* Equivalent to ISO/IEC 10149.

Wrobel, J. J., *Ramp Profiles for Optical Disc Incubation,* SPIE, vol. 2338 Optical Data Storage: 191-202; 1994

[3] Available from ECMA, 114 Rue du Rhône, CH-1204, Geneva, Switzerland.